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INTRODUCTION

INTO

OBJECTUAL PHILOSOPHY

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CONTENT

OVERVIEW AND LANGUAGE CONVENTION

The systemic approach on the world implies, first of all, the structural hierarchy of the forms revealing all the constitutive elements of the world as we know it. A simple classification of these "systematization forms" depending on the complexity degrees of the elements which make-up the world is not a new endeavor, and it is not enough for understanding the causes of this hierarchy, that is the structure of the surrounding material systems and of the systems from whom even ourselves are made-up.

Our duty is to discover the most general laws which are the basis of this entirely systemic structure, laws which define both the formation of the natural systems and their decomposition.

The paper herein tries to present these possible laws and principles, which, if accepted, they allow us to understand our world in a way which is both nonconformist and coherent. The present work was written mainly for the readers with higher education, with basic knowledge in the special mathematics, and with a broad and interdisciplinary scientific background.

The objectual approach of the cognition according to the principles defined in this paper is meant to create a new scientific way of thinking, which, if it is used with discernment and competence, becomes a means able to provide a special analysis and prediction capacity. The work has a prevalent qualitative character, following that, many of the quantity aspects of the depicted objects and processes to be subsequently settled, after the moment when the qualitative principles have became a working method.

Due to the fact that the meaning given by the author to some terms is mostly different as compared to the meaning from the current natural language (even scientific language), some ***reserved words and expressions*** *were introduced across the work contents, namely, some words or expressions (collocations) with a semantic value (meaning) which is invariant and context-free, value which is defined at the proper moment of the exposure. These words and expressions are also included in the list of reserved words which is found at the end of the paper, where there are hyperlinks to the definition of that particular word. The reader is warned that none of the terms which are considered as "tabu" by most of the scientists, such as, energy, force, pressure, field and many others, will not be neglected but they shall be redefined.*

In order to increase the amount of information which is communicated to the reader by means of limiting the semantic field of a notion (notion area), the intersection of the semantic fields of some similar notions shall be used. The term whose meaning is desired to be restricted (defined) shall be followed by a list with similar notions, placed in brackets, and the common meaning of these notions is the meaning desired to be transmitted to the reader. For example, the expression motion (transfer, displacement) *is used in order to communicate the common meaning of the three words (intersection of the semantic fields).*

As for the notation which is used, the scalar quantities shall be written with italics (e.g: V, dM, t, so on), and the vector quantities shall be written with bold characters (e.g: **v, f,** so on*) within the text, or overlined characters in some relations written with other editor (for example, $\overline{v}, \overline{n}$). The index of paragraphs, definitions, figures, comments and relations within the text are composed according to the following rule:*

[section no]. [paragraph no].<subparagraph no>[current no]

where the brackets [] show a compulsory index and <>, an optional one.

The work is divided in two fluxes: the main flux, made-up from the succession of chapters 1…9, where the basic concepts and principles of the objectual philosophy are exposed (we may consider this part as the spinal cord of the work), and the secondary flux, made-up from a number of annexes, which are far from being less-significant, but they are either detailed explanations of the concepts from the main flux (which were taken-out from this stream for not distracting the reader's attention too much), or the application of the principles of the present work under the re-interpretation of some objects or processes from the real or abstract world.

The additional explanations related to the text, required by some of the concepts or assertions, are structured on four levels of complexity: short explanations placed in brackets, footnotes, comments and (as mentioned above) annexes. The basic rule taken into account for drawing-up the text is that the neglecting of the additional explanations does not impair the paper coherence. In other words, if the text from brackets, footnotes and comments is not taken into consideration, the remaining one must be coherent, but it will depict only the minimum necessary information.

INDEX OF ACRONYMS AND ABBREVIATIONS

AAMS	**a**rtificial **a**biotic **m**aterial **s**ystems
AAV	**a**bsolute **a**ccurate **v**alue
AB	**a**stronomical **b**odies: stars, planets, satellites, etc.
AIPS	**a**rtificial **i**nformation **p**rocessing **s**ystems
AO	**a**bstract **o**bject
AT	**at**oms
ch.	Chapter
CM	**c**ellular **m**edia
CS	**c**entralized **s**ystems
DP	**d**imensional **p**oint
DS	**d**istributed **s**ystems (media)
EC	**e**ukaryotic **c**ells
EF	**e**nergy **f**luxes
EO	**e**nergetic **o**rbital
EP	**e**lectrically-charged **p**articles: electrons, positrons, protons, etc
ES	**e**quilibrium **s**urface
ETV	**e**lementary **t**ransition **v**olume
FA	**f**unctional **a**pparatus (subsystem of the organisms)
FDV	**f**lux **d**ensity **v**ector
fig.	figure
FQV	**f**lux **q**uantum **v**ector
GC	**g**alaxy **c**lusters
GM	**g**alactic **m**edia (media whose elements are the galaxies)
GX	**g**ala**x**ies
IF	**i**nformational **f**luxes
IPS	**i**nformation **p**rocessing **s**ystem(s)
ISS	**i**nformation **s**upport **s**ystem(s)
LTM	**l**ong-**t**erm **m**emory
MO	**mo**lecules
MS	**m**aterial **s**ystem(s)
NAMS	**n**atural **a**biotic **m**aterial **s**ystems
NC	**n**u**c**leus
NE	**ne**utrons
NIPS	**n**atural **i**nformation **p**rocessing **s**ystems
NM	**n**atural **m**edia (solids, liquids, gases, etc. media made-up from atoms)
OG	**org**anisms
OGM	**org**anism **m**edia
OR	**or**gans
par.	paragraph
PBS	**p**lanetary **b**io-**s**ystem (planetary biosphere)
PC	**p**rokaryotic **c**ells
PFM	**p**roximate **f**undamental **m**edia
PS	**p**lanetary **s**ystems (star-planets system)
p.v.	point of view
R	**r**otating reference (of an object) or rotating motion (flux)

RAV	**r**elative **a**ccurate **v**alue
RBS	**r**eal **b**oundary **s**urface
RM	**r**eference **m**edium
RS	**r**eference **s**ystem
SEP	**s**pecific **e**lementary **p**rocess
SO	**s**tructural **o**rbital
SOP	**s**ystemic **o**rganization **p**rinciple
s.o.	so on
STM	**s**hort-**t**erm **m**emory
T	**t**ranslation reference (of an object) or translation motion (flux)
1D	one-dimensional attribute
2D	two-dimensional attribute
3D	three-dimensional attribute
3F	fluxes triad (immergent, stored, emergent)
(#)	amusement sign

Ch.1 SYSTEMIC ORGANIZATION

1.1 Hierarchy of the known forms of matter existence

If we shall analyze the known forms of matter existence, from the level of "elementary" particles up to the galaxy clusters, it is worth mentioning, as a general feature, *the unevenness of the space distribution* of this matter. Thus, it is obvious the matter tendency of becoming "crowded" in quasi-independent units but which interact each other, these units being formed as a result of the association of other smaller units, with a less complex hierarchical level, which are also made-up from other units, so on.

The most appropriate way of defining this structure is the one which use *the system* concept, for the start, with the meaning which is generally accepted nowadays, that is sufficient for the scope of this chapter. It is worth reminding that *the system* is a collection of objects (either real or abstract) with functional bonds deployed between them. The system concept implies the possibility of its decomposition in more simple parts (subsystems), whose the most simple ones are known as *elements* of the system.

Because we are dealing with the matter's existence forms, "the objects" of the material systems are even the units where the matter arise from, therefore, they are material objects. For simplification purposes, we shall focus first only on the series of abiotic systems which are called *natural abiotic material systems (NAMS)* in order to differentiate them from the *artificial abiotic material systems* (AAMS) which have additional formation criteria, as compared to the natural ones.

Taking into consideration the knowledge gathered by the mankind so far, we can make a list of the hierarchical organization levels of NAMS, obviously with the explanation that it is not and it does not intend to be exhaustive, its exclusive intention being only to emphasize some of the organization levels known by now, some of the levels being deliberately excluded due to simplicity reasons. For the purpose of this section, the relevant meaning, we shall see later, is only the beginning and the end of the list.

Next, we shall present the list in ascending order of the space dimensions and of the structural level:

- EP (electrically-charged particles);
- NC (nucleus);
- AT (atoms);
- MO (molecules);
- NM (natural media: solids, liquids, gases, etc.);
- AB (astronomic bodies: stars, planets, satellites, etc.);
- PS (planetary systems: star-planets system);
- GX (galaxies);
- GC (galaxy clusters);

1.2 Time dependence of the cognition limits

In order to establish a hierarchy relation on the set of structure levels of NAMS, we may use the inclusion relations of sets belonging to the constitutive parts. According to the knowledge gathered so far, it is known that all the systems with the structure level over AT level (such as MO, NM, AB, PS, etc.) are made-up from AT systems, therefore, it might be said that:

1) {AT}set is made-up from two complementary subsets: the set of the atoms bound in molecules or other types of atomic systems (e.g.: metals) and the set of the free atoms

(unbound in any system). The result is that the set of the atoms from the composition of the molecule set $\{AT_{MO}\}$is included in {AT} set (see fig.1.2.1).

2) {MO}set is also made-up from two subsets: the set of molecules arisen in natural media $\{MO_{MN}\}$ and the free molecules set, resulting that the set of molecules which make-up $\{MO_{MN}\}$is included in {MO}, so on.

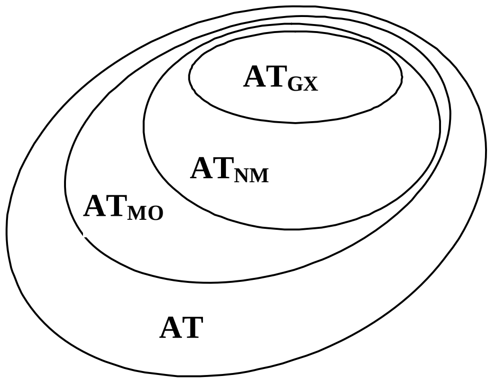

Fig. 1.2.1

Taking into consideration the figure 1.2.1, one may notice that there is an inclusions chain of the abiotic systems set, chain which may be represented by using the syntax of the sets theory, as it follows:

$$\{\mathrm{AT}\} \supset \{\mathrm{AT}_{\mathrm{MO}}\} \supset \{\mathrm{AT}_{\mathrm{NM}}\} \supset ... \supset \{\mathrm{AT}_{\mathrm{GX}}\} \qquad (1.2.1)$$

which means that the total atoms set includes the set of the atoms embedded in molecules, which in its turn, is made-up from the set of atoms from the natural media, etc.

Under a simplified form, the relation 1.2.1 may be written as:

$$\{\mathrm{AT}\} \supset \{\mathrm{MO}\} \supset \{\mathrm{NM}\} \supset ... \supset \{\mathrm{GX}\} \qquad (1.2.2)$$

or:

$$\{GX\} \subset ... \subset \{NM\} \subset \{MO\} \subset \{AT\} \qquad (1.2.3)$$

namely, the set of atoms from the galaxyes' composition is finally included in the total set of the atoms from the universe (with their intermediate organization levels, they are also subsets of the atoms set. But, since it is known that the atoms are systems made-up from EP, therefore, {AT}set is also included in the more extended {EP}set, that is the set of all the electric particles from the universe. Generalizing the inclusion relations 1.2.3 across the entire NAMS hierarchy range mentioned in par. 1.1, it may be written that:

$$\{RG\} \subset \{GX\} \subset ... \subset \{NM\} \subset \{AT\} \subset \{EP\} \qquad (1.2.4)$$

which means that the set of the electric particles which are found in the composition of the galaxy clusters is included in the total set of EP from the universe, but obviously, there is a set of EP which do not belong to any of their structure forms (free particles from the space between the galactic clusters).

Definition 1.2.1: The set of the systems with a more simple structure, whose elements are at the origin of all the systems with a more complex structure, is called the **generating set.**

For example, according to the relation 1.2.4, a generating set is {EP} set, because EP systems are found in the composition of all the material systems with a more complex structure, including in the stars core, where even the atomic kernels are dissociated. As for the biosystems from the Earth, it is also a generating set which might be considered as the set of all the living cells from the planet (either they are free, as bacteria, or bound, as the tissue cells), but also the set of the atoms found in the peripheral media of the planet, from which all the constitutive parts of a bio-system (including the cellular one) will arise.

Any subset belonging to a set is characterized by the fact that its constitutive elements have at least one distinctive feature as compared to the elements of the generating set (that is the set where the subset is included). In case of NAMS, this kind of feature is for instance, the spatial location of the elements, the atoms of a molecule being confined in a limited space, that is the molecular space. The group of properties which define a certain subset from series 1.2.4. shall be (temporarily) called as the formation criteria of the subset (system) and it is the main property of the organization level notion of that particular system. The result is that a system with a certain organization level implies the existence of some systems with an inferior organization degree. This chain implication (propositional) may be written in an abbreviated form by using the implication operator [→]:

$$? \to GC \to GX \to PS \to AB \to NM \to MO \to AT \to NC \to EP \to ? \qquad (1.2.5)$$

Relation 1.2.5 may be read as it follows:

"The existence of GC-type systems implies the existence (as subsystems) of GX-type subsystems, which also implies the existence of PS-type systems, etc."

But the same relation may be also read as: "*EP systems are the subsystems for NC, which in their turn, are subsystems for AT*", so on.

One may notice that the question marks delimit the current cognition limits in the abiotic field (we are talking about the certain, experimental cognition which is unanimously recognized by all the scientists). If we shall mark the same series of the systemic implications (organizational) of NAMS according to the knowledge degree at the end of 19-th century, we shall get:

$$? \to PS \to AB \to NM \to MO \to AT \to ? \qquad (1.2.6)$$

(by mentioning that the only PS system which was known was our planetary system), and in antiquity, the chain of the organizational implications was only:

$$? \to MN \to ? \qquad (1.2.7)$$

the four "fundamental elements": earth, water, air and fire.

1.3 Systemic organization principle

There are few important conclusions which may derive from the above-mentioned facts:

1) The number of the hierarchical structure levels of the abiotic matter, accepted by the scientists, depend on the knowledge amount accumulated at a certain moment;

2) The systems with the lowest organization level (the most simple) at a certain level of the general knowledge, are called "elementary" or "fundamentals". They are constitutive parts of all the systems with a superior structure (making-up the *generating set* of all these systems).

The order of magnitude (see annex X.1) of the spatial dimensions of EP systems is about 10^{-14} m, and of GX system is approx. 10^{21} m. Therefore, the abiotic matter organization within systems is maintained along an interval of over 35 orders of magnitude of the spatial dimensions. We must also take into account that the systemic matter organization was not known in the ancient times as we know it nowadays, but this does not mean that it did not actually exist. These findings give us the right to assert that:

1) There is no logical argument able to contest the existence of the systemic organization of the abiotic matter beyond the limits of the human knowledge accumulated at a certain moment.

2) The boundaries of this organization depend only on the cognition degree reached at that moment.

As a corrolary of the above mentioned statements, we may release the following one:

The systemic organization principle (SOP):
Version a: *Any form of matter existence is a system and belongs to a system.*
Version b: *Any form of matter existence has a generating set.*

Comment 1.3.1: As we are about to see later in this book, the matter (or more exactly, the material systems class) is divided in three large subclasses: - *abiotic systems* (natural), *biotic systems* and *artificial systems*. According to the aforementioned issues, some elements of the abiotic class hierarchy (such as the atoms) make-up the generating set also for the other two classes of material systems. SOP is unconditionally valid (according to the objectual philosophy) in case of the class of the natural abiotic systems, fact which results from the model of this kind of system, model which shall be analyzed in section 7. As for the classes of biotic and artificial systems, although they are also material systems, there are some properties which restrict their divisibility range; in case of such systems, there are basic elements which cannot be decomposed any more without loosing the class features, despite of the high cognition level. But these elements are further decomposed as an abiotic support of the biotic or artificial systems. For the attentive and detail-oriented reader, an apparent contradiction might arise between SOP and the division way of the abiotic MS in elements which make-up systems and the free ones, division which was used at the beginning of paragr. 1.2. There is indeed a fraction of MS which does not belong to many forms of organization from the above mentioned hierarchy, although there is always an organization structure which shall also include them. For example, the fractions belonging to free EP, unbound within the nucleus, atoms, media, may be part of an inter-planetary, inter-galactic medium, and they shall be compulsorily part of our universe, which is also a MS. The set of the free living cells (unbound into the multicellular organisms) shall be ultimately part of the planetary biosphere, the biggest bio-system known so far. If the first version of SOP (version **a**) has a generality level which depends on MS class (as it was above mentioned in this comment), the version **b** of SOP is universally-valid and it is one of the basic principles of this paper.

1.4 Some philosophical implications of SOP acceptance

Although it is not too obvious at a first seeing, the implications of the acceptance of this principle on the concepts regarding the world are very numerous and they cover all the cognition fields.

First of all, this principle postulates the divisibility in other systems of the abiotic material systems already known as “elementary”, without mentioning a limit for this divisibility (maybe even up to infinity). Secondly, at the opposite end of cognition, towards more and more large systems, this principle postulates the spatial finity of our Universe as an *object,* but it does not contradict the simultaneous existence of other similar universes which are spatially disjoint and also organized in larger systems. But, pay attention, we are not talking about the so-called “parallel universes” from SF slang, but about some entities which are similar to our universe, with clear spatial boundaries, yet located at unthinkable distances, unthinkable as the real dimensions of our own universe are, from which only a small fraction is visible.

Comment 1.4.1: The problem of accepting the idea of the existence of other universes is similar with the problem of the simultaneous existence of other planets, besides Earth, in our solar system. There was a time in the history of human cognition when this existence was denied, obviously due to lack of information (knowledge). Nowadays, since this problem was solved, we are now in the early stage of accepting the simultaneous existence of other planetary systems within our galaxy, acceptance which is rather difficult because there are no direct data concerning these particular objects, and the current scientific philosophy does not provide any clue in supporting the prediction on the existence of this kind of objects around each observable star.

Another consequence of SOP application is the prediction on the existence of other media generation, (also belonging to the abiotic category), made-up from much smaller systems as compared to any EP, the set of this elements being a generating set for {EP} set. These media, which are called *“proximate basic media”* (PBM)[61] are the components of the universe, in the same way as NM are the components of AB. We are using the term “media” instead of

[61] There were called *proximate* because if their existence would be demonstrated, this fact is itself a proof that there will also be other “much more basic” hierarchical media levels. The “proximate”attribute refers to the proximity to NM (in hierarchical order), the only types of abiotic media which are known so far.

"medium" because (according to the objectual philosophy) these media can also exist in various states (just like NM), either solid, liquid or gaseous. The acceptance of the existence of these media[62] is currently a difficult task, the most significant disproof coming once with the release of the results of Michelson-Morley experiment and continuing up to the present. Unfortunately for the human cognition, the hasty interpretation of this result which has led to this disproof, was (according to the author) a huge step backwards, step which led to the drastic limitation of the mankind access to the space, by only using the inertial propulsion equipment for space ships.

1.5 Void acording to the systemic concept

At a certain moment, there will be a mixture (reunion) of material systems with various organization levels found in a limited examination volume (precinct). It might be assumed that this volume has a dimension which allows only MO-type or less-sized systems (AT, NC, EP etc.) to be placed inside it. However, in case of MO and AT systems, this system shall comprise - under atmospheric pressure conditions - a significant number of specimens. We may assume that the number (cardinal) associated to each set of systems with XY organization level would be known (where XY may take one of AT, MO, EP values, etc) which may be included into the examination zone; these are finite sets (the examination zone is finite). If the set of XY systems is void (null cardinal), it might be stated that the examination zone is a "XY systems void". Practically, the void (vacuum) is a space from which AT-type systems or the larger systems should miss.

Some observations need to be promptly made:

1) The "void" notion is a property of a confined space (of a precinct), that is the incapacity of containing a certain type of objects (the set of the contained objects is void);

2) This property is relative at a reference which consists of a certain organization level of the systems removed from the precinct. For example, a sterile space is a precinct where there is no kind of living bio-system (we may consider that the precinct is void from living organisms, regardless of their organization degree). If the intention is to create a space void from AT systems, then, these systems (reference level) and the ones with a higher level of organization should not be present in that space.

3) It is very difficult to effectively build a space which is completely without MO or AT systems, therefore, a compromise is made: the decrease of AT systems number from the voided space under a certain value (indirectly determined by means of pressure). This value of the pressure from the precinct becomes the *void degree*, or, as a noun, "the void". The people have a tendency (wrong) to separate the properties of some objects from their holder, as if these properties would be able to have a free existence. This is what it happened with the void.

4) Even under the hypothetic situation of a perfect void realization of AT systems, this void refers to AT or to larger systems, but not also to the systems with a lower organization level, and obviously, with much small sizes (NC, EP etc.);

5) If as a result of using special techniques, a void would be created at EP level, it still cannot be stated that this space does not include material systems with deeper organization levels (currently unknown).

Comment 1.5.1: If we take as example an empty flat room (vacuumed from any abiotic or biotic objects) this "void" refers to the macroscopic, visible objects, but not to the huge number of gas molecules from that room, which our senses are not able to detect them directly. The situation with the void at EP

[62] Media whose existence was not contested in the 19-th century (under ether state), and even the existence of the ether as fluid and of the analogy between the fluid mechanics law and the laws on electromagnetic phenomena have led to the elaboration of Maxwell's equations, which are the basis of electrotechnics, and we might say, are the basis of current technical civilisation.

level is absolutely similar, the current scientific means being unable to reveal the existence of PBM elements.

As a consequence of the above mentioned issues, SOP acceptance leads to the denial of the absolute void existence (of a space where there is no kind of material system). Likewise, a property of a finite space, that is the capacity of containing a low or null number of atoms, cannot be considered as a basis for deploying real propagation processes, such as the propagation of photons, of the electromagnetic waves or of the gravity interactions.

The fact that Michelson-Morley experiment did not reveal a motion against the ether at the surface of the Earth, it is not necessarily a proof that the ether does not exist, but rather a proof that our mental model regarding this medium and regarding what propagation or displacement really mean in relation to it was not correct at that moment. On another occasion, we shall see that the objectual philosophy proposes another interpretation of the properties of this medium.

However, a barren foray through the field of mathematical definitions of the basic concepts belonging to the structure of the objectual philosophy needs to be done next. There is an attempt in making a compromise between rigor and conciseness for presenting these mathematical models, so that the reader to understand fast and easy <u>the essence</u> of the presented concepts. Due to these reasons, the presentation style is different from the style of classic mathematical papers, although the mathematical models are approached.

Ch.2 DISTRIBUTIONS

2.1 Overview

The reader is warned right from the start that the way how the distributions are approached in the present paper is different as compared to the style used in the works regarding the distributions theory, drawn-up by mathematicians[3]. This different approach was not chosen only for simply making all different, but due to other reasons:

1) The first from these reasons is the existence of a contradiction in the classic approach of the distributions, that is the rigor used within the differential and integral calculus for defining the notions such as *derivative, differential, primitive, integral* etc. which are valid only by mentioning the expression "for continuous functions only" along the continuous interval of their arguments, and the easy application of these notions also in case of the distributions with a clearly discontinuous character. Moreover, sometimes it is talking about a differentiation "in a classic, algebraic manner" and a differentiation "under the meaning of distributions"[4]

2) Another reason for the different approach of the distributions in the present paper comes from the specific organization of the information structure established by the objectual philosophy. According to this organization, the semantic information which is found in a message is mainly made-up from *objects* and *processes* (at which the objects are subjected to), the distributions being basic elements for defining these notions, as we are about to notice in the following chapters. Due to this reason, the definition of distributions had to be in compliance with this organization method.

3) Another reason which has determined the definition of distributions according to the selected mode is related to the purpose of their utilization. As I have already mentioned above, the distributions are in this paper a mathematical model used for representation of the objects (including the material ones), as entities which have a lot of properties (such as the shape, color, mass density, hardness, etc.), who are distributed on the object's surface or in the volume of the object. These elements of the concrete distributions are the values of those attributes in a certain point (a certain space location) which belongs to the object; in other words, the value of the attribute depends through a certain relation, on the location, actual position of that point. We shall see next, if these dependence relations would be able to be independent from the actual location of the point, and, at least for certain zones of the object, we might use (only for those zones) the classic functions from the mathematical analysis. Unfortunately, for most of the real objects, the above mentioned dependence relations are not invariant, they can be even random, therefore, other mathematical instruments must be used for expressing these dependence relations, such as the distributions, which are more general than the functions.

The approach according to the objectual philosophy model of the distributions, clearly settles the conditions when the old differential and integral calculus can be used, and the conditions required for using *the calculus with finite differences,* which is more difficult and less elegant, but universally applicable. In the latter case, the notion of *local derivative* (such as it is defined within the differential calculus, as a derivative in a point), does not make sense

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[3] Such as, for example **W. Kecs, P.P. Teodorescu** - *Introducere în teoria distribuțiilor cu aplicații în tehnică* - Editura Tehnică, Bucureşti 1975.

[4] For example in the work of **Emil Tocaci** - *Teoria câmpurilor, spațiul şi energia* - Editura Ştiințifică şi Enciclopedică, Bucureşti 1984, with an entire chapter focused on distributions.

anymore; it is replaced by a more general term which is called *density,* and the derived functions (any rank) are replaced by the derived distributions (any rank, too).

2.2 Virtual distributions

The notion of *distribution* from mathematics has been introduced as a generalization of the *function* concept, in order to also allow oprerations with the dependence between different variables, which could not be considered as functions, strictly algebraically speaking (for example, the discontinuous dependences). Few examples of this kind of discontinuous distributions, with a wide application field can be mentioned and these are: Dirac distribution $\delta(x)$ (also known as the *impulse function*), Heaviside distribution $\theta(x)$ (also known as the *step function*), etc.

For a better understanding of the distributions, it must be first understood the notion of *dependence* between the values of two *amounts*.

Comment 2.2.1: The meaning of the very general term of *amount* (magnitude, size) used in the mathematics field could be better understood by the reader after reading the entire paper, especially chapter 9. The only explanation which is made in advance is that an attribute (that is a property of a real or abstract object) has two components, according to the objectual philosophy: the *qualitative* component, represented by the name or the symbol of that property (property's semantic value) and the *quantitative* component, which is also called *existential attribute* in the present paper, a number (scalar) which shows the measure (size, amount, degree) of existence of that property. As we are about to see next, the two components are conjunctively associated within the relationships in this paper, which means that, in case of a certain object, they can exist only together (a null value for the existential attribute implies the non-existence of an associated qualitative property). In mathematics, for providing the language universality, the associated qualitative attribute is most of the times let aside, operating in most of the cases only with existential attributes (numerical values), or with literal or graphic symbols for displaying them. Because it cannot be omitted the fact that the numerical values are however the attributes of some properties, in case of real objects, this aspect shall be mentioned anywhere necessary. Basically, this is not a mathematic paper, but the mathematic is used as an universal language for expressing the relations between various amounts.

Let us assume that there is a qualitative attribute *X,* which belongs to a certain object which is related to a quantitative attribute *x* at a certain moment, whose possible numerical values make-up an ordered set *{x}*. In mathematics, the quantitative value *x* which may belong to a property *X* is called *amount x*, and because it can take any value from *{x}*, it is also known as the *variable x*. By assuming also that there is another qualitative property *Y*, with the existential attribute *y*, whose values belong to set *{y}*, another amount *y* (or variable) is therefore made-up. If the value *y* is modified as a result of changing the value *x* and it remains invariant if *x* is invariant too, we may say that there is a *dependence relation* between the two amounts. This relation may be univocal (in a single sense) or biunivocal (interdependence). For the time being, we are only interested in the univocal dependence relation, the univocal character being presumed when we are talking about dependence. The sets of numerical values *{x}* and *{y}* which were above-mentioned, have *the singular numerical values,* as basic (non-decomposable) elements.

Definition 2.2.1: The invariant numerical value which is attributed at a certain moment to a variable is called the **singular value** of that variable (synonym **-** the **concrete value**).

Comment 2.2.2: The association of "invariant" property to a variable seems to be quite bizarre in the first place, that is why an explanation is needed. At a certain moment, when concrete numerical values are given to a variable, both the independent and the dependent variable have only a single value. It is true that the two variables can take any kind of single value from their values domain, but by means of repeated, successive assignments for each value. The variables values remain invariant between two assignments. The reader will better understand this aspect after reading the entire chapter, because the fact that a quantitative attribute (numerical value of a variable) cannot have more than one value at a certain moment, this will be considered as a consequence of the specific approach of the objectual philosophy regarding the distribution's definition.

Definition 2.2.2: Amount *y* is **dependent** on amount *x* if each singular value x_k from *{x}* determines each singular value y_k from *{y}*, by means of a relation f_k.

In other words, the amount y can be modified only by means of amount x. According to the literal mathematic syntax, one of the possible ways of writing these dependence relations is:

$$y_k = f_k(x_k) \tag{2.2.1}$$

where $k \in \{N\}$ is the running number of the numerical values from the ordered set *{x}*.

Definition 2.2.3: Two variables *x* and *y* are **independent** if there is no dependence relation between their singular values (the dependence relations are null for all the values from {x}).

Definition 2.2.4: The ordered set of the singular values included between other two different singular values x_1 and x_2, which are accessible ($x_1, x_2 \in \{x\}$) for a variable *x* makes-up a **domain** of values (synonym – **interval**, **range**) of this variable.

The amount, quantitative value of this interval is:

$$\Delta x = (x_2 - x_1) \neq 0, \ \ x_2 \neq x_1 \tag{2.2.2}$$

Definition 2.2.5: The singular values x_1 and x_2, are the domain **boundaries.**

The domain boundaries can be part of this interval (*boundaries included* inside the interval), case when the interval is considered to be closed, or to not be part of this domain (to be only adjacent to the interval), case when we are dealing with an open interval (with *asymptotic boundaries*).

The underlining made at the definition 2.2.4 has the role to draw the reader's attention that the condition required for the existence of a *domain of values* must be the existence of its two boundaries, and their values to comply with the relation 2.2.2. Expressions such as "null interval" or "void interval" are not allowed because, according to this paper, an object with a null (quantitative) existential attribute means that it does not exist.

Definition 2.2.6: If a finite interval contains an infinity of singular values, those values are called **absolute accurate values** (AAV).

AAV case is minutely presented in annex X.3, and for the time being we may assert that these values make-up the so-called "set of real numbers"{R}from mathematics, and each of these values comprise an infinite quantitative information amount (with an infinite of figures), therefore, they are actually *virtual numbers*[5].

Each of the amounts implied in relation 2.2.1 can take single numerical values from a certain domain (a certain values interval) known as the domain of the independent variable, respectively, the domain of the dependent variable (sets *{x}* and *{y}* which were above mentioned). According to the most general case of dependence, each singular value x_k is related to a certain relation f_k and to a certain value y_k, as it is shown in relation 2.2.1.

Definition 2.2.7: Set *{f}* of the assignment relation between each singular value of set *{x}* (of the independent amount) and the corresponding singular value belonging to set *{y}* (of the dependent amount) is the **primary distribution** (synonym - **distribution of the singular values**) of the amount *y* along the domain of amount *x.*

Definition 2.2.8: The domain of the singular values of the independent variable (set *{x})* is the **support** of the primary distribution.

Comment 2.2.3: After the reading of the following chapter, in which the *strict set* shall be defined, we are about to notice that the support set of a distribution is this kind of set (which does not include identical objects, namely, identical singular numerical values). The sets *{y}* and *{f}* can be strict sets, but generally, they are not subjected to this kind of condition.

The qualitative attribute whose quantitative values make-up the set *{y}* is also called in this paper as *distributed attribute*, and the one whose values make-up the set *{x}* is also

[5] The concepts of *information amount* and *virtual object* are briefly defined in Annex X.3, but they will be minutely presented in chapters 8 and 9. The fact that the numerical values from set {R} are virtual, also gives the denomination of *virtual distributions* for those distributions which have this kind of support.

known as *support attribute*. Even if it is not necessary, we shall make once again the following assertion: the three sets *{y}*, *{f}* and *{x}* have <u>the same number of elements</u> (they are equipotent sets).

Definition 2.2.9: If the attribute *y* is cumulative[6], the total amount of attribute y, distributed along the support domain represents the **stock** of the primary distribution.

In case of the virtual distributions with continuous support, this support is usually represented by an interval from the set of the real numbers {R}, and this set, as we have previously mentioned, contains an infinite number of singular values in any interval, also resulting that the number of the relations from a distribution on this kind of range should also be infinite. The question is simplified if the relation *f* is <u>invariant</u>[7] along the support domain or along its subdomains (independent from the concrete, numerical values which are assigned to *x*). In this case, that particular relation is the classic *continuous function* stipulated in the mathematic analysis (where the term "continuous" means both the support continuity, but mostly the maintenance of the same dependence relations on the support range), which may be applied in the domain where this invariance is maintained. The continuous functions are therefore particular cases of distributions.

The main advantage of the continuous functions is that they replace an infinity of individual relations (for each numerical support value) with a single one, which is valid on its support domain (continuity domain). Most of the virtual distributions (mathematic) consist of several invariant relations of this kind (functions), which are defined on continuous subranges of the support domain, the gathering of this subranges making-up the overall distribution support.

Comment 2.2.4: For example, the unit Heaviside distribution with the internal reference x_0 (an AAV from {R}) is defined as it follows:

$$\theta(x)=\begin{cases}0 & x=(-\infty,x_0)\\ 1 & x=[x_0,+\infty)\end{cases} \tag{2.2.3}$$

One may notice that two continuous functions are defined: $\theta_1(x)=0$, which is valid on the open support subdomain $x\in(-\infty,x_0)$ and $\theta_2(x)=1$, which is valid on the semi-open support subdomain $x\in[x_0,+\infty)$. Heaviside distribution is therefore made-up from two invariant relations (continuous functions), each of them with its own support subdomain (it may be considered as a two-functions system).

According to the most general case of primary distribution, when the assignment relations are not invariant, we are dealing with a distinct relation for each singular value of the support amount (that is the case of the distributions made as lists, tables, matrix, images, etc.).

Comment 2.2.5: A simple example for showing this kind of distribution is Dirac *δ(x)* distribution, which in case of the *unit impulse* may be defined as it follows:

$$\delta(x)=\begin{cases}0 & x=(-\infty,x_0)\\ 1 & x=x_0\\ 0 & x=(x_0,+\infty)\end{cases} \tag{2.2.4}$$

We may notice the existence of two continuous functions, as in the case of Heaviside distribution, defined along two open intervals, but also the existence of a distinct assignment relation on a single x_0 value, internal distribution reference (the concept of *internal reference* shall be approached in the following chapter).

Based on the issues which were presented so far, the result is that a primary distribution is decomposable up to its basic element - the individual assignment relation between a singular value of the distributed attribute (dependent) and a singular value of the support

[6] An attribute is cumulative if it allows the addition and subtraction operations. Attributes such as the frequency, color, temperature etc. are not cumulative, but the electric charge, mass, spatial dimensions, so on are.

[7] The invariance of a relation means that, on a certain range of the independent variable, also known as the function's continuity domain, the dependence relation *f* between the two amounts is always kept the same (unchanged).

attribute (relation 2.2.1) - even in case of the continuous primary distributions (algebraic functions).

Comment 2.2.6: When the plot of a continuous, algebraic function is drawn-up on a computer, this shall use the assignment relation, by means of a repeated process, between the allotted value and the support value according to the number of the actual values (singular) which exist in the support range. The way of defining the distributions in this paper had to be consistent to SOP, which was presented within chapter 1, and due to this reason, a distribution must be considered as a system decomposable up to a basic element and composable up to the limit of the highest possible domain of the support attribute. SOP is one of the basic principles of this paper, so that, at each description of the new distributions-based objects, which are about to be presented in the following chapters, their (de)composition degree shall be minutely approached.

Therefore, the elements of a single *k* element of primary distribution are y_k, f_k and x_k. The dependence between the singular distributed value and the support value shall be also written as a product:

$$y_k = \rho_k \cdot x_k \tag{2.2.5.a}$$

or:

$$\rho_k = \frac{y_k}{x_k} = \frac{f_k(x_k)}{x_k} \tag{2.2.5.b}$$

where ρ_k (in case of a distribution element) is a simple numerical value.

Definition 2.2.10: The amount given by the local assignment relation, equal with the ratio between the actual distributed value and the actual support value within a distribution element is called the **density** of that distribution element.

In other words, the density is an attribute specific only to the elements of a distribution, it is therefore a local amount for a certain distribution. However, if the assignment relation depends on the support value by means of a relation $\rho(x)$ and this dependence is invariant on the support domain, then, we are talking about a *density function* of a distribution (of a primary distribution, in this case).

The assignment relations may be either simple or more complex[8]. We have previously seen that a distribution is simple if the assignment relation is invariant on the support domain (a continuous function). In such a case, there are once again simple or complex relations (functions); the most simple relation of this kind is a numerical constant (a numerical invariant value), evenly assigned along the entire support domain, which also gives the name of this kind of distribution, that is ***uniform distribution***[9].

This type of distribution with the most simple assignment function is a basic distribution, it can be therefore used as an element within more complex distributions. Right next to the uniform distributions, on a higher rank from the point of view of the complexity of the assignment relation, the ***linear distributions*** may be found (synonym - ***uniform variable***), which are called in this way because they are straight lines according to the graphical plotting.

Comment 2.2.7: For instance, the distribution:

$$y_k = mx_k + y_0 \tag{2.2.6}$$

is this kind of linear function (equation of a straight line which crosses the axis y in y_0), where amount m is invariant in case of a certain distribution and it is called the distribution's *angular coefficient*, equal to the tangent of the angle between that straight line and the axis X (support attribute). It may be noticed that if m is null, the linear distribution becomes an uniform distribution.

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[8] The relations are complex only in case of the invariant dependence relations (independent of the support actual value, that is the case of the continuous functions); the individual relations between an actual distributed value and one actual support relation (which define a distribution element) are always simple values (numerical or literal values).

[9] An example of this kind of distribution was noticed at the Heaviside distribution (given by the relations 2.2.3), which is made-up from two concatenated uniform distributions $\theta_1(x)=0$ and $\theta_2(x)=1$.

So far, we have discussed about the relations between the singular values of the two attributes involved in a primary distribution; it is the moment to see what kind of relations are between the variations of the numerical values of the two attributes, namely, between some intervals (which include sets of singular values) of the two variables. Therefore, we shall presume that the entire support domain $\{x\} \in \{R\}$ of a primary distribution *{f}* is divided into elementary intervals[10] (variations) of the same amount Δx (amount given by the relation 2.2.2 and imposed by the elementariness condition), therefore, the support domain is made-up from an ordered series of intervals (variations) with a constant amount Δx, concatenated, in which each element of the series has a defined position (within the series) by the singular values of its boundaries. Thus, a support interval which has the lower boundary at $x_1 = x_k$, $(x_k \in \{x\})$ and the other one at $x_2 = x_k + \Delta x$, we shall note it (provisional) with Δx_m (pay attention, *m* is this time the running number of the interval object Δx from the arranged series of intervals, which is a number different from *k* belonging to the primary distribution).

If the elementariness condition of the support intervals is met, along the interval $\Delta x = x_2 - x_1$, any kind of primary distribution *{f}* may be approximated by a linear distribution (a continuous function on Δx), namely $f_1 = f_2 = f_m$, resulting the following variation for the distributed amount:

$$\Delta y_m = f_m(x_k + \Delta x) - f_m(x_k) = f_m^{(1)}(x_k, \Delta x) = f_m^{(1)}(\Delta x_m) \tag{2.2.7}$$

where $m \in \{N\}, (m \neq k, m \prec k)$ is the running number of the interval Δx_m in the series of intervals $\{\Delta x\}$, in which *{x}* support is divided.

Relation 2.2.7 is similar with relation 2.2.1, but it defines a dependence between the set $\{\Delta y\}$ of the elementary finite variations of amount *y* and the set $\{\Delta x\}$ of the elementary finite variations of the amount *x*, where *x* and *y*, let's not forget, are the amounts whose singular values are linked by means of the primary distribution *{f}*. Variations Δy_m which comply with the data elementariness condition are also called as first rank *finite differences* of the variable y, and the variations Δx_m, are first rank finite differences of the support variable *x*.

Comment 2.2.8: It is very important for the reader to notice that the way of defining the elementary interval according to the objectual philosophy does not contain any reference to the amount of this interval, the only condition which must be fulfilled is to exist a uniform variation of the distributed attribute along this interval (or its real variation to be considered as even, because the support's variation is uniform by definition). For this reason we can utilize finite differences (whose size is not important in this situation). As an example, see annex X.2.

Definition 2.2.11: The set $\{f^{(1)}\}$ of the dependence relations between each interval belonging to the ordered set $\{\Delta x\}$ of the first rank finite differences (variations) of a support variable *x* and each corresponding interval from set $\{\Delta y\}$ of the first rank finite variations of the distributed variable *y,* where x and y are linked by means of a primary distribution *{f}*, make-up the **first rank derived distribution** of the primary distribution *{f}*.

In case of the first rank derived distribution, set $\{\Delta y\}$ of the first rank finite variations of attribute *y* represents the new distributed attribute, and the ordered set of the finite variations $\{\Delta x\}$ is the support of this distribution. It is also clear that the sets $\{\Delta y\}$, $\{f^{(1)}\}$ and $\{\Delta x\}$ have the same number of elements (but which is different from the number of the primary

[10] Attention! We are talking about elementariness according to the objectual philosophy, that is, informational, which means that there is no more (by convention) inner differential information within the elementary domain, in case of a non-null variation this fact means that the variation is even, both for the support attribute and for the distributed one (see annex X.3).

distribution sets from which it derives, within ratio $N_x / N_{\Delta x}$, N_x and $N_{\Delta x}$, being the number of the elements of set *{x}*, respectively, of set $\{\Delta x\}$).

Comment 2.2.9: It is once again important to observe that the basic element (non-decomposable) of the first rank derived distribution is an even variation (a set of singular values, an interval) Δy_m assigned to an even variation Δx_m, by means of relation $f_m^{(1)}$, while the primary distribution (from which the derived distribution arises) has as its basic element - as it was above mentioned - a single value y_k assigned to a single value x_k by means of a relation f_k. The reader will better understand the difference between the relations 2.2.1 and 2.2.7 after reading the following chapter in which the term "object" shall be defined, what an inner reference does represent, and moreover, after reading chapter 4, where we are about to see what does it mean the variation of an attribute's value, namely a process. We shall therefore notice that, although both relations display the same singular value x_k, in the relation 2.2.1, x_k is a *singular value* type object, and according to the relations 2.2.7, x_k is also a singular value type object but also an *inner reference* of an interval type object.

Just as in the case of the primary distributions, if the dependence relation $f^{(1)}$ is kept the same on the entire domain of the independent variable (in our case, of the set $\{\Delta x\}$, regardless of the concrete value of *m*) that particular relation is a *continuous function* along that interval, function which is called *the first rank derivative* of the primary function *f.* Similarly with the primary distributions, in case of the first rank derived distributions, the distribution element may be written as a product:

$$\Delta y_m = \rho_m^{(1)} \cdot \Delta x_m \qquad (2.2.8.a)$$

or:

$$\rho_m^{(1)} = \frac{\Delta y_m}{\Delta x_m} = \frac{f_m^{(1)}(\Delta x_m)}{\Delta x_m} \qquad (2.2.8.b)$$

Where $\rho_m^{(1)}$ is also *the density* of the distribution element, but this time, of the first rank derived distribution.

Comment 2.2.10: If in relations 2.2.8, the equation of a linear distribution given by the relation 2.2.6, is replaced, the result is:

$$\Delta y_m = m(x_m + \Delta x) + y_0 - m x_m - y_0 \qquad (2.2.9)$$

hence, resulting that:

$$\rho_m^{(1)} = \frac{\Delta y_m}{\Delta x_m} = m \qquad (2.2.10)$$

Namely, the density of a derived distribution element (which is the density of a linear primary distribution) is even the angular coefficient, tangent of the angle between the primary linear distribution and the axis of the independent variable (distribution support). The density of the primary distributions does not have any practical utility (at least for the time being), being introduced only for emphasizing the generality of the abstract object model, that is the *density*, valid for any kind of distribution, including the primary ones. The density values of the derived distributions, as we shall see in the following chapters, are abstract objects of major importance in this paper for processes' characterization, being the substitutes of the local derivatives from the differential calculus, also valid for the distributions with a discontinuous support (see annex X.2.1).

For the reader, it is clear enough that the derived distributions of a primary distribution *f* can also have higher ranks, with the specification that the only primary distribution remains *f*, all the other ones being derived distributions $f^{(n)}$, the elements of all these distributions having the same support (the elementary interval Δx), only the distributed amount (a finite difference of rank *n*) and the number of distribution's elements being different. For all these distributions, the elementariness criterion is the same, just like the definitions used for the distribution element and for its density.

We cannot end this paragraph without making some observations concerning the differences between the mathematical models introduced, and the objects from the classic mathematics (differences which also exist in other mathematical fields and which are minutely approached in annex X.3). First of all, it is revealed the preoccupation of the objectual philosophy for the clear structure of each used object (abstract), moreover for the non-decomposable elements of this structure, which are the basic elements. Once with the definition of these elements and of the relations between them, a coherent structure of the whole mechanism is revealed (the object made-up from these elements), even if this object look (and it is otherwise denominated) in the official mathematics.

If there are not too many differences between the primary distributions and the mathematic distributions (besides the unusual concept on the density of an element or of a function), the situation is not the same in case of the derived distributions where there are major differences. The definition mode of the derived distributions (and implicitly of the derived functions) is much more different from the one used within the differential calculus. An object similar with the classic n-ranked local derivative of a function f is, according to the objectual philosophy, *the density* of a n-ranked derived distribution of that particular function.

2.3 Realizable distributions

There are similarities and differences between the virtual distributions which are supported by set {R}, or by its intervals, briefly presented above, and the *realizable distributions* (which are also called in this paper as *systemic*). The similarity is that the systemic distributions also consist in a set of assignment relations between the value of the dependent variable and the values of the independent variable, and the domain of potential values of the independent variable makes-up the distribution's *support*. The basic difference between the virtual and the systemic distributions is represented by the fact that the elements of the virtual distributions (according to their definitions) are mostly *virtual* objects (non-realizable as the class instances, because the support singular values which belong to set {R} contain an infinite quantitative information amount), while the systemic distributions are *realizable* objects, either only abstract, or abstract and material.

Comment 2.3.1: The following chapters will allow a better understanding of the concept regarding the *realizability* of an object. For the time being, it is enough to mention that an object is *abstract realizable* if its related information is finite, therefore, the information amount may be included in a finite Information Support System (ISS). For example, an usual numerical value is contained in a finite number of digits. An abstract object is virtual if it is associated with an infinite information amount; this kind of objects cannot be actually realized (as instances of the objects class). An abstract realizable object whose properties may belong to a material object shall be a *material realizable object*.

As we have already noticed from the previous subchapter, the primary distribution element is represented by a singular value y_k of the distributed attribute, assigned to a singular value x_k of the support attribute by means of a relation f_k. The point of view on the singular numerical values and on the support domain amount is the essential difference between the virtual and the realizable distributions. If the virtual (mathematic) distributions are supported by the infinite domains and AAV (see Dirac distribution described in the previous chapter), the realizable distributions allows only finite interval supports, limited by the two boundaries, with values which were estimated in relation to the inner reference, and these intervals consist of <u>a finite number</u> of singular values.

Therefore, taking into account the support domain amount, a realizable object shall always have its properties distributed on a non-null and finite support domain. The most simple domain is the *pointwise domain*, any other domain could be made-up by means of composition (concatenation, joining) of a finite set consisting of such identical elements. As for this basic element of support domain, the objectual philosophy proposes a special denomination: *domain point* or *dimensional point* (DP) which is the geometrical representation of *a normal singular value* (for details, see annex X.3).

Definition 2.3.1: An absolute accurate singular value *x* which is associated with a non-determination interval[11] with the amount $\varepsilon_x \ (\varepsilon_x \neq 0)$, becomes a **normal singular value.**

Comment 2.3.2: The non-determination interval ε has the role to substitute the infinite number of digits required for the display of an AAV, which should follow after a reasonable series of digits representing the normal singular value, by providing in this way the finiteness of the information amount required by the abstract realizability. For example, the following numerical value:

$$x = \frac{1}{3} = 0.333(3333...)$$

If it would be written according to its value from {R}, we should also have an infinite series of 3 figures after the decimal point. Practically, if it would be written as x = 0.333, this means that we have drop out the infinite interval as a number of figures included in brackets, that part becoming a non-determination interval. The association of this non-determination interval was done since the ancient times up to nowadays, the people always operating with normal singular values, but without considering the discrepancy between the elements of set {R} (according to its definition) and these normal numerical values. Further on in this paper, when we shall be dealing with singular numerical values, these will be normal values, if not otherwise mentioned. According to the fashionable language, the dimensional point (DP) may be considered as a quantum for a variable domain, but unlike the fundamental quanta *h* from the current physics field, the quantum DP does not have an universal size, but it depends on the Information Processing System (IPS) type which uses it. If it is operated with a single-digit after the decimal point, then, $\varepsilon = 0.1$, and if the calculus is made with numbers with 6 decimals, then, $\varepsilon = 10^{-6}$

In order to comply with the definitions which were above-mentioned in this chapter, we must warn the reader that if we have defined DP as a domain (interval), even if it is pointwise, this fact means that its boundaries must be settled according to definition 2.2.4. Because DP is informationally equivalent with a single-determined numerical value (normal singular value), another known value is needed, namely the inner reference of other adjacent DP. In this way, the amount of the non-determination range related to DP is the difference between two normal singular, successive values of the support domain.

Comment 2.3.3: In this way, the continuity and coherence of the structure of the elements belonging to the objectual philosophy is provided, as we are about to minutely see in the following chapters, after we shall enlighten ourselves by using the *distribution* concept about what does the *object* mean and what does the *inner reference* of an object mean. We shall also see that the relations between two objects are actually relations between their inner references, in case of two DP-type of objects, the reference are the two RAV which have been associated with the non-determination intervals (see annex X.3).

On such a support domain element (DP type), which, once again, informationally speaking, is equivalent with only a single known value (a singular value), the result is, according to the definition 2.2.1, that the value distributed by means of relation *f* shall also be a single one (but which have also an associated non-determination interval), therefore, the basic element of *realizable* primary distribution is *a normal singular value, distributed on a DP support domain,* or otherwise speaking, a normal value y_k of the distributed attribute, determined through the relation f_k by a normal support value x_k.

Attention! Do not confound a non-determination interval of a variable value with an interval of deterministic variation of the same variable. If the inner differential quantitative information is null within the non-determination interval (the equivalent of an uniform distribution, equiprobable), this information is non-null within the deterministic variation (e.g. linear) interval. This aspect is approached in annex X.3, when we shall be dealing with the difference (in case of axis X, for example) between the domain quantum ε_x and the elementary domain *dx*.

As for the realizable distributions, based on the above-presented issues, we may notice that the support of the primary achievable distributions is no longer continuous (as it was in case of the virtual distributions), but discrete, any of its finite interval being made-up from a finite number of normal singular values.

[11] As we are about to see later on in this paper, non-determination means the lack (absence, nonexistence) of information.

2.4 Discrete distributions

Let us assume that we have a library shelf on which there is a known n number of books, carefully arranged on the vertical position and with an invariant succession (their arrangement order must not be permanently changed). If we assign a running number to each book (according to the usual manner, in ascending order, from left to right) we will have a series of objects (real, *book*-type) arranged in numerical order. Each book from this series shall have a related natural number $k \in [1, n]$, number which represents a new property (running number in series) associated to each object, besides the model properties of the particular item, called *book*. We have therefore a finite set of n objects with their related finite number of features. In this example, few attributes which are specific to a book-type of object are: the title, author's name, release date, number of pages, size, type of the contained data (literature, textbook, technical-scientific data), classification index and many others. If we make a list with the correspondence between the book title (dependent variable) and its running number from the shelf (independent variable) we shall have a collection of assignment relations of the property *title* within the ordered set of running numbers from the interval *[1,n]* (that is the support).

This collection of assignment relations (the numerically arranged titles list) make-up the distribution of the *title* attribute on the support *[1,n]*. In a more general case, the abstract object *ordered and finite series of objects* is a distribution of the property *object* on the support made-up from a finite segment of the set of integer or natural numbers.

Definition 2.4.1: A distribution is considered to have a **discrete support** if it has a discontinuous support, made-up from an ordered series of disjoint support intervals.

A discrete support distribution of a single type of attribute y on n objects of x type, under the assumption that the assignment relation is not invariant (similarly with the relation 2.2.1), has the following expression:

$$y_k = f_k(x_k), k \in [1, n], k \in \{N\} \tag{2.4.1}$$

Based on the above-mentioned issues, we can make a deduction that the virtual distributions on continuous supports are approximated by means of realizable distributions with discrete support, because their support is always divided into a finite set of objects (at limit, DP-type objects), with invariant sizes for a certain distribution.

Further on, we may assume that we have a set *{M}* with a total number N_T objects which all have property B, but on a different extent from an object to another (there is no uniform distribution). There are objects which own the property B in a small amount b_m and others which have it in a large amount b_M. If we divide the interval $\Delta b = b_M - b_m$ in an N number of DP of amount ε_b, an integer number $n(b_k)$ shall correspond to a such interval with the boundaries b_k and $b_k + \varepsilon_b, (k \in [1, N])$ shall be an integer number $n(b_k)$, the number of objects set *{M}* which own property B in amount b_k. In this case, the amount (property) B is the support attribute (being independent variable ordered in a series of N DP), and $n(b_k)$ is the distributed attribute (dependent), the total number of objects which correspond to a DP support. This integer shall be called ***the population*** of that support interval, and because it is an integer number, it clearly has discrete values. In this case, we are dealing with a primary realizable distribution of an attribute assigned with discrete values.

If it is taken into account that the only known numerical value from a support DP is the inner reference of the interval (value b_k, see also annex X.3), resulting that all the elements belonging to a support DP have that value assigned on them, otherwise speaking, we have an uniform distribution with value b_k. If the attribute B is cumulative, the quantity:

$$Q(b_k) = n(b_k) b_k \tag{2.4.2}$$

is the total amount (stock) of attribute B distributed on the population of the interval $[b_k, b_k + \varepsilon_b]$.

We shall return to this type of distribution after establishing in next chapter what do object and set of objects mean.

Comment 2.4.1: In case that the set *{M}* has a very large number of objects, such as the set of molecules from a gas in a precinct, the populations of each support interval may also have a very large number of elements. In such conditions, although the populations are actually integers, they can be written only under a scientific format (see annex X.1) and in this way, the decimal numbers are used. Another reason why this kind of populations are not represented by integers is also due to the inaccurate knowing of the number of elements belonging to the populations with a very high number of elements, or simply, due to the truncation (approximation) of these numbers by means of easier realizable values.

2.5 Chaotic distributions

Definition 2.5.1: A distribution of an attribute is **totally chaotic** if the assignment relations do not have any invariance domain, and the domain of the distributed and of the support attribute are continuous and infinite.

Comment 2.5.1: The distribution type was not mentioned any more in definition 2.5.1 (primary or derived distribution) because the definition is valid for both distributions types. When only the "distribution" term shall be used next in this paper, this means that any of its types are self-understood.

According to the definition 2.5.1, a totally chaotic distribution is a particular case of distribution, where there is not a single continuity interval across the entire support domain, for the assignment relations, the allotted values being totally random. The totally chaotic distributions may be also probabilistically defined, which means that these are the distributions at which the density of occurrence probability of any value is even (equiprobable values). After all the facts which have been aforementioned in this paper, it is obvious that the totally chaotic distributions are virtual objects, used in mathematics field, but unable to be realized. If the values domain of the distributed and support attribute is limited (finite and known), made-up from a finite number of normal singular values, then the distribution is only *partial chaotic* (that is the case of realizable chaotic distributions) and that is due to the fact that any restriction on a domain of values means a information amount growth, as we are about to see in chapter 8 and 9. In case of the totally chaotic distributions, the inner information amount associated to them is null.

2.6 Multiple support distributions

So far, we have discussed only about distributions which had a single type of support attribute (a single independent variable) because it was the most simple case of support and only the clear understanding of the *distribution* concept was important. If the distributed attribute y simultaneously depends on many variables $x_1, x_2, \dots x_n$ (independent both in relation to y and each other), relation 2.2.1 (based on the simplifying assumption that it is a function) may be written as it follows:

$$y_k = f(x_{1k}, x_{2k}, \dots x_{nk}) \tag{2.6.1}$$

In this case, we are dealing with the classic situation of a continuous function with many variables. As for the multiple support distributions, it is important to understand that this support is made-up from the union of n individual ranges of each variable, each combination of distinct singular values which may be assigned to the n variables being related to a single value of y. Otherwise speaking, an element belonging to this distribution (in case of the primary realizable distribution) is made-up from a normal value y associated through relation f to n normal simultaneously-existent values of the multiple support. In such case of a multiple support (also known as multidimensional, such is, for instance, the Euclidean 3D space), the relations 2.2.5 and 2.2.8 are also multiplied by n folds. Therefore, we shall have:

$$\rho_{1k} = \frac{y_{1k}}{x_{1k}},\ \rho_{2k} = \frac{y_{2k}}{x_{2k}},\ \ldots\ \rho_{nk} = \frac{y_{nk}}{x_{nk}} \tag{2.6.2}$$

relations which display the *partial* density values of the primary distribution elements, where $y_{1k}, y_{2k}, \ldots y_{nk}$ are linked by means of the following relation:

$$y_{1k} + y_{2k} + \ldots + y_{nk} = y_k \tag{2.6.3}$$

are the fractions belonging to the value of the distributed attribute y_k which correspond to each support variable. The same expression shall be written for the density of the first rank derivative distribution:

$$\rho_{1k}^{(1)} = \frac{\Delta y_{1k}}{\Delta x_{1k}},\ \ldots\ \rho_{nk}^{(1)} = \frac{\Delta y_{nk}}{\Delta x_{nk}} \tag{2.6.4}$$

where $\Delta y_{1k}, \Delta y_{2k}, \ldots \Delta y_{nk}$ are the specific variations of the distributed amount Δy_k due to the corresponding variations of the support elements (variables), the specific variations being the elements of the total variation:

$$\Delta y_k = \Delta y_{1k} + \Delta y_{2k} + \ldots + \Delta y_{nk} \tag{2.6.5}$$

It must be mentioned that the density values given by the relations 2.6.4 are achieved under the conditions of a total invariance of the other *n-1* support variables. These density values are the equivalent of the first rank partial derivatives from the differential calculus and the relation 2.6.5 is the equivalent of the total differential of the function *f* of variables *n.* The high-rank density values of the distributions and the variations of the same rank of the distributed attribute shall be approached again in the following chapters.

2.7 Conclusions

The meaning of the *distribution* concept used across this paper is not much more different as compared to the dictionary meaning, namely: allotment, division of a property (attribute) to some elements belonging to a set of objects which may own that property (see also the annexes X.2 and X.3). Taking into account the above-mentioned issues, there are few conclusions to retain:

1) A *distribution* is an abstract object made-up from a set of assignment relations of a property, on the objects of a support set. There is a strict, univocal correspondence between the two sets, each support object (which corresponds to an AAV in case of virtual distributions) must be related to an assignment relation and a value of the distributed attribute (even if this latter value is null).

2) If the assignment relation has the same form (invariant structure) for the entire support domain, that particular relation is the classic *continuous function* from mathematics field.

3) The distribution inside a *distribution element* of an allotted property is an elementary distribution (either it is even in case of the realizable primary distributions, or linear, in case of realizable derived distributions). For such an element, a distribution *density* is defined as a ratio between the variation of the distributed attribute which comes from the assignment relation and the variation (amount) of the support (we shall see in the next chapter that the values implied in the primary distribution element are also variations, but variations against an absolute reference).

4) Any type of uneven distribution is decomposable in elementary distributions, evenly or evenly variable.

5) The virtual distributions (from mathematics) are the asymptotic models (virtual objects toward which the realizable objects tend to) of the realizable distributions. Only for

this type of distributions, the infinite, continuous support domains or AAV singular support values are allowed.

Comment 2.7.1: The fact that the distributions have a higher generality level, as compared to the classic mathematical functions, this also provides a higher generality degree to the theoretical papers which are dealing with distributions. According to the current physics and chemistry (based almost entirely on functions), the properties of the studied objects are divided in two categories: *extensive* and *intensive* properties. The value of the extensive properties depends on the size of the object which owns the property, and the intensive ones are independent from these sizes. For example, the volume of a body, the number of elements (atoms or molecules) of the body, its total mass and energy are extensive properties, while the mass density, temperature, pressure, are intensive properties. By using the distributions, we may observe that the *extensive* properties are distributions or stocks of some distributions, while the intensive properties are inner references or densities of some distributions.

Ch.3 OBJECTS

3.1 Object's general model

Although the notion of *object* was used so far, without focusing on its definition, but rather by considering its generally accepted meaning settled by dictionaries and encyclopedias, this chapter shall expose minutely the model used by the objectual philosophy for defining this notion. Further on, concepts such as *property* (attribute), *process* etc. shall be used, by taking into account their dictionary-settled meaning, up to their subsequent re-definition. The only explanation which we are giving once again (we also did it in the comment 2.2.1) is that according to this paper, an attribute has two components:

1) *Qualitative* component, represented by the name or the symbol of that property (a substitute for the property's semantic value);

2) *Quantitative* component, also called in this paper the *existential attribute*, a number (scalar) which shows the extent (degree, proportion) of the existence of that property.

Within the relations from this paper, the two components are conjunctively associated, which means that they are able to exist only together (a null value for the existential attribute implies the non-existence of the associated qualitative property). The amount (value, quantity) of the existential attribute is given (as it shall be seen in chapter 8) by an information processing system (IPS), this process being one of the basic processes of information processing.

AXIOM I (***axiom of the quantitative value*****):** *Any value of an existential (quantitative) attribute is the result of a real or abstract variation process of that attribute against a reference value which is considered invariant. The zero value of this existential attribute means that the associated qualitative attribute does not exist. A zero-valued reference is an absolute reference, and the values assessed against this value are absolute values.*

Comment 3.1.1: This axiom expands the definition of the amount of quantitative values interval (as the difference between its boundaries), with any other value of a quantitative attribute. The axiom I could be better understood by the reader after covering the chapter 4, in which the concept of *process* shall be defined and analyzed. In that chapter, we shall notice that any value of an attribute may be considered as a result of a variation against the reference value. If the reference value is null (absolute reference), the difference against it is even the one which, according to the usual language, is called value, amount etc. In this way, it is explicitly point out that any amount of a quantitative attribute is the result of at least one variation process (either real or abstract), ranging from its non-existence (null value) up to the value from that particular moment. Due to this axiom, a meaning for the density of a primary distribution element can be easily accepted (as a ratio of two numerical values) because those values are also differences (but against an absolute reference). If in case of an abstract reference (e.g.: a reference system from mathematics) the variation process is also abstract, when we are dealing with the material systems, the natural references (the ones which are self-settled between the system's elements) are the result of real and natural processes. On the other hand, axiom I points out that any object, either real or abstract, can be considered as existent (existential attribute different from zero) only as a result of a process (generation), and an existing object cannot vanish (non-existence) without the occurrence of other process (annihilation, cancellation).

Definition 3.1.1: The **systemic set** is a set which contains $n \geq 2, (n \in \{N\})$ elements.

Comment 3.1.2: Unlike the general term of *set* stipulated in mathematics, which allows the existence of a set with a single element or even with zero elements (void set), the objectual philosophy does not allow this kind of virtual constructions in case of the set of objects, because here, the singular object and the set of objects cannot be mixed up. When the system model shall be presented, either material or abstract, we shall see that a system must be made-up from a systemic set of elements. On the other hand, as it also may be noticed within annexes X.3 and X.4 of this paper, the sets, just like any other object, are limited (contained) by an abstract container; if this container is empty, we are dealing with the equivalent of a void set.

Definition 3.1.2: A set which does not comprise identical elements (duplicate) is called **strict set.**

Definition 3.1.3: The **object** is a finite and invariant strict set of qualitative attributes (properties), with finite and invariant, simultaneous distributions placed on the same finite and invariant support, which are assessed against a common inner reference system.

Definition 3.1.4: The composition of the set of distributed attributes, type of the support attribute, distributions type, size of the support domain and the inner reference system, all of them with a simultaneous existence, make-up the **object's model**.

Definition 3.1.5: The model properties of an object are **inner attributes**, with their values established against the inner reference system.

Definition 3.1.6: The domain of the support attribute included within its boundaries is called the object's **inner domain**.

Therefore, an object is mainly equivalent with a superposition (union) of distributions, all of them with the same support. The boundaries of the inner domain create two complementary domains within the total domain of the support attribute (basis of complementariness, see annex X.5), the object's *inner* domain, and the object's *outer* domain. According to definition 3.1.3, there is at least one assigned attribute into the inner domain, the distribution does not exist or is different on the outer domain. This value difference of the attribute distributed at the border between the inner and outer domain represents the basis of separation (discernement, discrimination) between the object and the outer domain.

Definition 3.1.7: The following property is called **contrast**:

$$c = v_1 - v_2 \qquad (3.1.1)$$

equal with the difference between the values v_1 and v_2 of the attribute distributed on two different support elements.

In case of the boundary separation, the two support elements are placed on both sides of the object's boundary, but the definition is valid for any other two elements of a distribution. The contrast is a property which assign *distinguishability* feature to the objects, both as a singular object against the support domain not-occupied by the object, and both against other objects (in this case, the difference between the attributes allotted on the inner domains of the two objects). In case of an *even* distribution, the contrast between any other two elements is null. For the contrast existence, it must that at least one differential attribute (a property difference) to exist between two (or more) objects. It is worth mentioning that the values from the relation 3.1.1 can be both quantitative and qualitative values (semantic).

Comment 3.1.3: As we are about to see in chapter 8, the relation 3.1.1 represents an abstract comparison process; in case of the comparison between two numerical values (of the same qualitative attribute), the contrast is also a numerical value associated to the same qualitative attribute, while, if the two qualitative values are compared, the result can be nothing but *identical* (equal) or *different*. We shall see in chapter 8 and 9 that this attribute (contrast) is the *differential informatio*n which allows us to separate (distinguish, differentiate) two objects, and if the inner contrast is null, this means that the information limit of the abstract object decomposability has been reached (the elementary object was reached). This is the reason why the even distributions are elementary distributions in relation to the objects, and the linear distributions (with even density) are also elementary distributions, but this time, in relation to the processes.

The differential attribute (contrast) between two objects would be able to exist only if <u>at least one</u> of the following conditions would be met:

Condition 3.1.a: The sets of distributed attributes must be different by means of at least one component;

Condition 3.1.b: The type of the support attribute must be different;

Condition 3.1.c: The distributions of the common attributes must be different in terms of quantity;

Condition 3.1.d: In case of the model identity of the simultaneously existing objects (the same support attribute, the same set of distributed attributes and the same inner distributions) the support domains of the two objects must be *disjoint* and at most, *adjacent.*

Definition 3.1.8: The **disjoint domains** are considered to be two or more domains of the same variable, whose intersection of the sets of singular values is void.

Definition 3.1.9: The **adjacent domains** are considered to be two disjoint domains with a common boundary.

According to the definition 3.1.3, it may be noticed that an object is characterized by six main properties (attributes), with a compulsory existence of each of them, which shall be called the *set of existence criteria of an object* or the *set of general model properties*:

P1 - Composition (structure) of the distributed attributes set;

P2 - Type of support attribute;

P3 - Distribution mode (distribution type) of each attribute from the set;

P4 - Size of the support attribute domain (against the inner reference);

P5 - Inner reference system;

P6 - Unique singular value of the temporal attribute associated to all the object's elements (*simultaneous* existence criterion of these elements).

Comment 3.1.4: This unique singular value of the temporal attribute is assessed against a temporal reference, specific to IPS which certifies the object's existence. In chapter 8, we shall see that the objects "exist" only for an IPS which is able to assess (certify) their existence, namely, to be able to perceive the distributions of the characteristic properties. Each IPS has its own (inner) distribution of the temporal attribute, distribution which might be however correlated (synchronized) with other outer temporal distributions.

3.2 Elementary objects

Definition 3.2.1: The most simple objects (non-decomposable) which comply with the set of existence criteria P1…..P6 are called **elementary objects**.

According to criterion P1, the most simple object is the one which has a single component among the set of distributed attributes. The support attribute may be also multicomponent, multidimensional, such as the 3D Euclidean space, organized as a set of linear distributions with independent directions (axes). As regards the criterion P2, the most simple object is the one which is distributed on 1D support attribute (with a single dimension). We have noticed in chapter 2 that the distributions can be either simple or complex, and the most simple primary distribution is the *uniform distribution*. Therefore, as regards the criterion P3, the most simple object is the one who has an evenly distributed attribute. The amount of the support domain of an object may be either however big but finite, or however little but not zero (for the realizable objects)[12]. The minor support domain for a realizable object, as we have also seen in chapter 2, is the difference between two singular normal adjacent values (successive), with its geometric equivalent - that is a DP. The quanta DP of domain may be concatenated (jointed) in order to make-up domains of any size. As for the criterion P4, the most simple object is therefore the one which has a DP of 1D, that is an element of realizable primary distribution with an unidimensional support.

The inner reference system of an object shall be made-up from a number of elements equal to the dimensions of the support, and equal to the number of the distributed attributes within a set. In case of an isolated object (which does not have any relations with the outside), all these reference values are equal to zero (absolute reference). In case of the systemic set of objects which develop some relations between themselves, there will also be an <u>inner reference system for the set</u> (global) but which is external for the constitutive objects. In this

[12] Finiteness of the realizable object both towards zero and towards infinite is imposed by the necessity of contrast at the borderline, which is an essential attribute for considering an object as distinguishable, and also imposed by the related information amount which must be finite.

case, the inner references of the objects are assigned with values against this common outer reference. This assignment process occurs only for those attributes which are involved into the relations between objects. As a conclusion, the most simple object which complies with the criteria P1…….P6 - *elementary object* - is an element of primary realizable distribution. This object is composable, either under the meaning of making-up some objects with higher support domains, or by means of properties combination (superposition), for the formation of multidimensional objects.

3.3 The objects' hierarchical organisation

Considering the object O_1 from the figure 3.3.1, with an inner reference R_1 (assessed against the absolute outer reference R_0)[13], which has few objects O_2 (out of which, only one is represented) in its composition (in its inner structure), which in their turn, contain several objects O_3 , so on.

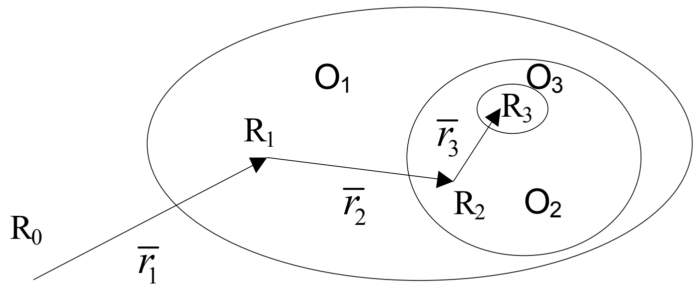

Fig. 3.3.1

If the attribute we are dealing with is the spatial position (but this matter is also valid in case of other attributes), the position of an object O_3 against R_0 is:

$$\overline{r}_{03} = \overline{r}_1 + \overline{r}_2 + \overline{r}_3 \tag{3.3.1}$$

where $\overline{r}_3$ is the position vector of the inner reference R_3 against R_2, $\overline{r}_2$ is the position vector of the inner reference R_2 against R_1, etc.

Let us consider that the object O_3 is non-decomposable, which means that either it does not have an inner structure any longer, or there are no available information on this kind of structure. Therefore, from ***analytical*** point of view, (in sense of its decomposability) this type of object has an unity level. But, the same object may be an element for a ***synthetic*** object (in sense of its composability) O_2. This synthetic object (composed, generated as a result of a synthesis) shall contain in its inner domain more objects of O_3 type whose external attributes are about to be determined against the reference R_2. This kind of object (O_2) shall have the analytical level equal with two (only a single level may be decomposed). The object O_2 can be also a component of another object O_1 which shall therefore have the analytical level equal to three, where there is another inner reference R_1 which is external to all O_2 components.

Definition 3.3.1: The integer number of hierarchical levels in which an object may be decomposed is the **analytical level** of the structure of that object.

The following remarks may be pointed out based on the aforementioned issues:

1) The objects are decomposable up to an inner informational limit equal to zero (null information), this limit being settled either by means of a convention (in case of the abstract objects), or by reaching the cognition threshold from a certain moment (for instance, in case of the abiotic material objects, as it was described in chapter 1).

[13] A simplified notation was used here, $R_0…R_3$ being considered as complete reference systems, but they were not drawn in this figure in order to prevent its complication.

2) The object's hierarchical level coincides with the structure level of the reference system associated to these objects, the inner reference systems being abstract substitutes for those objects (the external relations between objects are in fact relations between their reference systems).

3) The reference which is external to all the objects from a series belonging to the structural levels, with the highest analytical level (that is R_0 in this case) is an *absolute* reference, any other reference from the set being *relative* (linked through a relation) against this reference. Without the existence of any other reference able to set its value, this reference shall have zero value. The level of the absolute reference (mostly for the models within the real processes) also depends on the level of knowledge existing at a certain moment.

4) Composition (synthesis) of the objects is made by respecting the object's existence criteria, both for each component and for the composed object which was generated (criteria P1…P6).

3.4 Compound objects

As it was previously mentioned and as we are about to minutely see in chapter 8, the properties of an object, both the qualitative and quantitative ones, are assessed by means of an IPS, the notion of *object* being valid only for this special type of MS (your brain is also a part of this class, my dear reader). We saw that all the properties of an object must have a simultaneous existence, namely, to have an unique value of a continuous and evenly variable attribute, free from any of the object's attributes - that is *the temporal attribute.* The criterion P6 must be fulfilled both for the existence of the elementary and compound objects, otherwise speaking, the total number of objects which are constitutive parts of another object must have a simultaneous existence (even if these are the constitutive elements of our astronomic Universe), and the properties of the constitutive objects shall be added to the properties of our new compound object.

Definition 3.4.1: The **compound object** is a systemic set of objects, which develops invariant dependence relations between their inner reference systems against an unique reference system which acts externally in relation to all the constitutive objects - inner reference system of the compound object.

Comment 3.4.1: For example, in case of the compound objects from figure 3.3.1, R_2 reference is an inner reference for O_2-type of object, but an outer one, as regards O_3-type of objects from its composition. Similarly, R_1 reference is inner reference for the object O_1, but an outer one, both as regards O_2 and O_3-type of objects. The absolute reference R_0 is an external reference for any kind of object.

We have noticed that the properties of an object are distributed inside the object's support domain and they are called inner properties. In case of the compound objects, besides the inner attributes of each component, other properties are also associated to the objects which make-up the object, whose values are determined against the common reference. These properties are therefore *external* for the constitutive objects, but they are internal for the compound object.

Definition 3.4.2: The **external attributes** of an object are those properties which are assigned to the inner reference system of an object, and which are determined against an external reference system.

The inner reference of the compound object is therefore a common reference to all the constitutive objects (elements) of this object. Since the attributes of an object must be invariant, the relations between the constitutive objects must be also invariant, because these relations are inner properties of the compound object.

Definition 3.4.3: The **external composition** of objects is the formation of new objects by means of the combination in a compound object of many objects with invariant relations deployed between their external attributes.

Definition 3.4.4: The **internal composition** (synonym – **model composition**) is the formation of new objects by adding new elements to the inner (model) structure of the object.

When the general definition of the object was presented, we talked about a set of properties and afterwards, when we have focused on the elementary object, this set was reduced to a single property. It therefore results that a compound object is also that object which was obtained by means of superposition of some distributions of different attributes on the same support domain. In this case, the support reference remains the same, by adding only the references for the distributions of newly added attributes. Within such a composition, the object's model structure is altered, so that the result is an internal composition.

Other way of achieving compound objects is by means of the combination of the objects with the same model, but with disjoint support domains. The external attribute which is associated in such case to the elements of the compound object is for instance, the space position of the inner reference system of each element, against the reference system of the compound object. This is an example of the external composition of objects. In this case, the condition that each object to have its own support domain, requires that the support domain of the constitutive objects to be distinct (disjoint). The inner domain of the compound object will be made-up from the union of its inner elements domains.

Definition 3.4.5: The **compact object** is an object whose inner domain is equal to the sum (union) of the individual inner domains of the constitutive objects.

Otherwise speaking, the inner domain of a compact object does not contain intervals which belong to none of the inner objects, even if this domain is made-up through the combination (composition) of some disjoint domains (which are in contiguous relations). An example of compact object is the political map of the world (see annex X.2), which displays a compound object made-up from the adjacent union of the state's inner domains, where there is no bit of dry land which was let unassigned to the various existing states. Not any compound object is compact as well; for example, the object called planetary system (PS) is not a compact object, so as the object galaxy (GX), but both types of compound objects have their own reference system against which some elements of the inner reference systems are under invariant dependence relations (invariance between some limits and along certain duration).

The compact objects must comply both with the condition settled by the definition 3.4.5 and by the criterion P4 belonging to the general object model, that is, the global domains of two compound compact objects with a simultaneous existence must be disjoint (adjacent, at most). In case of the material systems, as we are about to see in chapter 7, the support domain is spatial, so that the following basic principle is valid for this class of objects:

Space-time exclusion principle: *The inner spatial domains of compact MS with a simultaneous existence must be disjoint, at most, adjacent.*

Comment 3.4.2: Space-time exclusion principle of compact MS, deducted according to the object's existence criteria (criteria mentioned in the general object model section), resulting as a logical conclusion of these criteria, conclusion valid only for a particular class belonging to the general class of objects (which can be also abstract, not only material). The underlining made within the principle enunciation has the role of attract the reader's attention that the principle is only applicable for the compact objects. As for the non-compact objects, there are domains of the support attribute which were not occupied by objects (that is the interstitial, free domains), which are domains available for other objects with simultaneous existence.

It is very important to notice that the process of objects composition is external for the elements of a compound object (if the components model is unaltered), while in case of the generated compound object, we are dealing with an internal composition because the model of the compound object is totally different as compared to the components model, even if these components are identical.

Comment 3.4.3: A nuclide is a compound object made-up from Z protons and N neutrons; during the process of nuclide formation, the protons and neutrons model remains unaltered, the formation process being external for them. The nuclide's model shall contain (among others) the number Z and N, otherwise speaking, for nuclear model, the association process of protons and neutrons is an internal composition process.

For a proper operation with objects and with relations between them, before proceeding to a more minutely description of the abstract objects (which shall be made in chapter 9), we shall briefly assert that the representation of an object which is meant for a certain perception organ (sense) is made according to certain rules which links the representation structure (which depends on the inner attributes of the sense organ) to the structure of the represented object. The entire set of these rules makes-up a *syntax* and each sensorial organ needs its own syntax. For example, as regards the sight perception system of the human, the visual syntax is being used (proper for this sensorial organ), which is divided in two sub-syntaxes: the literal and graphical syntax. In case of the hearing perception system, there is the auditory syntax (which is also divided in the phonetic and musical syntax).

Within the visual-literal syntax (mainly used in this paper), an object *Ob* is represented with the following simplified structure:

$$\{e_{Ob}Ob\} = \{\{e_a A\}op\{e_b B\}op...op\{e_f F\}\} \tag{3.4.1}$$

where the brackets are the object's boundaries (even of the elementary object), e_x (where X = *Ob, A, B* etc.) is the existential attribute (quantitative) conjunctively related to the qualitative property *X*, and the operator *op* is a composition operator. Between the existential attribute of the compound object (represented by the symbol from the left side of relation 3.4.1) and the existential attributes of their components, there is at least one dependence relation.

Comment 3.4.4: For example, if the object *Ob* is the position vector $\overline{r}(x, y, z)$ of a point *P(x,y,z)* from 3D space, the relation 3.4.1 becomes:

$$\{r\,\overline{r}\} = \{\{x\,\overline{x}\} + \{y\,\overline{y}\} + \{z\,\overline{z}\}\} \tag{3.4.2}$$

where the qualitative components have been represented with overlined fonts (directions, versors) and their existential attributes (modules) were represented with normal fonts. Between the existential attribute of the compound object (module *r*) and the existential attributes of its components, there is the following notorious relation:

$$r^2 = x^2 + y^2 + z^2 \tag{3.4.3}$$

As for the relation 3.4.1 and its implication, we shall discuss more on other occasions, but for the time being, we are only interested in the fact that the attributes *A, B, ...F* , pointed out in the right member of the relation, make-up the set of qualitative attributes allotted on the inner domain of the object *Ob*. The support attribute and the reference system do not occur in the literal representation, but there is no need of them anyway, according to the scope of this paragraph. Considering two objects Ob_1 and Ob_2 with the following structures:

$$\{e_1 Ob_1\} = \{\{e_{a1} A\}op\{e_{b1} B\}op\{e_{c1} C\}\} \tag{3.4.4}$$

$$\{e_2 Ob_2\} = \{\{e_{b2} B\}op\{e_{c2} C\}op\{e_{d2} D\}\} \tag{3.4.5}$$

We may notice that the sets of the model attributes of the two objects are different, but they also have common elements. If we are writing only the sets composition, the object Ob_1 has the set *{A,B,C}* and the object Ob_2 has the set {B,C,D}. The intersection set of the two sets is:

$$\{Com\} = C(Ob_1, Ob_2) = \{A, B, C\} \cap \{B, C, D\} = \{B, C\} \tag{3.4.6}$$

That is the ***common component*** of the qualitative information related to the two objects. Against this common component, considered as a reference, we shall have:

$$\{D_1\} = D(Com, Ob_1) = \{A, B, C\} - \{Com\} = \{A\} \tag{3.4.7}$$

$$\{D_2\} = D(Com, Ob_2) = \{B, C, D\} - \{Com\} = \{D\} \tag{3.4.8}$$

which are ***the specific components*** (differential, disjoint) of the two objects. These two classes of information components, associated to a set of objects, are basic abstract objects according to the objectual philosophy. Based on these, we would be able to make many things in the following chapters, one of them being the modelling of the information processing systems from biotic IPS, or making us to understand processes which are difficult or impossible to understand so far, such as the abstraction processes deployed in the human mind. The extraction of these components is made by means of abstract processes which occur only within the biotic IPS (for the time being), and they are symbolized in this paper by two types of functions (equivalent with the functions from the programming languages which also represent abstract processes) $C(A_1, A_2, \dots A_n)$ for the extraction of the common component of the operands, and $D(Com, A_k)$ for the extraction of the specific component D_k of each operand against the common component. Within these functions, $k = 1 \dots n$ and $A_1, A_2, \dots A_n$ are the function's operands (arguments), the abstract objects whose common and specific components are interesting for us and which can be as many as possible, but finitary. In case of the relations 3.4.6, 3.4.7 and 3.4.8, these functions are explicitly indicated.

3.5 Reference objects

Based on the above-mentioned issues, we have noticed that any quantitative value (existential attribute) of a property is determined through a difference against other invariant value - reference value. This evaluation is made (as we are about to see further on) by a information processing system (IPS), the only type of material system able to distinguish the object's attributes one from another, and to establish their existence degree. We have seen in chapter 2 that a distribution consists of a set of value-assignment relations of an attribute distributed on a support domain, without establishing the way how the assigned value may be evaluated. Now, it is time to assert that each of these values are evaluated (by an IPS) against the reference value, therefore, this kind of value shall be required for each assignment relation. Thus, we are dealing with another distribution - reference distribution - in which the distributed attribute is even the reference value, this distribution clearly having the same support as the distribution meant to be evaluated. The value allotted within the reference distribution is invariant, and is equal to zero, in case of the absolute reference. This uniform distribution with the reference value makes-up *a reference axis* (why it is called axis we shall see later on, when we will focus on processes). Since an object generally has a set of distributed attributes, each attribute from this set will have its own axis of reference on the inner domain of the support attribute.

Definition 3.5.1: The set of reference distributions for the model attributes of an object makes-up an abstract object known as **the inner reference system** of the object.

Because we are dealing with an invariant set of distributions on a common support, this means that the inner reference system of an object is also an object itself (obviously, an abstract one), which is called the *inner reference object*.

According to the approach way - either virtual or realizable - the inner reference object may be a virtual object, respectively, abstract realizable. In a virtual case (ideal, mathematic), this object is made-up from a set of continuous even distributions (with absolute accurate singular values), whereas in case of the realizable reference, it is a set of evenly realizable distributions with normal values, as reference values.

It is worth mentioning right even in this exposition stage that both the model of a real object and its reference object are *abstract objects* which exist only in the internal or external memory of an IPS (either natural or artificial one), in us, in our mind of human beings, but these make us able to perceive and evaluate our instant reality. This subject shall be broadly approached in chapter 8 and 9.

The distributions of the inner attributes against the inner reference values remain invariant in case of an invariant object. These reference values may be therefore considered as *common components* for a set of values assigned on the object's inner domain (as it was mentioned at the par.3.4). Since they are common components, any variation in the value of these references is equally transmitted to all the dependent values from that distribution, as we have already noticed in case of the compound objects. In case of the objects' composition, each object is represented in the outside by its reference object, the relations deployed between the objects which are included in this composition are relations developed between the inner reference objects belonging to these objects.

Comment 3.5.1: The reader will be able to better understand the truth and generality of the above mentioned issues if an analogy with the situation of relations between two objects belonging to the category of the current existing world's states is being made. It is a well-known fact that the political relations between two states are actually relations developed by their governments, more precisely between the ministries of foreign affairs belonging to these governments. In other words, the government of a state is an inner reference system of this object, against which both the inner attributes of the state's components and the outer attributes, revealed by the relations with other states, are determined. As for the human relationships within a community, there is a particular inner reference system for each individual in the evaluation of his conduct - that is the individual conscience - but there is also a reference system which is external to the individual but internal to the society - that is the moral conduct, ethics, good manners rules etc. - which makes-up the reference system for the behavior of all the society's members. The individual conscience of an element of society, as an inner reference, is granted (through education) with the proper values right from the set of conduct norms which is the society's global reference.

Because the *spatial position* attribute of a real object is very important in this paper, we shall focus a little bit on the reference object for this kind of attribute. We know since the schooling years that in order to define the position of a point in space, a system of reference made-up from three equally orthogonal axes (in case of a 3D space) is required, and these axes have a single intersection point- that is the system origin. According to the objectual philosophy, the axes of reference are some independent reference distributions which have only one element in common, which is their intersection (origin, common component of the three axes). This unique element for a certain object has a special denomination in this paper - ***T reference*** - because it is the element of the inner reference system involved in the translation processes (which shall be approached in the following chapter).

The other elements of the inner spatial reference system - the axes of reference (more exactly, their <u>directions</u>, invariant along their entire length) - make-up the second reference, that is ***R reference*** (which is involved in the evaluation of the object's rotation processes).

3.6 Conclusions

In fact, what is an object? According to the above-mentioned issues, it results that an object can exist only for an IPS able to validate this existence, as we are about to see later on. The purpose of this "invention" which was initially specific only to NIPS is to separate (distinguish, differentiate) a distribution of a property (which is perceptible by that IPS), with a certain inner domain, against the rest of the support domain on which the property is not distributed. We have noticed that this can be achieved by means of the differential attribute - that is *the contrast* - which is different from zero only in case of a "determinable" property difference. Therefore, an unevenness of the attribute distribution which is found mostly at the boundary of the object existence is the abstract support for the objects *distinguishability*. The contrast (differential information), as the object's essential attribute, requires however a special condition in case of the realizable objects, which shall be approached later on in this study, that is <u>their finiteness of the support domain</u> (both towards zero and towards infinite).

By analysing the definition 3.1.3, we may notice that the superposition of the distributions on the same support is equivalent with the association of more objects (abstract) with a simultaneous existence in a single one, this object being therefore qualitatively decomposable (an internal decomposition), and the joining (adjacent-disjoint concatenation) of the support domains of many objects can lead to a formation by means of external composition of another object.

Thus, another basic quality of the objects seems to be obvious, that is their *decomposability* up to the level of the elementary object (imposed only by the existing and workable information amount, or by the expiry of the object model) and their (outer, external) *composability* up to the boundary of the possible domain of the support attribute.

Finally, another basic quality of the objects, coming also from the definition 3.1.3, is the *invariance* of their model properties (for certain objects). Briefly, the object's basic attributes are: the *invariance* as model, *de(composability)* and *distinguishability*.

As I have already mentioned above, all the objects properties are evaluated by a MS belonging to IPS class, and their evaluation is made by comparison with (against) a reference system (RS), and because RS can be either *internal* or *external* to the object, these properties can be also internal or external. It is very important to notice that the outer properties of an object are assigned (associated) to the object's inner RS, and this inner RS is the object involved in the external relations (relations with the nearby objects).

With all the apologies given to those which might be offended, we have to make clear a characteristic regarding the approach on the notion of *object* in this paper, an approach which makes no difference between the non-living (abiotic) objects and the biosystems, objects which are considered as *creatures, beings,* and for which we should have a special appreciation, according to certain dogma. Obviously, when we shall deal with the models specific to the abiotic and biotic MS, there will be clear differences, but as regards the general (mathematic) object model, there is no difference. After reading chapter 8, it will clearly result that from the point of view of the objects perception mode, IPS makes no difference between the biotic and abiotic objects.

Ch.4 PROCESSES

4.1 Few process types

Another basic concept from the structure of the objectual philosophy is the notion of *process*. We have seen in the previous chapter that the objects are characterized (among others) by the invariance of the model properties, without excluding the possibility that some of the external properties of the objects to be quantitatively modified, such as the variation of the spatial position of a material object. Moreover, there is also the possibility that the model attributes to also vary, by turning an object into another, such as, for example, the nuclides transformation by means of radioactive disintegration. Even these variations of the objects attributes are the dependent (distributed) amounts in case of another distributions class, that is the *class of processes*.

Definition 4.1.1: The **process** is a variation's distribution of the attributes values of some objects, on an ordered series, made-up from even magnitude variations of a support attribute.

Therefore, the class of processes is a sub-class of distributions, which is different due to the fact that the distributed attribute (dependent) is always the variation (change of value) of an attribute, and the support (independent variable) is a series (an ordered set) of intervals equals between themselves as an attribute amount (which, most of the times, is the temporal attribute, but it can also be spatial, frequential etc.) However, we have seen in chapter 2 that this kind of distributions, in which the variations of a property are assigned, are called *derived distributions* (of a primary distribution).

Comment 4.1.1: Here is the moment to observe that the things seem to be connected, and we should be able to understand the role played by the derived distributions. If the primary distribution is the one who represents a "rigid", invariant distribution, for example the spatial position within a photo taken to some travelers which are at a certain moment in a railway station, and "frozen in time", the same property (traveler's position) seen with our own eyes, right from the spot, seems to be a set of motions (variations of the travelers position) distributed both in time and space. These motions are nothing else but *processes*, namely, distributions of position variations both on a spatial support (when we follow the traveler's movements against the steady railway station bench-marks) and on a temporal support (when we follow the time evolution of these movements).

In the case indicated by the definition 4.1.1, the process is made-up from a set of other processes, either they are simultaneous or sequential (concatenated), its decomposition might be done based on the following criteria:

- Number of objects which participate simultaneously to this process;
- Number of variable attributes on each involved object;
- A number of elementary (non-decomposable) concatenated processes.

Starting from the above-mentioned assertions, we may classify and denominate several classes of processes:

Definition 4.1.2: A **collective process** is a process in which a systemic set of objects is involved.

Definition 4.1.3: An **individual process** is a process in which a single object is involved.

Definition 4.1.4: A **specific process** is that process which allows only the variation of a single attribute during its unfolding.

Definition 4.1.5: A **multiple process** is the process which allows the simultaneous variations of more attributes during its unfolding.

4.2 Specific elementary processes

At the beginning of this chapter we have established that the mathematical model of a process is also a distribution, more precisely, a *derived distribution* of a *primary distribution*, and if a single attribute *Y* is distributed, then, the process is *specific*.

Both the primary and derived distributions (as we have shown in chapter 2), have the same type of qualitative attribute *Y*, distributed on the same type of qualitative support attribute *X*, but, within a primary distribution, the distribution elements are made-up from quantitative singular values y_k (virtual or normal), assigned by means of relations f_k or ρ_k on singular values x_k of the support attribute *X*, whereas in case of a derived distribution (such as the first rank distribution), the distribution element is made-up from an elementary Δy_{m1} quantitative variation assigned through a relation $f_{m1}^{(1)}$ or $\rho_{m1}^{(1)}$ to an elementary variation Δx_{m1} of the support attribute (the notations are those from chapter 2, but the difference is that the lower index *m1* represents the running number of the support element from a first rank derived distribution, whereas, in case of a second rank distribution, it would be *m2* etc. (see also the example from annex X.2). As objects, the support elementary intervals are limited by the two boundaries (x_1 and x_2 from relation 2.2.2) with values settled in relation to the inner reference x_k, corresponding with the values $x_1 = x_k$ and $x_2 = x_k + \Delta x$, which were mentioned in section 2.2.

Otherwise speaking, a support elementary variation starts from the singular value x_1 and it ends with the singular value x_2, the two values being related to the singular dependent values y_1 and y_2, which are the interval's boundaries of the distributed variation Δy. But this fact also means that a derived distribution element has two primary distribution elements as boundaries. These two primary distribution elements which "frame" a derived distribution element have a special name in this paper.

Definition 4.2.1: The total amount of the attribute's invariant values of an object Ob, at a singular value x_k of the support attribute, makes-up the **state** abstract object of object Ob, at a value x_k.

Comment 4.2.1: Definition 4.2.1 is a much more general definition than the case approached in the definition's preamble, that is why few explanations are required. When we have defined the object's general model in chapter 3, we have noticed that it is an union of invariant distributions on a common support. Let us assume that we have a real object, such as a piece of wood, whose properties are distributed on a spatial support, with the inner domain defined through its boundary - the object's outer surface. This piece of wood is decomposable in its elements (elements of space volume which are selected so that the properties to be evenly distributed on their inner domain), elements which have an invariant distribution of their spatial positions. This spatial distribution which is determined against the inner reference system, mostly for the elements which make-up the object's surface represents the *shape* of this object. Specific colors, hardness, temperature, etc. shall be assigned to a certain position from the body surface, all of these being properties which are specific to that position. The union of these properties within the defined spatial position makes-up a *state* of the body element from that position. In this case, the support attribute is the spatial one, but the state's definition is the same if the support attribute is another kind of attribute, such as the temporal or frequential one. If we move that piece of wood, the variable attribute is the spatial position of the object against an external reference. The object's spatial position together with all the other inner properties at the initial moment t_1 of the motion is a *state* of the object at that moment, and the position and all the other properties existing at other moment t_2 represent a state of the object at another moment. The following paragraphs will reveal that there are various sorts of *state* objects and as a result, we could identify to what class the above-mentioned state (definition 4.2.1) belongs to.

As we have noticed in chapter 2, within the support interval Δx_{m1} of the first rank derived distribution element, the distribution of the dependent attribute Δy_{m1} is a linear distribution, with constant density and specific to the inner reference value x_k of the support interval:

$$\rho_{m1}^{(1)} = \frac{\Delta y_{m1}}{\Delta x_{m1}} \tag{4.2.1}$$

Definition 4.2.2: The **specific elementary process** (SEP) is a linear distribution (with constant, even density), with finite support, of a finite state variation of an attribute.

In other words, a derived distribution element of a single attribute Y is a SEP of this attribute. As we have also noticed in chapter 2, the distribution elementariness (and of the process at the same time) is given by the fact that the variation density (the same with the density of the linear primary distribution) is evenly distributed, which means that there is no inner differential information (contrast) between the two values of the density from this interval.

This invariant density of a SEP has various denominations, depending on the type of the support attribute; if this (support) is for example, a temporal attribute, the density given by the relation 4.2.1 is also called *velocity* (or variation *rate*) of the distributed attribute.

Definition 4.2.3: The even density module of a SEP (a scalar) is called the **intensity** of the specific elementary process.

The presentation had a general nature in the previous mentioned paragraph, valid both for the virtual distributions (ideal, mathematic) and also for the realizable ones. As we have seen in chapter 2, the differences consist only in the type of the singular values (AAV or normal) and in the amount of the support intervals.

Let us assume that we are dealing with a specific *realizable* process (first rank, too) of the attribute Y (that is a derived distribution of a primary *realizable* distribution of this attribute). As for the primary distribution, we shall have therefore a discrete realizable support made-up from an ordered set of normal singular values (made-up from DP range quanta, of ε even amount), each with x_k inner reference. According to this distribution version, the *state* objects of an object *Ob* shall consist in normal invariant values of the object's attributes, related by means of assignment relations to some normal support values. The assembly made-up from the distributed attribute, support attribute, distribution type, inner range and the reference system form an *object*, as we have previously seen. Within a realizable process, the main invariance condition imposed to the properties of *state* object, in contradiction with the variability condition required to the process, lead to a compromise (an equilibrium) as regards the support DP amount, so that the attribute variation in this interval to be under the perception threshold of IPS which analyse this process.

Comment 4.2.2: A snapshot taken by a photo camera (at the end of a running contest, for example) represents a state of the *spatial position* attribute of the objects taken into consideration at a certain moment (that is the camera tripping moment). The exposure duration is settled so that the motion of the objects from the set to not be perceivable (to not impair the picture definition). This kind of time interval is in this case the temporal DP. Obviously, the motion processes have also continued during the exposure duration, but this motion is non-perceivable for the human IPS which analyzes the picture and it does not exist any more for the material support of the state information (picture), which must be invariant (information) once it has been recorded (stored). The faster the observing process, the lower must be the state's support interval (such as the exposure duration in this example). The same method - sampling - is being used in the case of electronic data acquisition taken from the real processes, characterized by two time intervals: sample duration and the duration between two successive samples. The sample duration is selected so that the variation process to be insignificant (null) during its unfolding, and the interval between the samples is selected so that a process to arise during its unfolding, but it must be considered even in case of the most uneven stage of the real process. These conditions are met if the sampling frequency f_e and the maximum frequency of the sampling process f_M comply with the Niquist criterion $f_e \geq 2 f_M$.

The state of an attribute is therefore a stationary abstract object (deliberate pleonasm), namely, invariant, that is an object with *a null process*, as its characteristic process deployed during its existence.

Comment 4.2.3: According to the natural language, the processes are represented by verbs (with all their flexional forms). For displaying the invariance of an object or of a property, the static verbs are also used, for example "to remain", "to stay" etc. These are examples of null processes which are specific to the objects during their invariance period.

We have discussed so far about first rank SEP, the ones represented by a first rank derived distribution element. If that specific process is more complex, there will be two different successive (concatenated) SEP, which means that there will also be a second rank derivative for the primary distribution. The element of such a second rank distribution shall be a second rank SEP, namely, a second rank finite difference assigned to a support element by means of that relation ($f_{m2}^{(2)}$ or $\rho_{m2}^{(2)}$). Here, a special remark is required: because all the support elements are equal one another, there will be no finite difference of higher rank (all of them being null), so that, all the elements of the derived distributions, regardless of their rank, shall have a support element of the same amount Δx, but integer exponents of Δx shall interfere in the expressions of the various ranks densities.

As a conclusion, any specific process, no matter how complex it is, can be modeled by some derived distributions of a primary distribution belonging to the variable attribute. The primary distribution is exclusively made-up from state-type elementary objects (we shall see next what kind of state), and the derived distributions are made-up from SEP-type elementary processes of various ranks..

4.3 Processual objects classes

Taking into consideration the aforementioned issues, a contradiction seems to occur (we might call it dichotomous contradiction) between the imperative invariance necessity required by the object model, and other variation imperative need required by the process model. Every time a contradiction appears, a negotiation takes place (#), which shall eventually lead to a compromise (an equilibrium) between two contradictory demands. In chapter 8, we shall see that the biotic systems have settled this dispute favorable to the objects, the processes being represented as systems of objects. The cause of this "choice" shall be also found out in the same chapter when the general IPS will be analyzed.

Now, let us return to the objects and processes. As we have also pointed out in par.3.1, in the comment to the axiom 1, in order to exist an object, it must be created during a special type of process - that is the *generation process*.

Definition 4.3.1: The variation process of the quantitative value of one attribute ranging from zero (nonexistence) to a value different from zero (existence) is a **specific generating process** of that attribute.

Obviously, the attribute variation during a generating process is also determined against a reference, but this time, it is an absolute reference. Any of the attributes of an object must be considered as a result of a generating process specific to that attribute. These processes may be either simultaneous (multiple) or successive (spaced out in time as external composition processes), real or abstract. The scope of this paragraph is not focused on the deep analysis of the generating processes, but only on their categorization as basic processes, without whom the objects and all which derives from objects would not be able to exist. At the completion of the generating process, the invariant values of all the attributes of object *Ob* taken from one temporal DP with an inner reference *t* (which is equivalent in the common language with a singular normal value of time, that is *t* moment) representing the *state* of object *Ob* at that moment, according to definition 4.2.1 (if a subsequent special specification would not be made, we are dealing with realizable processes).

Comment 4.3.1: The above-mentioned specification regarding the duration of the sampling time is relevant in general circumstances, when the attributes of the considered object are variable (there are non-null processes); in this case, as we have previously mentioned, on the duration of a temporal DP any process has an insignificant (by definition) variation (it may be considered as null). If these processes are missing, the state of the analyzed object is preserved as long as the processes are null.

Definition 4.3.2: The total ensemble of the invariant attributes of an object characterized by null processes makes-up the abstract **state S_0** object.

We have noticed that in the sampling interval (DP support interval) of state S_0 of the object *Ob*, the values of the object's attributes are invariant, we are dealing therefore with a null process. Between two successive states of S_0 type, which were taken at finite difference time intervals, (series of temporal concatenated DP) it might be a difference; since the two states are invariant, it means that the difference between them shall be also invariant, so the ratio between this value and the value of the support range (density of the variation distribution) shall be the attribute of a new abstract object, the state S_1 whose existential attribute is the intensity of a first rank elementary process.

Moreover, an invariant difference may also exist between two successive S_1 states, and then, we shall deal with a S_2 state, as a temporal density of a second rank process, so on.

Definition 4.3.3: The element of *n* rank derived distribution of an attribute is named **specific elementary process *P_n*** of that attribute.

Definition 4.3.4: The total ensemble of the invariant attributes of a P_n -type SEP from the support interval of that process, makes-up the **S_n state** object $(n \neq 0, n \in \{N\})$ of SEP.

One may find that *the state* objects are a subdivision of the objects class, at which the support attribute can have only a single value (an AAV in case of the virtual objects or a normal value for the realizable objects) for S_0 states, and a finite interval (a set of singular concatenated values) for S_n states.

Comment 4.3.2: The main feature (basic) of S_0 states is that their related processes are null[14]. Due to this reason, for the variable attributes the realizable sampling time of S_0 states is a single DP, only for preventing the existence of a process (in our terms, even if the process exists, the variation in the non-determination interval of DP must be under the perception threshold of IPS which analyse the process, so that the aimed attribute to be considered as invariant). If the sampling attribute is invariant, its state will be S_0 along the invariance duration. Now, we can understand that the state from the definition 4.2.1 is a S_0 state.

Attention! S_0 states are states of some objects and S_n states are states of some even processes P_n.

Index *n* is the rank of the finite difference against S_0 level. For making possible the unfolding of a non-null process, namely an observable property variation, the interval associated to the variation must be increased to a high enough value for allowing the occurrence of a variation, but also low enough so that the variation to be considered even, which means that the variation's distribution density to be invariant. This attribute (distribution's density), invariant along the support elementary time intervals is an attribute of an even specific process and because it is invariant along the duration of its support range, this is an object from class S_n. The finite difference rank which defines the state variation also grants the rank of the even specific process, therefore, we shall have processes such as P_1, P_2, …generally P_n just as the states temporally distributed along their course (see also annex X.6)[15].

Comment 4.3.3: It is very important for the reader to understand that we might also talk about an *object* (obviously, an abstract one) in case of a *process*, although (as we have mentioned above), the two concepts seem to be contradictory. Indeed, we are facing with a contradiction when we are dealing with one and the same attribute. In the same temporal support interval, the same attribute - let us say the spatial position - cannot be invariant and variable at the same time. But if the attribute is variable and its variation rate (velocity) is constant within the process' support interval, this rate is an invariant attribute, assigned on that support, namely, an abstract object. In the general case, although process means a distribution of some attribute variations, all the invariant attributes of the process existing in a certain support interval (such as the variation rate, direction, frequency in case of the periodic processes, etc.) shall make-up a S_n -type abstract object of that particular process.

[14] Which means non-existing processes, but symbolically marked with P_0 only due to the reason mentioned in comment 4.2.3, namely that the natural language provides verbs for the description of null processes.

[15] The complete notation of states and processes shall mainly consist of two indexes: one already defined (first from the symbol) which denotes the class order, and the second one which represents the instance index (of the object within its class). Therefore, if we are talking about a certain *k* process within class *n*, the notation will be P_{nk}. This notation is also applicable to the states.

4.4 Vectors

There is a special symbolistic used for SEP (regardless their rank), because this type of process is the basis (element) of all the other processes, otherwise speaking, any process, no matter how complex it is, may be decomposed into this kind of elementary processes. According to the visual syntax, both literal but mostly graphical, this kind of symbol used for SEP's graphical representation is the *vector.*

This symbol is a graphical substitute for an even attribute variation, that is a variation between two states: initial and final (corresponding with the two boundaries of the support interval). The two states are represented by two points whose positions are the attributes of the two state objects, and between them, there is a right-oriented segment which denotes the state's even variation. Oriented segment means that a certain direction was imposed (symbolized by the arrow direction), direction which shows a positive variation between the initial and final state. The size (length) of the right-oriented segment is proportional to the amount of variation between the two states (variation's amplitude)[16].

Depending on the information contained in the *vector* object, we shall have many types of such objects, whose denominations are already known in the scientific literature, but their approach method is a little bit different as compared to the method used in the present paper:

1) *Free vectors*, for which only the amount (module), sense and direction of the variations are known, the initial and final states being non-determined;

2) *Bound vectors,* for which the initial invariant state is known (vector's application point), module and direction of the state variation;

3) *Carrier vectors* (or *slide vectors*, according to some references), with the same attributes as the bound vectors, the difference consisting in the initial state which is variable.

Most of the vectors used in the vectorial calculus and in the vector fields theory from mathematics are free vectors. Subject matters such as Materials Strength or Hydrostatics operate with vector distributions with bound vectors, but there is also another important class of such vectors in mathematics and physics - the position vectors (bound by the origin of RS). The carrier vectors shall be the class of vectors used in the present paper as mathematic model for fluxes.

One may observe that when defining the vector-type objects, as well as of the substituted SEP, a new attribute occurs - that is the *direction*. This attribute is very important for SEP representation, therefore, it shall be minutely analyzed later on in this paper.

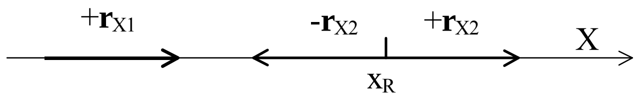

Fig. 4.4.1

The figures 4.4.1 and 4.4.2 shows a representation in the visual-graphical syntax of SEP (vectors) in two special cases:

1) When the variable attribute has a single qualitative component, in our case, it is *X* from the figure 4.4.1, attribute which is also called as *one-dimensional.* The values domain (domain of the existential attribute) of this qualitative attribute is a segment from the set (virtual or realizable, see annex X.3) of the real numbers {R}. An even variation of the value of this attribute means an even, successive covering of all the values from its values domain, running from an initial to a final value. The restriction that all these covered values to be included in a one-dimensional domain makes that this kind of running-through to have only two distinct attributes: *positive sense* (considered as the increasing one, which means that the

[16] It is worth keeping in mind that in case of a realizable SEP, there is no restriction imposed regarding their amount (magnitude), the only condition to fulfill is the evenness of their density along the support interval, and that is because an even distribution is an elementary distribution.

value of the final state to be higher than the one of the initial state) and the *negative sense* (reverse situation). This attribute - that is the sense - characteristic for the specific processes with an one-dimensional attribute (1D), can have therefore only two values (+ or -). We may notice that the sense of a variation, represented by its sign can be independent from the actual values of the two states (initial and final), but it is important only that the difference between them to have the required sign. This case is typical for the free vectors, as in the example from the figure 4.4.1 $\boldsymbol{r}_{X1}$. The situation is different if the initial state is settled, in this case, the value x_R. In such a situation, we are dealing with a new abstract object, that is the *direction,* for the one-dimensional case with only two possible values, corresponding to the two possible senses of the variation against the reference x_R (vectors $-\boldsymbol{r}_{X2}$ and $+\boldsymbol{r}_{X2}$ displayed in the figure 4.4.1). We shall see next that there is a way of defining the direction in a much more accurate manner in case of the multidimensional vectors.

2) When the variable attribute has two qualitative *independent* components (see definition 2.1.2), in this case, *X* and *Y* from the figure 4.4.2, attribute which is also called as *two-dimensional*. In this case, it may be noticed that a certain SEP of the attribute $\boldsymbol{r}(X,Y)$ is composed from two independent SEP (simultaneous and one-dimensional) $\boldsymbol{r}_X$ and $\boldsymbol{r}_Y$. These components are determined against a common reference (origin of axes O), each of them having the direction of the axis in which they are included (as we have seen in case 1) which is settled in relation to this reference. We may also assert that a variation *r* (an absolute one in case given in the figure 4.4.2) of a compound two-dimensional object is the result of the two independent variations (also absolute) and each of them contribute in a certain extent to the total variation. The two components from the figure 4.4.2 display even these contributions (also known as projections).

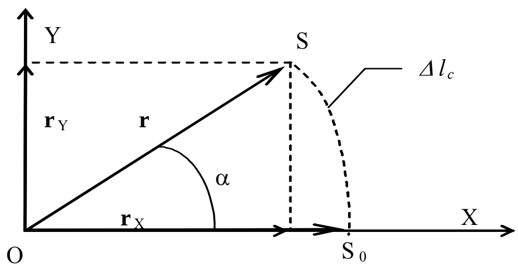

Fig. 4.4.2

In case that the compound attribute is the spatial position and by considering the analytical geometry, we know about the existence of some invariant relations between the module of vector *r* (total attribute variation) and the components modules (of projections) along the two axes: $r_x/r = \cos\alpha$, $r_y/r = \sin\alpha$. But, by taking into account the issues described in chapter 2, the amounts :

$$\rho_x = \frac{r_x}{r} \tag{4.4.1.a}$$

$$\rho_y = \frac{r_y}{r} \tag{4.4.1.b}$$

are at the same time densities of some even variations (absolute) of the components, on the common support - total variation (density values of the specific variations distributions over the total variation).

Definition 4.4.1: Numerical direction (synonym - **unit vector, versor**) of a two-dimensional vector v**V** against a bidirectional reference system **X, Y** is the abstract object made-up from the weight factor of the contributions provided by its independent components to the unit module variation:

$$\mathbf{V} = \{\rho_x \mathbf{X},\ \rho_y \mathbf{Y}\} \tag{4.4.2}$$

According to this definition, the numerical directions (unit vectors, versors) of the axes of reference are ***X****={1,0}* and ***Y****={0,1}*. Definition 4.4.1 is also consistent for the 3D case, by adding obviously the component ρ_z against the axis with direction **Z**. It may be noticed that in case of an one-dimensional attribute, the total variation is identical with the component's variation, therefore, the density 4.4.1 is equal to one and the contribution to the variation of another amount is null. This is the specific case of the axes of reference. The existential attribute (module) of the unit vector is equal to one, that is the reason why it was not mentioned in relation 4.4.2. Between the components ρ_x and ρ_y occurs the following known relation:

$$\rho_x^2 + \rho_y^2 = 1 \tag{4.4.3}$$

In practice, the direction of an unit vector is mostly determined by means of a solution of the equation 4.4.3, that is the above-mentioned α, given by the following relations:

$$\alpha = \arccos(\rho_x) = \arcsin(\rho_y) \tag{4.4.4}$$

and which is another type of existential attribute of one vector's direction against reference X. The amount α from the relation 4.4.4 is the ***angular direction*** of the vector in relation to the axis of reference.

Comment 4.4.1: The components of the numerical direction defined in relations 4.4.1, as a ratio between two linear variations (two P_1-type processes) are clearly dimensionless (that is why they were called numerical). The angular direction are defined in mathematics field as the ratio between the length of a circular arc (Δl_c from the figure 4.4.2) and its radius, fact which made the mathematicians to assert that the angle is dimensionless (that is also a number). However, the process analysis of the two involved abstract processes - circular arc and the radius of that circle - tells us something else. The circle radius is a right segment, therefore, a P_1 process, as we have seen so far, but the circular arc is a P_2 process. The reader is invited to decide by himself if the ratio between two processes of different ranks is dimensionless or not.

By using the concepts which were already introduced in the previous chapter, such as *common* and *specific* (differential) components of a compound object, we may observe that the variation $\boldsymbol{r}_X$ is the common component between the vector ***r*** and the axis of reference **X** (axis against whom the angular direction is evaluated). This common element of two concurrent SEP (with the same initial state), out of which one of them is considered to be a reference, is the current SEP projection along the reference direction.

Definition 4.4.2: The **common component** of two concurrent vectors v**V** and $v_R\mathbf{V_R}$ between which there is an angular direction difference α against the reference direction $\mathbf{V_R}$**,** a vector $v_C\mathbf{V_R}$ given by the following relation:

$$v_C\mathbf{V_R} = C(v_R\mathbf{V_R}\ ,\ v\mathbf{V}) = v\cos\alpha\mathbf{V_R} \tag{4.4.5}$$

According to the relation 4.4.5, the symbolic function C() is the one described in paragraph 3.4 and which generally represents the extraction function of the common component from a set of abstract objects, objects which are the function's arguments. In case of the compound object ***r***, the common component between the vector ***r*** and the axis with the reference direction ***X*** is:

$$\boldsymbol{r}_X = r\cos\alpha\,\boldsymbol{X} \tag{4.4.6}$$

that is the projection of vector ***r*** along this axis[17].

SEP ***r*** has another component $\boldsymbol{r}_Y$ along the direction of the independent ***Y*** axis, that is also a SEP but which has in common with the axis of reference only the intersection point, that is origin O, therefore, it is a disjoint (specific) component of vector ***r*** against the axis of reference ***X***.

[17] Attention! In this paper, the projections of a vector are vectors too, because the components of a vector are also vectors. This specification is made because the relation 4.4.5 may be mistaken with the dot product between vector **r** and axis **X;** the projection module is indeed equal to the dot product, but the vector is oriented on the axis direction.

Definition 4.4.3: The **specific** (differential) **component** of a vector v**V** concurrent with a reference vector v_R**V_R** between which there is an angular direction difference α against the reference direction **V_R,** a vector v_D (**V_R**+ $\pi/2$) given by the following relation:

$$v_D\,(\mathbf{V_R} + \pi/2) = D(v_R\mathbf{V_R}\,,\, v\mathbf{V}) = v \sin\alpha\,(\mathbf{V_R} + \pi/2) \qquad (4.4.7)$$

The function D() from the relation 4.4.7 is the extraction function of the specific components of an abstract object against the common component of a set to which that particular object belongs to (function which was also mentioned in paragr.3.4). The positive sense of the direction variation is the trigonometric positive sense, also against the reference direction of axis ***X*** from the figure 4.4.2.

Comment 4.4.2: The relation 4.4.7 is a consequence of a law which shall be approached in chapter 9, but it was already briefly mentioned in the previous chapter, according to whom, the properties of an object which belongs to a set of objects are made-up from two united classes of properties: *common properties* to all the set's objects, and *specific properties* to each object. Otherwise speaking, in case of a vector against a direction reference $\boldsymbol{V_R}$, we might say that the vector object is the union (sum) of the two component types:

$$\boldsymbol{V} = \boldsymbol{V_C} + \boldsymbol{V_D} \qquad (4.4.8)$$

But we know that the two components of a vector which comply with the relation 4.4.8 must be orthogonal one another (that is independent). This is the reason for which the common component of a concurrent set of vectors is normal on a plane which includes their specific components (against the common component). A more detailed discussion on this matter may be found in annex X.15 and X.17.

The disjoint component of a vector against the same reference direction shall have (in case of a 3D space) its direction included in a normal reference plane (that is also a vector projection but on a normal plane along the reference direction). A relevant property of the common and specific components of a vector against the concurrent reference vector is that all these vectors are *coplanar.* The discussion on a two-dimensional SEP may be extended in the same way to the three-dimensional vectors, by adding obviously the component after the axis **Z,** but the issue is more complex and it is not the subject of this section, because its scope is to enlighten the reader on the correspondence between a vector and a SEP.

We cannot end this short description of the vector representation for SEP without making a specification. All SEP may be represented by means of vectors, but not all the vectors represent SEP, more exactly, there are vectors which represent only reference directions, without representing state variations as well. Such a category of vectors are the versors of the axes which were briefly above-mentioned, but also the ones which make-up the local *R* references of a curve or of a spatial surface, which are the *tangent, normal* and *binormal.* These vectors do not represent SEP but only reference directions which are valid in their application point.

4.5 Concatenated specific elementary processes

We have seen that a SEP (represented by a vector) is an even process, of defined variation of a state attribute, between two values - the initial and final state. If the final state of a process SEP_1 (S_{02} in fig.4.5.1) becomes an initial state for other SEP_2 process, we might say that the two processes are *concatenated* (or linked, in case of the temporal support processes*, successive* SEP). This abstract process of concatenation may go on as long as possible, specific and individual processes of any kind could be represented in this way, so in the same manner as any type of distribution, no matter how complex it is, can be decomposed into even elementary distributions.

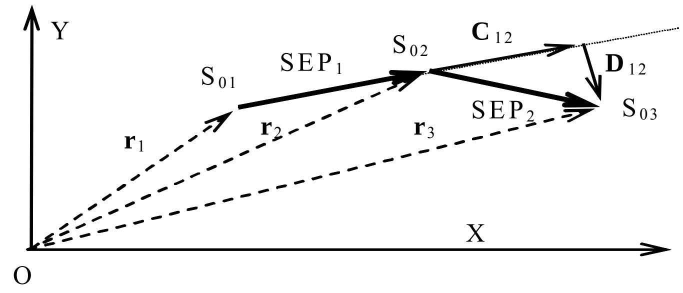

Fig. 4.5.1

The figure 4.5.1 shows two such concatenated SEP, namely SEP_1 and SEP_2 which according to the relations 4.4.5 and 4.4.7 have a common component $\mathbf{C}_{12} = C(SEP_1, SEP_2)$ and the specific component (of SEP_2 against SEP_1) $\mathbf{D}_{12} = D(\mathbf{C}_{12}, SEP_2)$ determined against the same reference direction of the previous SEP. The common component has the same direction with the reference direction and the specific component has the orthogonal direction oriented on the reference direction.

We may notice that two successive SEP shall have the same direction if there is no specific component (normal on the common direction) between the two SEP.

Comment 4.5.1: Introduction of the common and specific component concepts of two concurrent SEP and of their definition relations, provides new means for defining hard or incorrectly defined notions. One of these notions is for instance, the straight line definition. According to the elementary mathematics textbooks, the frequent definition of this abstract object is the following one: "The straight line is the shortest way between two points". This definition mode enunciates an optimal property of the straight line (as a result of a selection between all the possible pathways between the two points) but not also the generation process of this kind of object. The utilization of the common and differential component notions of two SEP, which is also applicable for the concatenated processes, allows a processual definition of the straight line: "A series of concatenated first rank SEP, at which the specific component of two adjacent SEP is invariantly null is represented by a straight line".

The cause for the occurrence of the differential components into a set of concatenated SEP shall be revealed in the following chapters or annexes. For the time being, we notice that the absence of such a component leads to an even process with the same direction, represented by a straight line according to the visual-graphical syntax, as we have aforementioned. This fact explains the graphical representation under the form of straight lines (axes) of the continuous set of values belonging to an one-dimensional attribute (this is obvious because since there is a single dimension, the differential component of the direction between two successive variations cannot exist), but this fact is also the basic explanation of the motion along a rectilinear trajectory of the material systems which are not subjected to the action of some forces with a normal component on its trajectory, that is a special situation - the absence of the action exerted by any force - corresponding to the motion of an isolated MS with an initial velocity.

4.6 Specific elementary processes with spatial support

At the beginning of this chapter we have mentioned that the processes are a class of special distributions which are characterized by the variation of an attribute, as a distributed amount. The type of the support attribute is another criterion for the processes classification. From this point of view, the processes which have the temporal attribute as their support are considered to be models for the real processes, and the ones with other support type (spatial, frequential etc.) are models for some of the abstract processes.

Comment 4.6.1: The assertion that the temporal support processes are models for the real processes must be accepted with tolerance by the reader, because it contains only a half-truth. The real processes, in which the material systems are involved may be actually, as we are about to see in the following chapters, spatio-temporal or frequency-temporal distributions. Otherwise speaking, the real situation is much more complex but in the scope of this chapter, a short simplified expression is allowed.

As we shall see in the chapter 9 which is focused on the abstract objects (objects with whom the IPS class can operate), there is also a class of processes in which the variations of the properties of some *information support systems* (ISS) are involved - these are the abstract processes. This kind of process occurs within ISS medium (which shall be minutely approached in chapter 8), either inside of an IPS or on the external ISS. In the purpose of this paragraph, we must mention that specific elementary processes also exist for the abstract processes and these are similar with the above-mentioned ones, being representable by means of vectors, but they can have both temporal, spatial or frequencial intervals as support ranges.

An example of such an abstract SEP is the one in which the attribute variation has a spatial support, when SEP represents the even state variation of an attribute between two points of different and invariant spatial location. This spatial distribution of the variation of an attribute is also representable by means of SEP (namely, by means of vectors), but those particular vectors are variations between two simultaneous states, but located in two different spatial positions. The density of this type of SEP with spatial support in case of a scalar primary distribution is known as the *directional derivative* of that distribution, according to the theory of vectorial fields, and the direction on which this derivative has maximum values represents the *gradient* direction of that distribution (see annex X.8). The gradient is a local S_1 state of a scalar distribution with spatial support.

Comment 4.6.2: If the reader shall analyze the classic relation which defines the gradient from annex X.8 by comparing it with the definition relation of the first rank density of a multiple support distribution, he might find out the resemblance between the two abstract objects. In this way, it may be noticed that the gradient of a scalar spatial 3D distribution is a vector (namely a SEP) which represents the total variation of the attribute assigned between two points, that is the amount of the specific variations according to the three support coordinates. Obviously, the distance between the two points is selected so that the density of the specific distributions to be considered as even.

Within the same category of SEP distributions with spatial support, but with a much more complex definition, the *curl* and *divergence* of a vector field are also included. We shall not minutely review these kind of processes because they are depicted in the textbooks on the vector fields theory, the sole intention of this section is to include some of these abstract objects into their appropriate classes, according to the classification system of the objectual philosophy, and to point out once again the fact that any SEP may be represented by means of a vector.

4.7 Periodical processes

We have seen in the section focused on the concatenated SEP that any specific and individual process may be represented as a succession (series) of even elementary processes, in other words, any process of this kind is a distribution with temporal support of some even variations of state.

The series of the reference states[18] (S_0 states) which deploys certain variations within their values, contains a finite n number of such objects in case of a finite process P_A (with temporal support):

$$P_A = \{S_0(t_1), S_0(t_2), \ldots S_0(t_n)\} \tag{4.7.1}$$

The time interval $\Delta t = t_n - t_1 = T$, that is the temporal support of the process P_A, is also known as the *duration* of that particular process, and the state $S_0(t_k)$, $(1 \le k \le n)$ is called the process *phase* at t_k moment. If the final state of a process P_A is the same with the initial state of other process P_B, with the same temporal states distribution:

$$P_B = \{S_0(t_1 + T), S_0(t_2 + T), \ldots S_0(t_n + T)\} \tag{4.7.2}$$

[18] Series which represents the primary distribution with temporal support of the variable amount.

a temporal concatenation of the two processes takes place. In this case, the processes P_A and P_B made-up from the same number of S_0 states with the same distribution and with the same T duration, are instances (realizations) of the same class of abstract objects known as *periodical* (synonym - *cyclical* or *repetitive*) *processes* with $A(t)$ distribution and with T period (the invariant duration of some repetitive concatenated processes is called *period*).

$A(t)$ distribution of $S_0(t)$ states is also known as the values distribution of the variable attribute, and according to a graphical representation, this distribution becomes the *form* of that repetitive process. For instance, as regards the processes in which variations of the electric charges within an electronic circuit may occur, these periodical variations are also known as *waveforms*, and the form of these waves may be rectangular, triangular, sinusoidal, so on. As for the periodical processes class, a very important attribute is the period's inverse, attribute known as *frequency* and which has a number of periodical processes in a time unit, as an associated semantic value.

$$f = \frac{1}{T} \tag{4.7.3}$$

In the next chapters, we are about to see that the frequency, together with the space and time, is one of the fundamental support ranges of the distributions used by IPS for the perception of real periodical processes. The hearing organ of the advanced bio-systems (mammals, birds) consists in a multi-channel analyzer - parallel in the frequency range - of the periodical pressure variations from the outside medium, which, under the form of recognizable sounds, may be signals with associated semantic value.

4.8 Motion processes

A basic class of processes, especially for the material objects is represented by those specific processes in which the variable attribute is the *spatial position* of an object (in case of an individual process) or of a set of objects (subject which shall be minutely analyzed in the next chapter focused on fluxes), which are called *motion* processes. We have seen in the previous chapter that the position of an object is in fact the position of the object's inner reference against an external reference. The object's motion is therefore a variation of the position of this internal reference against the external reference. This motion may be decomposed into motions of the internal reference system's (RS) components against the same components of an external RS. The spatial RS which were briefly mentioned in the previous chapters are the *T* reference (common component of the reference axes), and *R* reference (the specific directions of the three axis ***X, Y, Z***). The spatial position of the *T* inner reference of the object is given by the position vector $\overline{r}(x, y, z)$ which unites the two references - external *T* reference (application point which is invariant by definition), and the internal *T* reference of the object. Since the position vector has an invariant application point, it belongs to the class of bound vectors, its other attributes besides the application point being the size (module, magnitude) and the direction (defined in relation to the external R reference).

The overall (global) motion of an object shall be made-up, according to the above-mentioned issues, from the variations of the two elements which define the object's spatial position, the two components belonging to the spatial RS: *T* and *R* references. Because we are dealing with two qualitatively different attributes, we shall have two types of specific processes.

Definition 4.8.1: A specific process of external variation of the inner T reference position of an object is named **translation**.

If the direction of the translation process remains invariant, we are dealing with a ***pure translation*** (motion on a rectilinear pathway).

Definition 4.8.2: A specific variation process of a vector's direction is named **rotation.**

If the spatial position of the application point of the rotating vector is invariant, we are dealing with a ***pure rotation***. One may notice that pure rotations are mostly assigned to the position vectors, either against the internal R reference (for the object's elements) or against the external reference, for the object as a whole.

Definition 4.8.3: A translation motion of an object during which its position vector performs a pure completed rotation (2π radians) is named **revolution** motion (around the application point of the position vector).

Comment 4.8.1: The reader is invited to observe the approaching differences on the objects motion, between the objectual philosophy and the classic approaches. The objectual-processual approach specific to this paper takes strictly into consideration the variable attribute, because a single qualitative attribute must be variable in case of a specific process. According to this approach, the motion of an object means the motion of its inner reference system against an outer reference. *T* reference belongs to the inner RS and it can be considered as a null rotation point, therefore, it is able to generate only translation motions, and *R* reference is made-up only from directions, and as a result of this fact, it is able to operate only rotation motions. Thus, it becomes very clear that the rotation motions can be attributed only to the vectors (either the position ones or the ones which make-up *R* reference). The rotation of an object means also the rotation of its inner R reference (against the outer R reference), that is a rotation which generates however a lot of revolution motions of all the inner elements of the objects which have non-null inner position vectors.

Depending on the above-mentioned definitions and on the variable attribute, we could point out few specific motion processes, which shall be presented only because that the reader to understand the objectual-processual approach of the motions:

– invariant $\overline{r}$ both as a module and as a direction, but the angular position of the inner R reference is time variable; in this case, we are dealing with a *rotation* of the object, decomposable along its three possible simultaneous rotation axes and determined against the outer R reference. As we have also mentioned in the comment 4.8.1, it is worth noticing that a rotation of a compound object is decomposable in the same number of inner revolution motions of the object's elements.

– time variable $\overline{r}$ but only as a direction, the variations being coplanar, a circular *revolution* motion of the object occurring in this case (it is decomposable as well and determined against the outer R reference).

Comment 4.8.2: If there is an invariant relation between the direction of the position vector and the inner R reference of the object which operates the revolution motion, then a rotation motion of the position vector determines also a self-rotation of the object (around an axis which is parallel with the rotation axis of the position vector). This is the case of S-type media (which shall be defined in the following chapters, but which are momentarily assimilated with the solids), in which there are invariant relations both between T references and between R references of the constitutive objects (the free translation and the free rotation of the elements are forbidden). In this case, a rotation motion of the S-type compound object determines, besides the revolutions of the inner elements, also a simultaneous rotation of each constitutive element (a curl vector field with an even distribution is generated).

– variable $\overline{r}$, but the successive variations are collinear, a *pure translation* (obviously, an external one) being produced in this case. As also regards the pure translation (except the case when its direction coincides with the direction of the position vector), we are simultaneously dealing with a rotation of $\overline{r}$ (finite but non-null), and if the condition mentioned in the comment above exist, we shall simultaneously have a self-rotation.

Comment 4.8.3: It is well-known that in order to maintain an electro-magnetic communication with a space probe, directional (paraboloidal) aerials are attached both on the probe and on the ground station, whose axes must be kept as collinear as possible (an invariant relation must exist between their directions). The space probe is a S-type object with an inner RS against which the aerial has a steady direction. The probe trajectory is usually a closed curve, its position vector (against the terrestrial RS) has a variable direction, therefore, either the ground control centre, or a control system within the probe must permanently initiate the forced rotation of the probe in order to align the axes of the two aerials, simultaneously with the rotation of the axis of the aerial located on the ground. In this case, the direction of the ground aerial axis corresponds with the direction of the position vector of the probe against the terrestrial RS, direction against which the control system of the probe's rotating position must maintain an invariant relation. It is clear that the probe's rotation depends only on the direction of the position vector (regardless of the distance towards the probe), and the intensity of electro-magnetic flux received from the probe (which depends only on the distance, in case of the alignment of the aerials axes) is independent from its direction. This example implies an artificial invariant relation between RS of two objects (that is a informational relation maintained by some automatic control systems), but there are also numerous situations in which this relation is natural. That is the above-depicted case of S objects, but also of the natural satellites with isochronous orbital and axial movements (such as the Moon, the great Jupiter's satellites, etc.). As also regards these satellites, there is an invariant relation between the inner R reference of the satellite and the direction of its position vector against the central planet.

At the paragraph 4.5, we have seen that a certain specific and individual process may be decomposed into concatenated SEP, and these SEP are uniform variations with the invariant direction (vectors). According to the above-mentioned motion types, we may notice that the translation process belongs to this SEP class. Therefore, any type of translation motion is decomposable in series of elementary translations. We might also add that a pure translation with a constant velocity is a P_1-type of process, while its temporal density (uniform velocity) and its direction, a S_1-type of state.

4.9 Conclusions

1) The processes are distributions of the attribute variations of some objects, on different support ranges (temporal, spatial, frequencial etc.), which means that they are derived distributions.

2) Any process may be decomposed into specific processes, which in their turn, are made-up from concatenated SEP series.

3) SEP consist of a finite variation of a single attribute, distributed on an elementary support interval, which means that it is an element of derived distribution of that attribute.

4) The finite difference rank of the attribute variation (and of the derived distribution as well) is also a SEP rank.

5) The invariant density of the distribution of a SEP of rank n on its support interval is an abstract object from class S_n $(n=1, 2,...)$, but also other invariant attributes of P_n process existing on the same support interval may belong to the state S_n (such as the direction for translation, or the axis and the plane of the trajectory for revolution motion).

6) SEP, regardless of their rank are represented by means of vectors.

7) The processes with an invariant internal temporal distribution, concatenated into series against a common external temporal reference make-up the class of periodical processes (cyclical, repetitive).

8) The motion processes may be either translation or rotation movements (inner and outer). An elementary revolution motion (in case of a simplified 2D space included into the revolution plane) may be decomposed into two elementary translations which are perpendicular one another (the common and specific component of the current SEP against the previous SEP).

9) The sets of SEP which have a common external reference and which mutually deploy dependent invariant relations (which make-up a compound abstract object), may have common and specific components against this common component.

Comment 4.9.1: In the following chapters, we shall see that the statement from the point 9 is a very important one. If we are dealing with a set of spatially distributed motion-type SEP, that is a vector field, this field is able or not, to have a common vectorial component; in this way, we could determine if that field has or does not have a global motion (overall motion). If there is an overall motion, the vectorial common component shall be non-null; if this component is null, the field is motionless (see annex X.17).

Ch.5 FLUXES

5.1 Overview

The *flux* notion is essential for understanding the objectual philosophy, therefore, a special attention shall be payed to the description of the accurate meaning of this notion across the entire paper, mainly because it has other meanings, according to some specialized papers. For example, in The Encyclopedic Dictionary[19], the *flux* term (coming from the Latin “fluxus”- flow) has the following meaning:

- (PHYS) Particles current;
- (PHYS) Amount which shows the transfer velocity of another amount through a certain surface;
- (PHYS) Number of field lines which cross a certain area;
- (TECHNO) Continuous circulation of the raw stock, of the unfinished goods, etc. in the sequence of the operations generated by a technological process;
- (INFO) Ensemble of data, information and decisions required for the unfolding of a certain activity;
- (INFO) Ratio between the data amount and its transfer time;
- (BIOL) Continuous liquid (blood, pith) or information circulation through a bio-system;
- (MAT) Surface integral of the normal component of a vector.

Taking into account the above-mentioned list which is much more abbreviated than the dictionary version, we may notice that almost every professional field defines the flux in its specialized manner, some of the definitions being contradictory, which means that on the one hand, the flux is a motion process of an amount and on the other hand, it is an intensity of this process. Due to its unifying “calling” which derives from its generality degree, the objectual philosophy shall explain these aspects in the following sections.

5.2 Definition and flux models

In order to display the motion process of a singular object, it is enough to assert that its position is variable (eventually, continuous) depending on time, and the ratio between the position variation and the time interval which is necessary for this variation (density of the variation’s temporal distribution) represents the intensity of this motion *process* (velocity magnitude). But, if we are dealing with the motion of some spatial distributions of material objects, their motion issue is not simple any more, the introduction of a new term being required - that is *the flux* - which in the present paper is defined as the *simultaneous motion of a set of objects*, namely, a *distributed motion* (or a motion distribution).

Based on the facts presented in the previous chapter, few correlations may be established, because since we are talking about motion, we already know which is the variable attribute - *spatial position* of the mobile object. With only a single variable attribute[20], the result is that the motion process is a *specific process*. Since there are many objects which are in motion (a spatial distribution of objects with a simultaneous existence) within this process, we are dealing with a *collective process*.

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[19] *Dicționar Enciclopedic* - Editura Enciclopedică București, 1996

[20] Although we have asserted that the motion consist in translations and rotations, only the translations are important in case of the flux model, because only them are involved in a translation process.

Definition 5.2.1 The collective and specific motion (transfer, transport, displacement) process of some spatial distribution of objects or processes is called **flux**.

As we have noticed in chapter 3, an object means an invariant distribution (against its inner reference system) of a collection of properties. In order to initiate a motion of an attribute (*amount* - according to the mathematic language) we must have a motion of an object which is the holder of that property. Even in case when we are dealing with an information transfer (abstract objects), we are about to see in the following chapters that this also means the transfer of some objects, namely, material information support systems (ISS). The following section which is focused on the flux model according to the mathematic version (virtual), shall let aside the real property's support (the carrier object), because this is the operation mode in mathematics. In chapter 2, we have seen that the distributions are divided in two categories - virtual and realizable - that is why the flux's mathematical models shall be divided according to the same classification.

5.2.1 The virtual flux model

Let us assume that the amount (property) of conveying, a scalar *M*, is presented at a certain moment as a continuous 3D spatial distribution included into *V* volume, with a certain position against a reference system. It's worth reminding that a spatial distribution of an amount is also known as *field*, in mathematics; depending on the distributed quantity (either scalar or vectorial), we shall have a scalar or vectorial field.

In our case, the scalar field of amount *M* is defined as a primary spatial distribution, in which each element of volume *dV* on the coordinates *x,y,z* is related to the scalar quantity:

$$dM(x,y,z) = \rho_m(x,y,z)dV \tag{5.2.1.1}$$

where $\rho_m(x,y,z)$ is the volume density of the continuous and even distribution of amount *M*, on the volume element *dV*, which tends to zero and "surrounds" a point with the position vector $\bar{r}(x,y,z)$. As we may notice from the above-mentioned relation, the distribution is static for the moment, the spatial coordinates of the distribution do not depend on time. Under these static conditions, the total quantity[21] of amount *M* from volume *V* makes-up the *stockpile* of this amount (see stockpile definition from chapter 2).

If the distribution is moving, the position of each distribution element shall become variable. In the overview of this chapter, it was mentioned that the motion process of an object is characterized by *the motion intensity*, as an existential attribute, which is also better known as the velocity modulus, velocity which, according to the classic theory[22], is given by the following relation:

$$\bar{v}(x,y,z,t) = \frac{d\bar{r}(x,y,z,t)}{dt} \tag{5.2.1.2}$$

The motion of a continuous distribution is therefore represented by means of the connection (association) of a vector displaying the motion intensity and direction to each assigned value (more exactly, at each element of the spatial primary distribution). However, in each point (virtual, dimensionless point of the distribution), there is an amount $\rho_m(x,y,z)$ which moves at the same time with it, therefore, we shall finally have another amount which represents the transport process of the attribute *M* in a certain point.

Definition 5.2.1.1: The **flux density vector** (FDV) of an amount M is the following quantity:

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[21] We are dealing with quantity and stockpile only in case of the cumulative attributes (extensive), for which the addition, respectively, integration make sense.

[22] Theory which allows the simultaneous existence of the position and velocity of an object at the same time.

$$\overline{f}_m(x,y,z,t) = \rho_m(x,y,z)\overline{v}(x,y,z,t) \tag{5.2.1.3}$$

Comment 5.2.1.1: According to the virtual approach (based on dimensionless points) of the flux, due to the infinite number of these points in any spatial interval, a nonsense occurs concerning the value of the distributed amount on each support element of primary distribution - a singular value from set {R}, namely an AAV. If a support interval, regardless its size, consists of an infinity of singular values, the logical conclusion is that a finite quantity of the assigned attribute, divided to an infinite number of singular values leads to a null value of the attribute associated to each singular value. But the question is how such a null value can lead, by means of addition (integration) to a result different from zero? This nonsense vanishes within the realizable objectual approach, where the support of any distribution contains a finite number of singular normal values.

This new amount - FDV - is a local characteristic of the motion of a spatial distribution. One may notice that through the attachment of a vector which represent the transport velocity to each element of the primary distribution from the volume *V* (occupied by the initial scalar distribution *M*), the scalar field becomes a vectorial field, the distributed amount being this time FDV of the amount *M*.

According to the vectors classification made in chapter 4, FDV is a *carrier vector*, which conveys the amount $\rho_m(x,y,z)$ attached to its application point, from the initial point, up to the final point of the flux line (which shall be defined a little bit later). The modulus of this vector represents the local surface-density (see annex X.15) of the transport process, the existential attribute of the abstract object *flux* in a virtual point from the space.

In accordance with the virtual approach (and with the realizable one), there are two ways for the approach of this vector field, variable both in time and space, which is considered as a representation of a flux:

1) Analysis on the motion of a single object (in this case, of a single volume element of the scalar distribution) on a temporal interval of the flux existence;

2) Analysis on the spatial distribution of the ensemble of objects belonging to the vector field (namely, of FDV set) at a certain moment, after the flux initiation.

The first method, also known as Lagrange method, provides a *temporal distribution* of the spatial position of a single object involved in the flux, distribution which according to the current language is called *trajectory* (pathway). This pathway of a carrier vector is, according to the classic theory, a continuous curve in space, at which that particular vector remains permanently tangent, and which is called a *flux line* (or a flow line).

The second method, also known as Euler method, provides a snapshot at t_k moment of the total or partly *spatial distribution* of the set of objects which are in motion. This snapshot is a *global state* of the flux, at t_k moment, a steady vector field in 2D or 3D space. If this vector field is crossed by a steady surface Σ with a known equation (distribution relation) and area (reference area), we shall get the *superficial* distribution of FDV of that particular flux at the moment t_k, on the surface Σ.

Definition 5.2.1.2: The area of a normal Σ surface in any point on $\overline{f}_m(x,y,z,t_k)$ and which contains the set of all the flux lines of the flux **F**, is named **effective area** (synonym - **effective section**) of this flux.

Considering the local elements of this distribution: the position vector $\overline{r}(x,y,z)$ of a point located on Σ, "surrounded" by an area element $d\sigma$, $\overline{n}$, normal line on Σ in that point and $\overline{f}_m$, FDV in the same point (given by the relation 5.2.1.3). For simplifying these relations, we shall not mention their spatial coordinates, knowing that these coordinates make-up an invariant distribution for the points on Σ. According to the vector field theory, there is the following relation (see annex X.8):

$$I_\Sigma = \int_\Sigma \overline{f}_m\, \overline{d\sigma} = \int_\Sigma \rho_{mv}\overline{v}\,\overline{n}\, d\sigma \;=\; \left.\frac{dM}{dt}\right|_\Sigma \tag{5.2.1.4}$$

which defines the *flux* of vector $\overline{f}_m$ through the area Σ. According to this interpretation version, the flux is a scalar and represents the quantity from the amount *M* which crosses the area Σ in the temporal interval *dt.*

Attention! This flux definition is not valid according to the objectual philosophy, because the definition 5.2.1 is the valid one in this paper, which states that the flux is a distributed *process*, that is a vector field rather than a scalar one. In exchange, the relation 5.2.1.4 is also valid in this paper, but it defines the ***global flux intensity*** through the area Σ.

Comment 5.2.1.2: As it is also stated in annex X.3, as compared to the mathematic version of the flux definition of a vector, the concept of flux cannot be approached in this paper if there is no displaceable amount. Based on the mathematic version, the vector whose flux is computed may be any free vector, such as the velocity $\overline{v}$; according to the objectual version, if the vector $\overline{v}$ is not attached to a displaceable scalar amount (ρ_m in the above-mentioned case) the flux concept does not make sense any more. In accordance with the objectual version, the vector $\overline{f}_m$, whose flux must be computed, is always a carrier vector.

Under the above-mentioned conditions, if the intersection of the volume *dV* with a calculus area Σ is $d\sigma$, knowing that the inner vector distribution is even, an ***elementary flux*** results, a uniform vector distribution of FDV, with an effective area $d\sigma$. The vector distribution is uniform if both the modulus and the vectors direction are invariant (field with parallel vectors belonging to the same modulus).

5.2.2 Systemic (objectual) flux model

5.2.2.1 Overview

As for the flux's systemic model, we must use the specific concepts of this approach, as the definition 5.2.1 also states, we shall be dealing with a *realizable* spatial *objects* distribution, and these processes are subjected to a *collective and specific motion process*. According to the objectual philosophy, the motion of an object means the motion of its inner object's reference system, against an outer object's reference (that is because the inner reference system of the object represents the object within its external relations). Any object is also decomposable up to the level of an elementary object, the element of primary realizable distribution, with a DP support, and according to the systemic theory, this last object being meant to replace the virtual point from the classic mathematic model.

The virtual point (dimensionless) from 3D space characteristic for the classic approach, which had to be "surrounded" by a volume element, becomes the inner T reference of an elementary 3D object with an invariant *dV* volume, at which the inner R reference is associated, and this is made-up (in a Cartesian-type RS) from three length elements *dx, dy, dz*, with the directions **X**, **Y**, **Z** which are orthogonal one another. For the real fluxes of some cumulative attributes, the most suitable selection of the inner T reference position is the central one, that is in the middle of the intervals *dx, dy, dz*, which is a position associated to the circumstances described in the current specialized references, with the "surrounding" of the T reference point.

Comment 5.2.2.1.1: As it is minutely presented in annex X.3, the definition mode of the elementary objects is one of the major differences between the objectual philosophy and the classic mathematics or physics. If according to the classic approach, the volume, area or length element is the result of a process (at limit) of a gradual decrease towards zero of these elements, according to the objectual approach (by means of realizable distributions) the elementary object may be obtained by meeting a simple condition that the distribution of the dependent attribute to be considered as uniform (even for the most uneven areas of the distribution from which the element belongs to) on its inner domain. It is true that the gradual decrease towards zero fulfills the condition of the uniform distribution, but this method (of extreme abstraction) has many inconveniences which are coming from the fact that the informational restrictions imposed by the realizability of both of the abstract processes and of IPS which runs these processes are not taken into account. The gradual decrease towards zero of the elementary interval cannot be used any longer when the distribution support is a segment of the natural numbers set. Besides the issue concerning the size of the elementary objects, another main difference in the specific approach of this paper consists in the compulsory presence, for each object, even elementary one, of an inner reference system, that is a system which represents the object in its external relations.

During the motion process, the relations deployed by an object involved in the flux both with the external reference and with its neighbors (the objects from its nearby proximity) are very important. If the spatial relations between the flux's objects remain invariant, the object as a whole will move as a solid body; if the relations are only partly or non-invariant, the motion will be a fluid-type one, as we are about to see next. Thus, a new and coherent way for the classification of the media types seems to occur, depending on the RS spatial component which is variable during the motion process, classification which shall be depicted in the following chapter.

Under the systemic flux model, the elementary flux represents the motion of an elementary object against the outer reference. The main condition which must be fulfilled by any object is the invariance of its model properties during its entire existence period; therefore, the object's motion means the simultaneous motion of all its properties. Reciprocally, any motion of a property, namely of its flux, means the motion of some material objects to whom that particular attribute belongs to. In other words, there cannot be a flux of an amount without the existence of its material support (see annex X.13 for the difference between the concepts of *material support* and *abstract support*).

5.2.2.2 Distribution elements and quanta

In chapter 2, we have seen that a primary realizable distribution is a discrete distribution, whose constitutive element is an equipartition of the attribute distributed on a DP support. In case of the spatial distribution of the amount *M* from the paragraph 5.2.1, the support of an element is a 3D DP with an ε^3 volume (a volume quantum) on which a specific value of the amount *M* is evenly distributed. If the amount *M* is cumulative, a volume quantum with the position vector[23] $\overline{r_i}(x, y, z)$ shall contain a stockpile quantum:

$$q_m(\overline{r_i}) = \rho_m(\overline{r_i})\varepsilon^3 \qquad (5.2.2.2.1)$$

where q_m is the amount of attribute *M* associated (assigned) to a support quantum (a 3D DP located at that position, that is the equivalent from the objectual philosophy of the material point from the classic physics), and $\rho_m(\overline{r_i})$ is the distribution density, but also the assignment relation.

Comment 5.2.2.2.1: **Attention!** In this paper, the term "quantity" has a quite different meaning than the one used in the common language, denoting the value of the quantitative attribute associated to a qualitative property. According to the common language, the word "quantity" refers to the cumulative attributes (countable, integrable, extensive) on a certain domain, resulting a total quantity. According to the objectual philosophy, the word "*stockpile*" defines this total quantity. In case of the non-cumulative attributes, (intensive, such as the temperature, pressure, etc.) the word "value" or "amount" is being used, a quantitative quanta *ε* being also related to it, but it does not represent a stockpile, but only a normal numerical value. As for the intensive attributes, there is also a difference regarding the meaning of the word "density" of the distribution element. While for the extensive attributes, the density was a ratio between an elementary evenly distributed stockpile and its elementary support interval, in case of the intensive attributes, the density is only a ratio between an absolute (in case of the primary distributions) or relative (in case of the derived distributions) value, evenly distributed and the elementary support interval. The reader is invited to accept the fact that the concept of *quantity* in the objectual philosophy refers to the existential, quantitative attribute of a qualitative property, regardless if that property is cumulative or not. However, the attention must be maintained on the integration reasoning; it may exist a volume distribution of the temperature, but its integration does make sense only if this attribute is converted into a cumulative amount, such as the thermal energy quantity.

Because within the achievable distribution 5.2.2.2.1, the variables *x*, *y*, *z* vary gradually rather than continuously, with the amount ε, any interval of these variables shall contain a

[23] Attention! We are talking about the inner position vector determined in relation to the distribution's inner reference

finite and integer number of values such as N_x, N_y, N_z (see annex X.3.8), resulting also a finite and integer number of volume quanta for any spatial domain of the distribution of amount *M*. As it was mentioned in annex X.3, the number of the elements belonging to the realizable primary distribution 5.2.2.2.1 can be very high (but not infinite as in the case of the virtual distributions), because $\varepsilon = 2^{-N_b}$ is usually very small (N_b is the number of bytes used for the display of a normal numerical value). For reducing the information amount which must be processed and for cutting-down the time required for this processing, in case of the distributions realizable on AIPS, the volume which includes the spatial distribution of amount *M* is divided not in 3D DP, but into volume elements *dV* with the sizes *dx*, *dy*, *dz*, which were selected so that the inner distribution of the amount *M* with the density ρ_m can be considered as even on this elementary unit.

Comment 5.2.2.2.2: Besides the amount of the inner domain, another major difference between the volume quanta and the volume element is represented by the composition of the inner reference system of the two elementary objects. In case of the volume element *dV*, we have seen that it has both a T reference and a R reference made-up from the directions **X**,**Y**,**Z** of the three segments *dx*, *dy*, *dz*. In case of the volume quanta q_V, the inner reference is made-up only from T reference, the rotations being totally non-determined for this kind of object, just as in case of the dimensionless point.

Under these circumstances, we may write (only for a cumulative attribute):

$$dM(\overline{r_i}) = \rho_m(\overline{r_i})dV \tag{5.2.2.2.2}$$

Where $dM(\overline{r_i})$ is the stockpile from the amount *M* assigned to the elementary volume *dV,* placed on that spatial position.

Attention! In this paper, both the elementary volume and the volume quanta are *objects* with an inner RS, and T reference (origin) of this inner RS is the one who has assigned the position $\overline{r_i}(x, y, z)$, defined against the inner RS of the distribution (as compound object), and inner distribution's RS position is defined against an outer RS (an absolute one). According to the relations 5.2.2.2.1 and 5.2.2.2.2, the position vector $\overline{r_i}$ of each element is defined against this inner RS of the distribution (with its components T and R). When the distribution starts to move against an outer reference (for instance, an absolute reference), the variable attribute shall be $\overline{r_c}$, the position vector of the inner T reference of the distribution, against the outer T reference, and once with it, the positions of all the distribution elements shall become variable. If there are S-type relations (which shall be defined in the following chapter) deployed between the distribution elements, an overall motion of the inner R reference against the outer R reference may also occur.

The relation 5.2.2.2.2 is identical <u>from the point of view of its form</u> with the relations from the current scientific papers depicting spatial distributions of some amounts, (and in which the expression with "surrounded" point by the volume element is being used), but its meaning is the above-mentioned one. The distribution 5.2.2.2.2 is also a primary spatial distribution of the amount *M*, but with a higher approximation degree and requiring a less calculus volume as compared to the distribution 5.2.2.2.1.

At the moment when the distribution of the amount *M* which was initially static, begins to move as a whole, the spatial position $\overline{r_c}$ of the inner *T* reference of the distribution becomes variable and once with it, the positions of each distribution element become variable as well. All of these variations are *time* dependent.

Comment 5.2.2.2.3: This additional variable - that is the time - is approached in the present paper just as any other realizable variable, which means that a temporal quantum ε_t (a temporal DP) shall be assigned to it and also an elementary interval *dt* (see annex X.3 for the relation between the two elements types). In case of the temporal attribute, the difference between these two elements consist not only in their amount, but also in each specific utilization. The temporal DP quantum of amount ε_t with the inner *t* reference is the support of an element of temporal primary distribution (a state $S_0(t)$), while *dt* element (with an inner asymptotic reference at *t* moment) is the support of a temporal derived distribution (a state $S_x(t)$, $x=1…n$).

5.2.2.3 Flux's objectual model

In the previous section, we have asserted that the essence of the objectual approach consists in the organization of the information about a specific phenomenon in *objects* and *processes*. In case of the distribution 5.2.2.2.1 or 5.2.2.2.2, the existence criteria of an object (established in chapter 3) are:

P1 the set of assigned attributes contains a single attribute *M*.

P2 the support attribute of the distribution is the spatial position $\overline{r_i}$;

P3 the distribution type is provided by the relations 5.2.2.2.1 or 5.2.2.2.2, specific to a certain type of spatial distribution;

P4 the amount of the support domain is the volume *V* (divided into the finite set of the quanta or of the volume elements) in which amount *M* is distributed;

P5 the inner reference system of the complex object - *spatial distribution of the amount M*;

P6 t_k moment (a temporal DP) of the simultaneous existence of all the model properties P1…P5.

The properties P1…P4 have been explicitly settled by means of the initial data, which were the same, both for the virtual flux model and for the systemic one. However, the criterion P5 is specific for the objectual approach, therefore, it will be minutely analyzed.

In chapter 3, we have seen what does the object mean, what does the complex object mean and most of all, that the abstract object which is the *inner reference* of the objects with spatial support has two components: T reference and R reference. We have also noticed that the motion of an object is represented by the motion of its inner reference system against an outer reference. Hence, two types of *specific motions* have resulted and they are directly related to the element of the inner reference system whose quantitative attribute changes during the motion. If the position of the inner T reference is the only one who changes, we are dealing with a specific *translation* (displacement) process, and if only the position of the inner R reference is variable, we are dealing with a specific *rotation* process. As for the motions deployed in a 3D Euclidean space (Cartesian coordinates), each of these two motion types has three components, specific to each axis: T_x, T_y, T_z, respectively R_x, R_y, R_z.

We have also seen in chapter 3 that a complex object has an inner RS, which is however external to all the elements from which the object is made-up. As compared to this common RS, the inner reference systems of the constitutive objects can be involved in three types of relations:

1. *S-type relations* - If the relations between the inner T and R references of the constitutive objects are invariant during the motion, both between the neighbouring objects and against the homologue common T and R reference, the entire distribution of the amount *M* shall move just as a solid (rigid) body. In this case, there is a global (common) T and R reference of the distribution 5.2.2.2.1 or 5.2.2.2.2, with their positions defined against an outer RS, against which the overall motion of the spatial distribution of amount *M* would be determined. One may notice that within S-type relations, the inner motions of the complex object's elements, either T or R are forbidden.

2. *L-type relations* - If only the relations between the inner T references of the neighbouring elements are maintained invariant (the elements remain adjacent, permanently in contact during the motion but they are able to rotate freely), the entire distribution shall be moving just as a finite liquid portion which preserve its volume but it is not able to preserve its shape (inner distribution of the elements'spatial position).

Comment 5.2.2.3.1: The volume preservation is made just because the inner spatial domains of the constitutive objects remain permanently adjacent. In this way, if the number of elements is constant, even the sum of the domains amount (total volume) will also remain constant.

In this case, there is only one common T reference (the mass-center for a liquid portion) whose motion against an outer T reference is the overall motion of the complex object. As regards L-type of relations, both the inner translations and rotations are allowed, either on the element level or on the group of elements (cluster), but these motions are interrelated.

Comment 5.2.2.3.2: The translation motions of the elements which are in permanent contact are the same with the translation motion of the center of a spherical body which rolls without sliding on a surface. In this case, the shifting motion of the inner T reference of the body is exclusively generated by its rotation (rolling), otherwise speaking, if there is no rotation, there is no shifting, and other way round, any shifting must compulsorily come with a rotation.

3. *G-type relations* - If there is no invariant relation between the inner T and R references of the components and the common T and R reference of the distribution, those particular elements do not make-up a compound object any longer, each of these elements moving freely, just as the molecules of a gas. In case of G-type relations, any kind of inner motion is allowed and there is no interrelation between the T and R motions.

The flux model is different for each of the above-mentioned cases, but they all have in common the fact that we are dealing with a distributed motion, first spatially and then temporally, that is a spatial-temporal motion distribution.

5.2.2.4 Flux elements and quanta

In the section 5.2.2.2, we have seen that the support of a realizable spatial 3D distribution may be based on two elements: the volume quantum and the volume element. In case of the ensemble motion of the distribution, its inner T reference (if this reference however exist, precisely in case of some S or L-type relations between the distribution's elements), with the position vector $\overline{r}_c(t_k)$ against an outer T reference, it shall have a translation motion with the velocity $\overline{v}_c(t_k) = \dfrac{d\overline{r}_c(t_k)}{dt}$, motion which shall be evenly transmitted to all the distribution elements. In such conditions, the stockpile quantum given by the relation 5.2.2.2.1, with the external position $\overline{r}_c(t_k) + \overline{r}_i$, would be moved with the velocity $\overline{v}_c(t_k)$, resulting a *flux quantum*:

$$q\overline{F}_m(\overline{r}_c(t_k) + \overline{r}_i) = q_m(\overline{r}_i)\overline{v}_c(t_k) \qquad (5.2.2.4.1)$$

Because the flux quanta represents the motion of a 3D DP, on which the quantum $q_m(\overline{r}_i)$ is evenly distributed, otherwise speaking, the motion of a realizable "material point", the vector $q\overline{F}_m$ is also called flux quantum vector (FQV) in this paper, and it is the realizable version of FDV from the virtual model.

If it is taken into account the motion of an elementary quantity given by the relation 5.2.2.2.2, we shall have an *elementary flux*:

$$d\overline{F}_m(\overline{r}_c(t_k) + \overline{r}_i) = dM(\overline{r}_c(t_k) + \overline{r}_i)\overline{v}_c(t_k) \qquad (5.2.2.4.2)$$

Comment 5.2.2.4.1: Within the relations 5.2.2.4.1 and 5.2.2.4.2, there is a series of states $S_0(t)$ (samples of the spatial positions of a distribution element 5.2.2.1 or 5.2.2.2), taken at the moments t_k $(k = 0, \ldots n)$, which t_0 is the moment of the flux initiation. The sampling interval (period) is *dt*, so that the velocity (temporal density of the motion process) could be considered constant on its duration.

Attention! Within the relations 5.2.2.4.1 and 5.2.2.4.2, the objects $\overline{r}_c(t_k)$ and $\overline{v}_c(t_k)$, although they have the same temporal reference t_k, they do not have a simultaneous existence but, as it is mentioned in annex X.6, their support temporal ranges are adjacent but also disjoint. For $\overline{r}_c(t_k)$, the moment t_k is included in the support range, whereas for $\overline{v}_c(t_k)$, the moment t_k is not included, that is a right asymptotic boundary.

The main feature of both types of flux elements is that the FDV distributions are even on their support elements. In case of the vectorial distributions, the technico-scientific literature uses the term of *resultant vector,* an abstract object which is substituted to a set of vectors through a single one, with a significant decrease of the information amount which needs to be processed. In case of the vector equipartitions, the resultant vector shall be a vector with the same direction with the represented vectors, and the modulus shall be equal to the sum (integral) of all these vectors. As regards the relations 5.2.2.4.1 and 5.2.2.4.2, the vectors $q\overline{F}_m$ and $d\overline{F}_m$ are even those vectors coming from the integration along the volume quantum or along the elementary volume of FDV. The application point of these resultant vectors is the inner T reference of the elementary object.

Similar with the case of the flux virtual model, the objectual model has also two study methods of flux :

1) Study on the motion of a single object involved in flux (Lagrange method);
2) Study on the global spatial distribution of the vector field at a certain t_k moment (Euler method).

The distributions 5.2.2.4.1 and 5.2.2.4.2, are distributions with temporal support of the spatial position of inner T reference of a spatial distribution element belonging to the amount *M*. Therefore, these are *Lagrange distributions*, trajectory of a single elementary object set in motion. Just like in the virtual model, this kind of pathway is a flux line (or a flow line). The set of all the flux quanta $q\overline{F}_m(\overline{r}_c(t_k)+\overline{r}_i)$ or of the elementary fluxes $d\overline{F}_m(\overline{r}_c(t_k)+\overline{r}_i)$ existing at a single t_k moment makes-up an overall state of the flux of amount *M* at that moment, that is a vector field which was called an *Euler distribution*.

5.3 Flux types

As it was already mentioned in paragraph 5.2, a flux is a transport process of a distributed amount, each element of this flux drawing a pathway which is called the flux line (or flow line). According to the virtual model, this pathway is a continuous curve, and according to the systemic model, it is a concatenation of right-oriented (vectors) segments which represent a series of concatenated SEP.

The spatial configuration of the flow lines allows the classification of fluxes in two categories, which will serve only as asymptotic (virtual) bench-marks for the real fluxes.

Definition 5.3.1: The flux at which all the flow lines are open curves is named a **totally open flux.**

The amount which is transported by these fluxes cannot be localized in space. The totally open flux is able to transfer an amount from an object to another, provided that at least a part from these flow lines to intersect the area of the receiving object.

Comment 5.3.1: The word *localized* used in this paper means the definition of the spatial position of an object or of an amount which belongs to an object. Mathematically speaking, the position of an object is given by the position vector of that object against an external RS. The precise localization of the object requires that this vector to be invariant. But for the objects which are in motion (such as the fluxes), it is obviously that this vector vary continuously. In this case, we are dealing with a global definition of the domain in which the position variation of objects takes place and this global definition is possible if only the objects in motion are kept inside a known space with a definite position, as we are about to see next.

Definition 5.3.2: The flux at which all the flow lines are closed curves, confined inside a closed area Σ is named a **totally closed flux**.

The closed fluxes are also known as *storage* fluxes. For these fluxes, a closed area Σ may exist and this area contains all the flux lines inside it. This area confines a volume *V*, in which the entire scalar quantity *M* shall be found, this quantity representing the conveyance attribute of the closed flux. Based on the assumption that its position is determined in relation to a reference system, the area Σ allows the localization of amount *M* even if, in the inside, it is the object of a flux. Thus, as regards the outside section of area Σ, it might be stated that the volume *V* contains the amount *M* (but with a higher degree of non-determination than in the absence of the closed flux, without mentioning the inner static distribution of the amount *M*). The closed fluxes are the only method of localization and storage of some amounts which are able to exist only as fluxes (found to be in a continuous motion, such as, for instance, the photons).

A closed flux arises (is generated) as a result of a *closure process*, which means the forcing of the flux's flow lines for their confinement only within a closed area Σ, and this closure can be done by using different means which shall be minutely described in the following chapters, but which are only listed in the present chapter:

a) Reflexion (special case - elastic collisions);
b) Refraction;
c) Rotation.

Comment 5.3.2: The closure of a flux is made, as it was already depicted, through the modification of the direction of the transfer rate so that the flow lines to become closed pathways in a confined volume. As we are about to see in the following chapters, the boundary surface of a medium does not allow the entire flux passing over; therefore, there will always be fractions of the initial flux which shall return into the origin medium (the reflected fluxes), otherwise speaking, this flux section shall be kept closed in this medium. As for the propagation fluxes, the same process of modification of the flux direction caused by the unevenness of the propagation medium's parameters can lead to the propagation by curved flux lines which can be confined in a limited and definite volume. The closure through rotation is the most notorious closure method, knowing that any system which moves is equivalent with a flux; if a body has a known volume and it spins around a defined axis, all the pathways of the constitutive elements shall be curves confined in a definite volume, with the center in a point along this axis.

The totally closed or totally open fluxes are flux virtual models (theoretical, mathematical, ideal), most of the real fluxes being only partly open or closed, therefore, a certain flux is associated to a certain *closure degree* (complementary with the aperture one), that is a degree which represents the fraction of the closed flux lines from the total number of flux lines).

Comment 5.3.3: An eloquent example for displaying the closure degree of a flux is the case of a fluid which flows through a pipeline, in which case two types of flow exist: laminar and turbulent. The laminar flow in which the flux lines are theoretically maintained parallel is an example of a totally open flux, with a null closure degree. As for the turbulent flow, most of the flux lines are locally closed (the vortex phenomenon occurs), but there is an overall motion of all the swirls, an open flux, that is the common component of all the vortex vector fields, motion which determines the effective fluid flow through the pipeline. If a fluid fills a steady pot, any inner motion of the fluid (convective or turbulent) will represent a totally closed flux inside the pot volume.

The fluxes can also be divided in two groups according to a previous-mentioned parameter, called *effective area* (or section) (see definition 5.2.1.2). To not be mistaken with the capture cross section from the nuclear physics field, although they are interrelated notions.

Definition 5.3.3.: The flux with a constant effective section across its entire pathway is named **isotom flux** (synonym **corpuscular flux**).

The flux which outlines the translation motion of an EP, AT, of a missile, of an AB (for example, of a planet within a PS) as well as of an isolated photon, all of these being examples of isotom fluxes. All the other fluxes (non-corpuscular) make-up the class of fluxes with *variable effective section* (divergent or convergent fluxes depending on the sign of the effective section variation - plus or minus - on the covered distance unit).

If the Euler distribution of FDV is temporally invariant, we are dealing with *stationary* fluxes, otherwise, they will be *non-stationary* (time-variable).

From the point of view of the object which is involved in the flux and based on the process type, the fluxes can also be divided in *displacement* fluxes and *propagation* fluxes.

Definition 5.3.4: The flux which carries material objects along its entire pathway is named **displacement flux**.

The displacement fluxes carry material systems (abiotic, biotic or artificial) from one spatial location to another. The running water, wind, sea streams, people, goods and migratory animal flows, etc. are only few examples of displacement fluxes.

Definition 5.3.5: The flux which carries local state variations of a set of objects is named **propagation flux**.

The propagation fluxes carry local state modulations (mainly symmetrical variations around a reference value), the motion processes of the inner reference of the objects involved within the flux are cyclical (reversible) and strictly local processes. According to the above-mentioned facts, we may assert that the propagation fluxes carry processes. Within a propagation process, the elements with an altered state are not always the same but they are different every time. We shall return to the propagation process in the next chapter, after the medium's definition shall be presented. These flux types are also abstract (ideal) models, the real fluxes containing components of both models in various ratios. Any propagation also involves a low local displacement (that is a local displacement flux), and the displacement fluxes imply state variations between the objects which are set in motion (which are therefore local propagation processes).

The equipartition of some vectors means an even spatial distribution of the application points and an evenness of the direction and modules of these vectors. Otherwise speaking, the *direction* and the *module* are common attributes on the set of the vectors distributed on the flux element, whereas *the positions of the application points* are specific (differential, disjoint) attributes of each vector.

Definition 5.3.6: The flux with null specific components of FDV modules and directions (all vectors have the same module and the same direction) is named **totally coherent flux**.

The totally coherent fluxes are therefore fluxes with FDV equipartition, the pathways of the application points (flux lines) are in this case clusters of parallel straight (or curved) lines. This flux type occurs only as an abstract model, the real fluxes might be only *partly coherent*. An example of this kind of flux is the elementary flux which was previously presented. The opposite situation is when FDV set of the flux has a *null common component.*

Definition 5.3.7: The flux with a null common component of FDV set is named **totally stochastic flux**.

Comment 5.3.4: The fact that the totally stochastic flux has a null common component of FDV set (or FQV), this means that there is no global motion (conveyance) process, which might lead the reader to the conclusion that there is no flux (namely, motion). Indeed, an overall flux does not exist, but a space-temporal distribution of the motion processes of the stochastic flux elements exist, therefore, there is also a flux (but a special type of flux with a null coherent component of the FDV set). The same fact (lack of an overall displacement of the flux elements) makes that the totally stochastic flux to be a totally closed flux.

The Euler distribution of a totally stochastic flux is a *totally chaotic* distribution (see par. 2.3). Neither this type of flux can really exist (it is also an ideal model), the real fluxes being only partly stochastic or otherwise speaking, for each real stochastic flux, there is an associated level of analysis (decomposition into domains) for which the common component of the flux elements set is no longer null (there is a local coherency, at the level of spatial or temporal domain).

Comment 5.3.5: For instance, in a gas where there is a partly coherent molecule flux (a flow) oriented in a given direction. If this flux would be entirely coherent, this means that no interaction would be able to exist on the direction normal on flow direction, so, the static pressure into the flow would be null. This is not allowed by the external flux molecules (not involved into the flux) which are ready to occupy the section with null static pressure, and they shall restrict the flux's coherency degree up to a value which is always subunitary.

Although the real fluxes are neither totally coherent nor totally stochastic, the two basic flux types are very important for the objectual philosophy. We have seen that the inner T reference of a compound object is unique and common to all the object's elements. The result is that the motion of this reference is evenly submitted to all of these components, which means that the inner T references of the components shall basically have the same motion (with the same modulus and direction), therefore, we are dealing with a totally coherent flux. This means that if a totally coherent real flux cannot occur in a medium, we might have in exchange totally coherent components (abstract) of these fluxes.

We shall see further on that not only T component of an isotom flux belongs to this category but also other components with invariant direction (for example, the normal and tangent component on a boundary surface or the components which are settled based on the directions of the axes of reference). We shall also notice that a coherent component of a real flux cannot simply vanish just like that, but as a result of an interaction process with a boundary surface, this component may turn into a stochastic one. There is also the reverse process of the transformation of a stochastic flux into a coherent flux (more exactly, into a flux with a totally coherent component), but this is also conditioned by the presence of a boundary surface.

Comment 5.3.6: For example, in case of the collision of a ball with a wall, the initial kinetic flux (impulse) is the totally coherent T component of the set made-up from the molecules of the ball's membrane and the molecules of its inner pressure gas, all of them moving with the common translation velocity. At the moment of collision, there is a temporal interval in which the ball is deformed by the impact with the wall, but it does not move (the coherent component of normal translation at the wall is null). What has happened to the coherent flux? It's simple! The initial coherent flux has turned into a stochastic flux (with a null coherent component), namely, into pressure and heat, and after that, very short temporal interval of immobility, the reverse process of turning the stochastic flux again into a coherent flux, but with an opposite direction (the ball reflection on the wall) to be initiated.

Therefore, we shall be dealing in the following sections with totally coherent or totally stochastic components of a flux, but these will be presented in a brief version, which means that a flux with a totally coherent component is referred to as a flux with a coherent component, a partly coherent flux, or coherent flux component. The same procedure is applied to the stochastic fluxes.

Comment 5.3.7: The concept of *coherency* has a broader meaning in this paper than the term used in the regular scientific language, and it is closely-connected to the notion mentioned in chapter 3, that is a *common component* of a set of objects. According to the definition of the totally coherent flux, the result was that, in case of the translation fluxes, if the directions and FDV modulus are the same (therefore, they are common on the vectors set), that particular flux is therefore totally coherent. However, the same coherency issue is valid for the rotation fluxes, but the difference is that, in this case, FDV directions cannot be invariant any longer, the modules also depend on the radius of gyration, but, the sense and the angular speed can be invariant. Therefore, the fluxes' coherency criteria are different due to the motion type, but in case there are common components of SEP, there are also coherency degrees.

It is very important to be understood that a flux such as the stochastic one, contains a distributed motion of some objects within itself, but this motion is not perceptible from the outside of the space occupied by this flux, in the absence of a global, external component of the motion. This fact (inexistence of an apparent common motion) does not also mean the inexistence of the elementary fluxes, therefore, of the objects' inner motion.

Comment 5.3.8: A classic example of this kind of flux is the chaotic motion of the molecules of a pressure gas inside a gas cylinder with a steady position, motion which obviously does not have a common component since the gas cylinder is motionless. The attribute which strictly depends on the intensity of the stochastic kinetic flux of the gas molecules is the pressure of the gas from the inside, pressure transmitted to the cylinder's wall, where it causes a stretching effort of the cylinder casing material (another stochastic flux, but this time, it belongs to the cylinder casing's atoms). As long as the intensity of the kinetic stochastic flux from the casing is under the breaking point of the cylinder material, the two fluxes (the stochastic one of the gas and the other stochastic flux of the casing atoms) will be in equilibrium on the bounding surface. When this limit is exceeded, the casing medium breaks, the equilibrium vanishes and the fractions of the cylinder walls will move together with the gas molecules towards quaquaversal directions (flux with a coherent component - the motion sense) as compared to the former position of the cylinder. None of these visible motions could not have been generated if the stochastic flux, occult but persevering, of the gas molecules would not have existed.

We are about to see in the following chapters that the introduction of these two basic concepts, of *stochastic* and *coherent flux,* allows us to have a new approach on notions, such as the equilibrium between forces, or the energy classification in the two components - kinetic and potential.

5.4 Stockage

As we have previously noticed, an amount M placed in a certain area of the space, in a known volume V, limited by a closed area Σ, can be described by means of a spatial distribution of this amount on volume V. The total quantity of attribute M distributed in a spatial domain with volume V, limited by a closed area Σ is the attribute *stockpile M* inside that volume. **Attention!** In the chapter which was focused on distributions, we made the statement that the stockpile definition is valid only for the cumulative, extensive attributes (for which the addition and integration of the values assigned on the distribution's elements is possible).

If the distribution refers to scalar, time invariant quantities (such as the mass density of a motionless body), we might say that the amount M is statically stored in that particular volume (such as the raw stocks, goods stored in warehouses, etc.). On the contrary, if the amount M is characterized by a distribution of some vectorial quantities (such as, for instance, a closed flux), then, it might be said that we are dealing with a dynamic stockage (for example, the quadergy from the electric circuits, kinetic energy charged in fliers, superconductor magnets, stockage rings of the accelerated particles, but also the blood stock of the live animals or the sap stock of the plants etc.).

Comment 5.4.1: There is always an analytical decomposition level of the stockage type, at which a stockage which is apparently static, it proves to be in fact purely dynamic. For example, a parameter such as the pressure which is scalar by definition, but when it is subjected to microscopic analysis, it proves to be generated by the motion of molecules and by their collision with the walls and with each other, in fact, due to some corpuscular fluxes, (vector fields), open at the molecular level, but closed at the macroscopic level, confined within the limits of the medium characterized by that particular pressure. Basically, any atom consists of an amount of inner EP fluxes, which in their turn… After the complete reading of this paper, the reader will understand that actually, there is no static stockage in the real world, but only a scalarisation of some purely dynamic processes (see annex X.9).

Returning to the amount M, placed inside the confined Σ area which limits the volume V and characterized by the distribution $\rho_m(x,y,z)$, we may write:

$$Q_M = \int_V \rho_m(x,y,z)dV \tag{5.4.1}$$

where Q_M is the stockpile from the amount M, placed in volume V. Any modification brought to this stockpile shall be made only through Σ, by means of some fluxes which convey the amount M. If we take the positive sense of the normal line $\overline{n}$ at the surface Σ, inward-oriented (vice versa as compared to the conventions from mathematics), the inward-oriented fluxes shall lead to a stockpile increase (the dot product from the relation 5.2.1.4 shall be positive). Obviously, the fluxes which convey the amount M with the overall direction oriented to the outside shall lead to an inner stockpile decrease.

Comment 5.4.2: The aforementioned assertions are not and they cannot be valid in case of the virtual surfaces from mathematics, because the stockage of a flux is not possible inside them, due to their total permeability. The reader will better understand the stockage issue after reading the following chapters, in which we are dealing with bounding surfaces which are partly permeable or even impermeable for fluxes, and consequently, able to store a stockpile inside.

Definition 5.4.1: The fluxes which generate positive stockpile variations (increase) in a volume V are named **inflows** (or **immergent fluxes**).

Definition 5.4.2: The fluxes which generate negative stockpile variations (decrease) in a volume V are named **outflows** (or **emergent fluxes**)[24].

As we have noticed in par.5.2, a spatial distribution of VDF ($\overline{f}_m(t)$ in the relation 5.4.2) shall occur across the closed surface Σ, which is also associated with its temporal distribution if the flux is unsteady. It is obvious that the amount of stockpile $Q_M(t)$ at a certain t moment shall be:

[24] The above- mentioned denominations are used on a wide scale in most of the scientific papers. Starting with chapter 7, other denominations shall be added to the existing ones, which are momentarily irrelevant.

$$Q_M(t) = \int_{t_0}^{t} \frac{dM}{dt}\bigg|_{\Sigma} dt = \int_{t_0}^{t} \oiint_{\Sigma} \overline{f}_m(t)\,\overline{n}\,d\sigma\,dt \tag{5.4.2}$$

which means that the stockpile $Q_M(t)$ is the outcome of all the variations of the fluxes intensity of the amount *M* through the boundary surface Σ of the spatial domain *V*, from its creation (at the moment t_0) and until the moment *t*.

After all of the above mentioned facts, the following conclusions regarding the stockpile may be drawn:

1) We cannot have a stockpile of an amount *M* placed in a space limited by a confined surface Σ, without the preliminary existence of some inflows towards the volume *V*, which would be able to convey this amount through Σ;

2) We cannot have outflows of the amount *M* through the confined surface Σ, without the preliminary existence of a stockpile of amount *M* inside this section.

5.5 Conclusions

1 The fluxes are basically some complex distributions of the motion deployed by a set of objects, at first, spatial distributions (Euler-type, at a given *t* moment, an overall state of the flux at that moment), then, temporal distributions of the spatial ones. Briefly, we may say that these are spatial-temporal distributions of the above-mentioned motions. Just like in case of any other distribution, there will be at least one element of it, that is an uniform distribution. In case of the realizable fluxes, the spatial distribution element is represented by the *flux quantum* or by *the elementary flux*.

2 Because the intensity of a flux is determined against a steady reference surface, the two levels of the realizable fluxes quantification - *the flux quantum* and *the elementary flux* - refer both to the element type of this surface, and to its quantity (attribute stockpile) conveyed by the flux element.

3 Since they are specific distributed processes, the fluxes are spatial distributions of SEP, namely, vectorial distributions (vector fields).

4 The elements of these vector fields are a special class of vectors - *the carrier vectors* - which represent a transport SEP of an elementary quantity from the amount meant for conveyance.

5 Among the most important attributes of the fluxes, there are few worth mentioning: *the closure degree* (null for the totally open fluxes), *the effective section* (invariant for the isotom fluxes), and the *coherency degree* (which is null in case of the totally stochastic fluxes).

6 From the point of view of Euler distribution type which is specific to a certain flux, two major flux classes (as virtual models) may be considered: the *totally coherent* fluxes (with an even Euler distribution) and *totally stochastic* fluxes (with a totally chaotic Euler distribution).

7 Besides the very general classifications of the fluxes according to the virtual models, which have been already presented, the real fluxes can also be differentiated (distinguished) according to the type of the conveyed attribute, and in case of the same type of conveyed attribute, another fluxes differentiation may be operated, based on the carrier object type which conveys that particular attribute. For instance, in case of abiotic MS, an essential amount which is conveyed by all the fluxes is the energy. We shall see in chapter 7 that the energy attribute is transmissible and it has as many carrier types, as many forms of matter existence are (photons, electromagnetic waves, pressure waves, EP, NC, missiles, asteroids, galaxies and many more). The same situation with the information fluxes, where its carriers (ISS) are also very diverse.

8 Finally, we must underline that the motion of an object means the motion of all its model attributes; if there is a complex object, this motion is transmitted (distributed) to all its

components, therefore, the properties contained at deeper analytical levels shall be also moved, even if these properties are not transmissible. According to the objectual philosophy, a motion of an amount cannot be taken into account without the existence of some objects which are the support of that amount. For example, in case of the energy fluxes which were above mentioned, some objects which are the support of that property must exist at any analytical level of the material systems organization.

Ch.6 MEDIA

6.1 Overview

We have seen in the previous chapter that the flux of a property (amount), as a distributed process, requires the preliminary and compulsory existence of a set of objects which own that property, set which will move in ensemble, and which will convey that property from one place to another. The carried property may be transmissible or not from one object to another. For example, the spatial structure of a molecule from the liquid jet released by a vehicle used for dispersing manifestants is a property which moves once with that objects (molecules) but it is not a property which is transmissible from one molecule to another, whereas the kinetic energy of the molecules is transmitted both from one molecule to another and to any other object which intersect with that jet (flux). In this chapter, we shall be dealing briefly even with these sets of objects which can be involved into a collective motion process and which can therefore be the material support of a flux.

Because our goal (that is the goal of the author-reader couple) is to prepare the ground for defining the general model of the material system, model based on material fluxes (at which the involved objects are material objects), this time, we shall also be using notions such as “material”, “interaction” etc. with the meaning from the textbooks and dictionaries, up to the moment of their subsequent redefinition.

6.2 Few general classification criteria of the material systems

When we have discussed about the complex objects in a previous chapter, we have noticed that there are dependence relations of some properties between the elements of these objects. If these are interrelationships, then the properties of the objects which are involved in such relations exert an influence on one another. In the real world, as we are about to see in the following chapters, the relations between the real objects (material systems) are always decomposable into bilateral interrelationships, and the term which denotes these relations is known as *interaction* (term which shall be more accurately defined in the following chapter). Because the interaction term is applicable to any MS, regardless of its organization level, the type of this interaction may be an universal classification criterion.

The interaction attributes which might be distinguishing criteria of MS are:

1) *The distribution type of the interaction intensity on the set of possible elements couples* belonging to the system;
2) *Working radius of the interaction* (distance between the elements which might interact);
3) *Spatial (an)isotropy of the interaction intensity* between the system’s elements (spatial distribution of the interaction intensity, in polar coordinates, against the inner reference system of the elements is even in case of the isotropy);
4) *Temporal distribution of the interaction intensity* (permanence or intermittence of this interaction);
5) *Interaction sense* (attraction or repulsion).

6.3 Centralized and distributed systems

After reviewing the classes of abiotic MS from the list from the paragr.1.1, by considering the current knowledge level of the structure and of their properties, we shall notice the existence of two major categories:

a) Systems with a relatively low number of elements, made-up from a subsystem placed in the system's central zone and many other satellite elements which are kept bound by the powerful interaction with the central subsystem;

b) Systems with a very large number of elements, made-up from systems with a similar organization level, where the interactions occur only between the proximity neighbors, these interactions having almost the same size grade of the intensity.

From the point of view of the interaction intensity distribution on the set of the possible elements couple of the system, the systems from point **a** are characterized by an increased unevenness of this distribution. In this case, the interaction intensity with the central subsystem is much more powerful than the intensity of the interaction deployed between the satellite elements. This fact makes that the effect of this central interaction to occur on all the system's elements (working radius of the central element is extended on all the MS elements). The systems which belong to this type of organization are called *systems with central organization*, in short, *centralized systems* (CS). AT or PS systems are included (according to the list from par. 1.1), among others, in this category.

As for the systems from the point **b,** it is important that the interaction intensity to have the same size grade on all its elements (the mean value of this intensity per element has a saturation trend) and the fact that the working radius of this interaction is limited only at the proximity neighbors. Paradoxically, it is even this limited working radius the one which allows the non-limited increase of these types of MS by "attaching" new elements at the system's boundaries, so that these systems to be able to have an extremely large number of elements, and accordingly, extremely high spatial dimensions. The systems with this kind of organization are named *distributed systems* (DS).

Comment 6.3.1: The "distributed systems" denomination is allowed in the objectual philosophy field due to the utilization of this term into the scientific papers. In accordance to the paper herein, any material system has a distribution of properties (including the ones with a central organization), so that it is "distributed" anyway. Objectually speaking, the correct term for the distributed systems would be systems with an *even* distribution of the mean interaction intensity.

If the number of elements which are allowed to enter into a distributed system is that high so that the system's parameters can be statistically estimated (the laws of large numbers are valid) and propagation processes may occur (which shall be approached later on), this kind of distributed system is called ***medium***. For example, NM systems belong to this category. This type of material system (DS) hosts many type of fluxes, mostly of the propagation ones, that is the reason why we are continuing with DS classification.

6.4 Types of distributed systems

We have seen in section 5.2.2.3 that the material fluxes, as collective conveyance processes of a set of objects, can be divided in three basic classes S, L and G, according to the type of the relations deployed between the inner spatial references of the objects and the spatial global reference of the set.

It is worth reminding that these relation types are:

1) *S-type relations* - If the relations between the inner T and R references of the constitutive objects are invariant during the motion, both between the proximity objects and against the homologue common T and R reference, the entire distribution of the amount M shall move just as a solid (rigid) body. In this case, there is a global (which is internal within the set) T and R reference with the positions defined against an external RS, and the variation of this position represents the overall motion of the set's spatial distribution. One may notice that within S-type relations, the inner free motions of the complex object's elements, either T or R, are forbidden.

2) *L-type relations* - If only the relations between the inner T references of the neighbouring elements are maintained invariant (the elements remain adjacent, permanently connected during the motion, but they are able to rotate freely), the entire distribution shall be moving just as a finite liquid quantity which preserves its volume, but it is not able to preserve its shape (inner distribution of the elements'spatial position). In this case, there is only one common T reference (the mass-center for a liquid portion) whose motion against an outer T reference is the overall motion of the complex object.

3) *G-type relations* - If there is no invariant relation between the inner T and R references of the components and the common T and R reference of the distribution, those particular elements do not make-up a complex object any longer, each of these elements moving freely, just as the molecules of a gas. In case of G-type relations, any kind of inner motion is allowed and there is no interrelation between the T and R motions.

The possibility of relative translation motions within the pairs of proximity elements, as we are about to see later on, is strictly connected to the temporal distribution of the interaction intensity. As for a DS whose elements are permanently related (the inner spatial domains are always adjacent), their free translation is excluded (there are translation motions, but they are not free and are generated as a result of the continuous action exerted by a system of forces). The possibility of the rotation motions also depends (in case of some permanent interactions) on the unevenness of the spatial distribution of the interaction intensity against the inner RS of each DS element. The uneven is the distribution (more anisotropic), the less possible is the rotation of the elements one another. If this distribution is even (isotropic), there are no favourite bonding directions, and the elements will be able to rotate freely and autonomously against their neighbors.

According to these specifications made in case of the distributed systems, two of the criteria - *(an)isotropy* and *time distribution* of the interaction intensity - allow their classification in the following types:

a) *S-type systems* (with their representative element, that is the solids), characterized by:

- permanent interaction;
- increased anisotropy of the interaction intensity (which leads to the drastic limitation of the changes produced in the elements position, both T and R). In case of this DS type, there are only S-type relations between its elements.

b) *L-type systems* (with their representative element, that is the liquids), characterized by:

- permanent interaction;
- interaction intensity (determined against the inner RS of DS's elements or of a group of elements) is quasi-isotropic (the position change by means of indefinite rotation is allowed, at least at the level of elements subset). In case of this DS type, there are L-type relations, either at the element level, or at the elements subset.

c) *G-type systems* (with their representative element, that is the gases) characterized by:

- non-permanent interaction (most of the times, the elements are isolated each other, the interaction with the rest of the medium is insignificant, the only type of interaction is represented by the collisions which occur only on very short time intervals);
- interaction's intensity is isotropic (the parameters of the interaction generated by means of collision do not have a preferential direction). In case of this type of DS, only G-type relations occur between their elements.

The non-permanent interaction which is specific to G media allows the introduction of the *free system* concept, considered to be the system whose interactions with other systems are negligible (for certain periods of time). This fact makes that the pathway covered during the time when the system is isolated to be called *free pathway*. The free pathway (or free path) notion is real only in case of this type of medium (the volume restraint by means of compression is made only based on the reduction of the free pathway and not through the modification of the interaction intensity, resulting therefore the high compressibility of these media).

Few remarks regarding the above-mentioned classification may be pointed out:

1) The systems with permanent interaction (S and L-types) do not allow the free inner translation, thus resulting their very low compressibility degree; the existence of this continuous interaction, inclusively for the elements placed at the system periphery makes that these DS to have a defined *bounding surface* (as area and form for S-type media and only as area for L-type media) against the outside medium, and accordingly, a proper defined volume.

2) The systems with an isotropic distribution of the interaction intensity against the inner R reference of the elements allow the elements rotation. As we are about to see on another occasion, the systems with anisotropic features of the interaction at a short distance are able to make-up an isotropic medium (or quasi-isotropic), if the conditions for the elements rotation are created (for example, by increasing the space between the elements over the working radius of the anisotropy, that is a situation which occurs, for instance, during the flow phase of the materials subjected to the stretching force, or as a result of the thermal dilatation).

Comment 6.4.1: It is the moment to make a specification regarding the *(an)isotropy* term. One aspect must be clearly understood: so far, in this chapter, the discussion was only about the isotropy or anisotropy of the spatial distribution of a single attribute, that is: the intensity of the bilateral interaction between the elements of a DS (in case of a NM, between its atoms or molecules). We are not talking about the isotropy or anisotropy of other properties, such as the mass density, refractive index, photon transparency etc., all of these were mentioned because of an error found in the technical papers, namely, the case of glass which is also called "undercooled and frozen liquids"[25]. The fact that the above-mentioned macroscopic properties deploy an isotropic distribution inside the glass, similarly with the liquids, does not mean that at the molecular level, the distribution of the interaction intensity between the glass molecules is not highly anisotropic (with preferential bonding directions), by hindering in this way the molecules rotation one to another, which gives the non-deformable character of this material.

It is important to notice that, within the media which have a prohibited free translation, the translation motion is however possible, not under a free form, but rather through the modulation of the interaction intensity, that is the forced translation (such as the vibratory one). The same thing is also valid in case of the rotation motion.

The classification into S, L or G systems is universal. As we are about to see further on, the category of S-type of systems shall also include, besides solids, also the bio-systems, artificial material systems, information support systems (therefore, the abstract systems) etc. The category of L-type systems may also include the media of the conduction electrons from metals, the plasma structures (their ionized fraction), dry grained media etc. Besides the non-ionized gases, the G-type systems also comprise an extremely significant DS segment - which is represented by the bio-populations (organismal media or the ones made-up from independent cells) - in which the meaning of concepts such as "free" and "freedom" remains the above-mentioned one.

As regards the maintenance capacity of DS without additional external barriers (which shall be analyzed later on in this paper), this time involving the interaction sense, DS are divided in:

a) *DS with self-maintenance*, which consists of only the S-type DS, with attractive interactions known as S_A, the only systems which are self-maintained without external barriers;

b) *DS with forced maintenance*, which can be also divided in:

[25] **HÜTTE** – Manualul inginerului, Editura Tehnică, Bucharest 1995.

– Systems with permanent attraction interaction, but insufficient for maintaining the system without the addition of an external barrier. These systems are a fraction of L-type of media which are called L_A-type media with the representative element found in the common liquids (which are maintained in a liquid phase, at a specific temperature, only under the conditions of air pressure caused by the gravitation field - natural barrier - or also under pressure inside a solid precinct - that is the natural or artificial barrier).

– Systems with permanent but repulsive interactions (either remote repulsion or only at the contact between elements), which consist of S media with repulsive interactions called S_R[26] and the rest of L-type media, known as L_R (the surface layers of the grained material deposits, dry powders, sand, gravel, but also the medium of the conduction electrons existing in metals, etc).

– Systems with non-permanent interactions, G-type DS.

So far, we have focused on the maintenance of the natural abiotic systems, but we have to mention that the issue of media maintenance has the same approach as in the case of the biotic systems. For example, the tissues or the organisms are S_A-type of media (they are therefore self-maintained as long as they are alive), whereas the human populations (for example) are an ensemble of G-type media (with forced maintenance); these populations cannot be preserved without some barriers:

a) natural barriers (gravitation field, relief forms, food and energy resources etc.);
b) artificial barriers:
   – the administration's barriers (the frontiers well guarded);
   – the informational barriers (language, traditions, religions etc.).

The artificial barriers are provided by a centralized system - state's authority - which maintains all the social media (population's constitutive media) by means of its powerful interaction).

The S-type systems can also be divided according to the number and the position of the elements which make-up the proximity of an element considered as a reference:

1) *one-dimensional* S systems (series type), in which the proximity oriented in a certain direction is made-up from a single element (linear molecules, written or spoken information support systems, so on);

2) *two-dimensional* S systems, in which the proximity is made-up from elements with positions included in a plane which is parallel with the tangent plane through the reference element (the outer surfaces of the solid bodies, the organisms' epidermis, 2D images etc);

3) *three-dimensional* S systems, comprise all the other S systems.

The classifications made so far have taken into consideration that the elements of the above-described systems have an non-altered (complete) structure. If some of the elements from DS structure are partly decomposed, we shall be dealing with a partly *dissociated* system, the system's dissociation degree being in proportion to the number of the decomposed elements as compared with the total number of the elements belonging to the system (medium). This category comprises for example, plasma structures, ionic solutions, bio-populations made-up from families of sexual individuals, among which other mature individuals who are not joining to a family are also introduced, so on.

Comment 6.4.2: The "dissociation" term suggests the reverse operation of the association, that is the breaking-out (decomposition) of a system. Through dissociation, the system may lose one or more of its elements (as compared to the complete model configuration), until the entire decomposition of the system. The currently used meaning for this word is limited to the description on the dismemberment of

[26]For instance, the solid helium is a S_R medium because it does not solidify only as a result of the simple temperature dropping, a compression being also needed (maintenance barrier). The inner sections of the dry grained materials deposits (powders, sand etc.) belong to the same class, as well as the solid parts of the external earth shell, kept in a S state despite of the high temperature, only because of the pressure exerted by the earth crust.

some particular systems (such as the atoms, molecules), but it can be also used for the decomposition of other systems which show charge attributes, such as the families of the sexual bio-systems. In case of the dissociated systems, the interaction of the fragments coming from the dissociated system is much different than the one of the non-dissociated system. As we are about to notice further on, this aspect is specific mainly to the systems characterized by charge interaction. As a result of the intensity and duration modification of the interactions, the dissociation may lead to the modification of the medium type as compared to a non-dissociated medium. For example, the ionized gases (plasmas) are not G media any longer, because the interaction of the ionized molecules is permanent (as long as the ionization lasts), therefore, there is no free pathway except the one for the non-ionized molecules.

If the systems which belong to a DS are all of the same kind, we may consider that particular medium as a *pure* one. The purity concept is gradual (measurable), rarely noticed at the abiotic media, but more frequent at the biotic and artificial media.

Comment 6.4.3: If according to the usual language, the *purity* concept is mostly used in relation to the natural media (pure crystals, liquids or gases etc.), this does not mean that it cannot be used for the characterization of other media made-up from a single type of elements. For example, a bacterial culture made-up from the division of the same cell type under sterile conditions is genetically speaking a pure medium (if no mutations are interfering). There is also the term of ethnic purity for the social media.

6.5 Propagation process

Besides the differences pointed out in the previous sections, the distributed systems also have common features, the most important deriving from the fact that the interaction between the elements occurs along a short distance. Due to this reason, the variation of the interaction intensity at the system's borderline shall not be instantly conveyed to all the elements, but rather gradually, to one by one.

Definition 6.5.1: The transmission process of a variation of the interaction intensity <u>from one element to another,</u> inside a distributed system, is named **propagation process** (of that particular variation).

The spatial-temporal distribution of the state variation against the equilibrium level existent before the perturbation occurrence is called *wave,* and an isochronous surface of this wave makes-up a *wave front.* Taking into account these definitions, the systemic philosophy postulates the following statements:

AXIOM II (propagation axiom): A <u>propagation</u> process deployed outside a <u>distributed material system</u> (of a <u>propagation medium</u>) cannot exist.

Comment 6.5.1: Axiom II seems to be more like a logical conclusion after all the aspects which were depicted about the distributed material systems. However, the current science asserts that there can be propagation processes through vacuum, namely, in the absence of a support medium for this kind of process (see also section 1.5). Consequently, the above-mentioned statement has been promoted as an axiom for emphasizing once again that the assumption on the ether non-existence is a fallacy. One thing is to assign the negative result of the Michelson-Morley test to the ignorance regarding the properties of this medium, or of a model which is insufficiently elaborated for the propagation process, and other thing is the assertion that there are propagation processes of some real amounts into…nothing.

The propagation velocity of a wave depends on the parameters of that medium and it is not the topic of the present paper. It is only relevant that this velocity increases in proportion to the duration and the intensity of the interaction deployed between the system's elements[27], which is higher in case of the media having a permanent duration of this interaction. It is also worth noticing that the propagation does not involve the displacement of the medium's elements once with the wave front, with the propagation velocity, but only low *modulations* of their relative positions against the equilibrium position, or of the other medium's statistical parameters.

[27] We are referring to the media composed from the same type of elements, but which are within different phases (S, L, G).

Comment 6.5.2: *The modulation* is a reversible modification (variation) process of an amount against a value which is considered (at least temporarily) as a reference value. Depending on the parameter which is modified, the amplitude, frequency, phase modulations are known facts. If the modulated parameter is the system's position vector, a spatial modulation of the intensity of the field generated by the system might occur. It is self-understood that any modulation has also a time distribution, therefore, the modulation of a medium attribute is a process with a spatial-temporal distribution.

Another very significant feature of the propagation process is that the object[28] which is conveyed (which was above-referred to as wave front) is not made-up from the same elements of the propagation medium, since its constitutive parts are always different, but the energy contained inside it (we call it the distributed attribute stockpile) is always the same - the one contained in the initial front coming from the source[29].

There are different wave types which are propagated inside a DS, depending on the local state attribute which fluctuates or depending on the motion type which the element might have within the distributed system. Thus, in case of S media, for the three possible (but not free) translation directions, the compression waves (or longitudinal) are associated, and as for the rotation motions, the transversal (or shearing) waves are associated. In case of L media, there could be only the compression waves, and only in a less extent, the transversal (viscosity) waves. As regards G media, it is obvious that there can be only the pressure waves by means of the modulation of the free pathway (resulting a modulation of the interactions frequency).

6.6 Conclusions

1) The material systems may be divided in two major classes according to the distribution type of an attribute which is common to all MS - that is *the interactions intensity between the possible system's couples.* These MS classes are:

a) Systems with an uneven distribution of the above-mentioned attribute, by means of a privileged system (central system) whose interaction's intensity with other elements involved in the system is much more powerful than the interaction's intensity of the other elements; these systems are also called *centralized systems* (CS).

b) Systems with an even distribution of the mean value of the bilateral interaction intensity on the set of MS involved in the system, which are called *distributed systems* (DS), according to the current nomenclature.

The two MS classes are also differentiated according to another attribute - that is the *mean working radius of the bilateral interactions.* In case of DS, the working radius of the interactive fluxes is extended only up to the elements in the proximity of the reference element, whereas in case of CS, the central element has a working radius so that it is able to comprise all the other elements involved in CS.

2) The distributed systems with a large number of elements, in which a propagation process may occur, are called *media*.

3) The temporal distribution of the interaction's intensity and the type of relations between the possible motions of the elements belonging to the distributed systems generate the existence of three basic media classes: S, L and G.

4) The maintenance conditions of the media allow their classification in *self-maintained media* (S_A media) and *forced maintenance media* (the rest of the media).

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[28] The wave front is a processual object, because it is a spatial distribution (at a certain moment, a temporal DP, an invariant Euler distribution) of a set of invariant properties of the propagation process (direction, velocity, contained energy etc.)

[29] Not only the energy contained in the wave front is preserved; within an isotropic medium (in which the propagation velocity does not depend on the direction), the shape of the wave front (its spatial distribution) preserves the radiator shape (obviously, with its sizes in proportion to the distance towards it).

5) The media with a permanent interaction deployed between their elements have a proper *bounding surface* (and obviously a proper volume) as compared to the other surrounding media.

6) The limited working radius of the interactions between DS elements makes that the local variations of the intensity reached by these interactions to be transmitted into the rest of the medium only by means of *propagation,* namely, through the transmission (transfer) from one element to another.

Ch.7 MATERIAL SYSTEMS

7.1 Fluxes' model

Since the ancient times, people have noticed the motion of the surrounding objects, both of the single objects and of the set of objects. The properties of the object's motion have been identified and general laws have been released for describing these motions. Even since the ancient Greek Era, the scholars were aware that everything around us is a motion, either an individual or a collective one. When the people found out that the bodies have an inner structure based on atoms and molecules, it was revealed that any motion of a solid body, liquid or a gas is a collective motion, the same as the military maneuvers, animal herds or bird flocks were. These collective motions are very obvious mostly at the level of human society which was organized in families, clans, tribes, nations etc. For those who were noticing the human activity, it was very clear that there were collective movements (mostly warriors who were attacking a nearby human settlement by taking all its biotic and abiotic goods). After they have had enough of wars, other collective movements were taking place between the same settlements, which were represented by the exchange of the necessary items (goods), objects which were either naturally (slaves, animals, fruits, seeds etc.) or artificially (weapons, household objects etc.) produced. We have seen in the previous chapters that these collective (distributed) motions are called *fluxes.* Let us make a brief review of the various organization levels of these fluxes which may be seen in the real world.

7.1.1 State systems

The careful observation of the processes produced inside a large-sized social system (for example, a contemporary state) reveals us numerous objects movements (fluxes) deployed inside it. These extremely varied fluxes may be fluxes of people (towards and from specific locations: home, work place, school, church, supermarket, recreation places etc.), fluxes of goods (food, clothes, household products etc.), fluxes of ISS (newspapers, magazines, books, audio-video cassettes, CD's, radio-TV shows etc.), raw stocks, fuel, electric power fluxes and many more.

These fluxes occur mostly inside the state's borders, they are therefore confined (closed) inside this area. But there are also numerous fluxes which take place through the *real boundary surface* (RBS, which shall be defined in a subsequent section) of the state system, namely, fluxes of people, finished products, raw stocks, fuels etc. This RBS which limits the inner spatial domain of the state system is made-up from the terrestrial, sea and air borders (boundaries) of the state, and these are limits settled as a result of the interactions with the neighboring countries (wars, conventions, treaties etc.), and this RBS is strictly controlled and protected by the government of that state. In fact, if there is no flux which makes the attempt to cross it, this is an abstract area (it does not exist always physically, but its sizes are settled by means of the world conventions on the territory space), but at the moment of an intrusion flux occurrence, the inner defense system (which is as real as it can be) grants it the status of RBS, by means of specific fluxes which are opposed against any unauthorized flux who tries to cross it.

We have (as we are about to see later on) a case of stochastic, non-permanent RBS, which includes an equilibrium surface between two opposite fluxes which interact each other: fluxes which try to enter or exit through RBS and fluxes which are against these processes (the latter are fluxes belonging to the state's inner defense system). The fluxes access through this surface is strictly monitored and it can be done (in most of the cases) only through specialized areas of this RBS, the so-called transit areas (custom houses). In these areas, the input/output (import/export) fluxes are either accepted or rejected, the conveyed (closed) and reflected fluxes will therefore exist.

The coherent inner fluxes, which are vital for the state system, have, as any other flux, some stocks from which they are originating: raw stocks, fuels, food, people etc. That particular stocks are either natural (deposits found on the territory of that state, agricultural, forestry resources etc.) or artificial, as a result of the storage of some coherent import fluxes, or as a result of the objects synthetization in production systems. The amount of these stocks determines the lifespan of the state system; under the assumption of a total isolation (for instance, a total embargo), that is the absence of the import/export fluxes, the state shall run normally until the depletion of these stocks. The maintenance along an endless duration of the system's integrity under the conditions of the existence of finished inner stocks is therefore possible only by means of the existence of some import/export fluxes (interchange) with other similar external systems.

7.1.2 Individual bio-systems

Although it is very obvious, the existence of the fluxes within the bio-systems was found (through the fluxes model) only about one century ago. By examining the human and animal metabolism, the input (inhaled air, food, water) and the output fluxes (exhaled air, faeces, urine, perspiration etc.) may be noticed.

As a result of entering inside the bio-system (animal slaughtering, surgery, injuries), the inner fluxes have been found first (food, blood, lymph flows), then, the fluxes of the inner secretions, the nervous ones and finally, the fluxes inside the cells. In the same way as the state systems, there are however fluxes which are stored internally, inside the bio-system limited by RBS (this time, with a permanent physical existence represented by the epidermis) and fluxes through RBS, import/export fluxes. As for the bio-systems also, the fluxes transfer through RBS is strictly controlled from the inside, and it occurs only via the specialized transfer areas (nose, mouth, anus, urethra, pores etc.), which are able to control only the passage of certain type of fluxes.

Similarly with the state systems, the coherent, vital inner fluxes are coming from some inner stocks, except that, in case of bio-systems, there are no natural pre-existing stocks (deposits), all the inner stocks being collected through the accumulation of the import fluxes, right even from the embryonic stage.

The bio-system's life span[30] strictly depends on the amount of these stocks; in case of an average human being, the oxygen stock is enough for several tens of seconds, the water stock is sufficient for couple of days, and the protein stock-for about a month. If there is no import flux added during this time in order to recover the stock, the system is destroyed (it dies).

7.1.3 Common model of the bio-system-based systems

Only two types of material systems were indicated (both the state systems and the bio-systems are obviously material systems) which clearly shows an inner structure based on amount of fluxes, but the examples may continue with the family systems (the element-systems of the human society, but also of other sexual-based animal communities), the economic systems (from the handicraftsmen up to the transnational companies). All the

[30] In the absence of an external aggression which would lead to the premature bio-system failure.

above-mentioned material systems are either individual bio-systems, or systems made-up from bio-systems, or artificial systems built by the bio-systems.

All these systems have some common features (specific attributes):

a) Existence of some fluxes stored in an inner spatial domain, separated (isolated) by the outer domain through a RBS. These fluxes are the vital inner fluxes;

b) Existence of some coherent interchange fluxes (import/export) through this RBS, by means of which the systems either are filling their own inner stocks (import fluxes), or are contributing to the completion of the stocks of other external systems (export fluxes);

c) The amount of the inner stocks determines the system's lifespan, its life ceasing when any of this vital fluxes will have been depleting their resources;

d) The individual lifespan of the associated systems may be increased (moreover, under unfavorable external conditions and lack of resources) by means of a mutual supply of the fluxes required for the completion of the inner stocks.

As we are about to see in chapter 9, the common attributes of a set of objects make-up the model of that particular objects class; in case of the above-mentioned systems, the common attributes from the points **a** and **b** define a generic model, that is the model of the fluxes triad, model which may describe the operation of any of the above-mentioned material systems, ranging from the individual cellular bio-systems up to the most complex systems made-up from bio-systems or by the bio-systems. The same question as in chapter 1 may be phrased:

If a model is valid for a very wide[31] *domain of the current knowledge regarding the material systems, why would it not be valid outside this domain, namely for the abiotic material systems?*

Well, this was the starting point for the elaboration of the general material system model: *the model of the fluxes triad.*

7.2 General model of the material system

For the description of any kind of *material system* (MS), either abiotic, biotic or artificial, the objectual philosophy proposes an universal model. In chapter 3, we have seen who is the model of *an object*, and in chapter 9, we shall minutely define what the model of a *class of objects* really means. For the time being, it is enough to assert that the model of a class of objects is made-up from the common component of the attribute model set of all the objects which belong to that particular class. If the model attributes which define a class of objects are associated to the specific attributes, a class *instance*[63] may be obtained, that is a particular object which belongs to that class. In case of the material systems, the class model settles the common properties of all the elements which make-up the class of the *material objects.*

As in the case of other notions, we shall use the word "material" with the dictionary meaning, until its redefinition after the introduction of the MS model, and mostly of a special type of MS - information processing system (IPS). This general model of MS must fulfill a specific number of requirements, couple of them being worth mentioning:

1) Explanation of the causes of the natural formation and destruction of MS;
2) Explanation of MS's lifespan;
3) Clear separation between the MS and the abstract system notions;
4) Explanation of the interactions occurred between MS and of the causes of these interactions;

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[31] From couple of micrometers, as the dimension of the spatial size grade of a procaryote cell up to the planetary sizes of the world socio-economic system.

[63] Term borrowed from the objects-oriented programming languages, because it has almost the same semantic value as the one intended by the objectual philosophy.

5) Explanation of the origin of the MS's inner energy and of the energy from the fields released by these MS.

7.2.1 Bounding surfaces

The first material systems where we first met the "bounding surface" term were the distributed systems, which were briefly approached in the previous chapter. If they have a permanent interaction (such as the S or L-type ones), these types of material systems have also their own volume and a surface which confines this volume, and due to this reason, it is called *bounding surface.* All the exchanges between the outer and inner systems take place through this surface. These exchanges are defined by the transfer through the bounding surface of some distributed amounts, process which it is called flux, as we have previously mentioned. Therefore, fluxes (displacement or propagation type) may cross through the bounding surface, both inward and outward of the volume confined by it. The fluxes oriented inward of the surface shall lead to accumulations into the confined volume of the amount carried by these fluxes (which are therefore positive quantities or stock increment), whereas the outward-oriented fluxes shall lead to a stock decrement of those amounts.

Due to this reason, the fluxes whose FDV are oriented inward of the bounding surface shall be considered as positive. The bounding surface of a body is not a theoretical surface (computing, imaginary, abstract), similar with the surfaces from mathematics or from the theoretical physics. Not all the incident fluxes are able to run freely through a surface like this; some of them shall cross only partly, some, not at all (they shall be totally repulsed, reflected). By considering I_{ik} as the intensity of an incident *k*-type flux on the bounding surface (intensity given by the relation 5.2.1.4), and I_{tk} which is the intensity of the same type of flux which has succeeded to cross it (flux transmitted through the bounding surface).

Definition 7.2.1.1: The transmittance (permeability, transparency) of the bounding surface for *k*-type fluxes is considered to be the following amount:

$$p_k = \frac{I_{tk}}{I_{ik}} \tag{7.2.1.1}$$

where index *k* is a running number from a list of all the fluxes which are incident along the surface, selected according to the transported amount (energy, information, structure objects etc.) or according to other distinctive properties of them. It is obvious that there is a different transparency of a certain bounding surface related to the various fluxes which cross it, but it ranges within the same interval, between *0* and *1*.

The numerical value of the bounding surfaces transmittance allows their classification in two major groups:

1) *Real* surfaces, with $p_k < 1$ for the real fluxes;

2) *Abstract* surfaces (theoretical, computing ones, which are existent only for IPS as abstract models of the real surfaces), for which $p_k = 1$, for any type of flux (total permeability), because these surfaces do not physically exist.

Few remarks seem to be necessary:

1) According to the objectual philosophy, the only real surfaces are the bounding surfaces of MS, which shall be called *real bounding surfaces* (RBS);

2) As for the real surfaces, the transmitted flux shall be always lesser than the incident flux.

7.2.2 The fluxes triad model

By considering a volume *V* confined by a real close bounding area Σ, which is convex with no topological holes, with its sizes conceived so that this volume might be able to include all the system's elements and only them (without alien elements). The surface Σ shall be the boundary between two complementary[33] spaces - the *internal one* with volume *V* and the *external one*. ***Three flux classes*** may be defined by means of this surface Σ, and these are:

1) Fluxes $\mathbf{\Psi}_i$, known as open *input* fluxes (*immergent* in V or *afferent* to V), which cross the surface Σ from the outside to the inside (*convergent* or *import* fluxes);

2) Fluxes $\mathbf{\Phi}$, *stored* (closed) fluxes into the inner V volume of the system;

3) Fluxes $\mathbf{\Psi}_e$, open *output* fluxes (*emergent* from V or e*fferent* to V), which cross the surface Σ from the inside to the outside (*divergent* or *export* fluxes).

Comment 7.2.2.1: Although it is quite unpleasant and boring, the specification of all the denominations of the fluxes involved in the transfer by means of RBS is important for the start, because in certain papers, only some of these denominations are used, but since we are talking about a general model, these denominations which are specific to a certain professional domain, seem to be similar with the others from other domains. Until the "standardization" of a single denomination for each flux type, we have to mention all of them. The category of *efferent* fluxes shall also include, as we are about to see later on in this paper, the fluxes which are not coming from the inside of volume V, but from its surface (reflected fluxes); it is important that these reflected fluxes are also open, with their direction oriented outward of volume V just like the emergent fluxes, since they are output (divergent) fluxes as well. If the reader has knowledge regarding the vector fields theory, then he is able to instantly note that the two classes of input and output fluxes (more exactly, their normal components on RBS) shall have the divergence different from zero (positive or negative) and a null curl, whereas the coherent components of the stored fluxes with a non-zero circulation shall have a null divergence (through Σ) and a non-zero curl. In this way, the model of triad fluxes "makes a connection" between the two basic flux classes (the ones with a non-zero divergence and the ones with a non-zero curl) which seemed to have no connection until this moment.

The *k*-type attribute stock at a certain *t* moment and which is contained in a flux stored inside a MS is given by the following relation:

$$Q_k(t) = \int_{t_0}^{t} \oiint_{\Sigma} \bar{f}_{ik}(t)\,\bar{n}\,d\sigma dt - \int_{t_0}^{t} \oiint_{\Sigma} \bar{f}_{ek}(t)\,\bar{n}\,d\sigma dt \qquad (7.2.2.1)$$

where $\bar{f}_{ik}$ is FDV of the *k*-type input flux, and $\bar{f}_{ek}$ of the output flux, namely, the inner stock of a certain attribute is the difference between "the history" of the affluxes and effluxes within the system, history which begins at the moment t_0, the moment of the material system formation, which coincides with the occurrence (we call it "generation") of the stored $\mathbf{\Phi}$ fluxes.

For a certain type of MS, there is a stored $\mathbf{\Phi}_{kr}$ flux which contains a stock known as ***model stock*** Q_{kr}, which is a reference stock of the *k*-type attribute (amount), against which the real flux stored at a specific moment may be lesser or higher. The difference:

$$\Delta Q_k(t) = Q_k(t) - Q_{kr} \qquad (7.2.2.2)$$

is the ***demand*** (necessary amount) of *k*-type flux, if the difference sign is negative (the stored flux is lesser than the model stock), and the ***excess*** (surplus) of k-type flux if the sign is positive.

Comment 7.2.2.2: For example, in case of humans, the water flux demand is manifested through the signal given by the inner IPS expressed by the sensation of thirst, with an intensity in proportion to the needed flux amount (demand); after the completion of this amount, the flux surplus is signaled by means of the satiety sensation. The same situation occurs in case of the oxygen, food demand, so on, only the signal given by inner IPS being different.

Causally speaking, the stored flux $\mathbf{\Phi}_k(t)$ [34] (whose FDV is noted with $\bar{\varphi}_k(t)$) is the effect of the input flux accumulation $\mathbf{\Psi}_{ik}(t)$, and the source (cause) of the output flux

[33] In this case, the complementariness basis is the entire infinite Ω space (see Annex X.5 for details concerning the *complementariness basis* term).

[34] It is clear that the fluxes which make-up the triad depend also on the spatial attribute (because the fluxes are distributions with a spatial-temporal support), but for simplifying the relations, we shall mark only the temporal dependence because time is a key-issue for the stocks evolution.

$\Psi_{ek}(t)$ .Between the fluxes which make-up a triad (under an equilibrium state, that is the stock maintenance of an inner attribute *k* equal to its model stock), there is a basic conservation relation:

$$\int_{t_0}^{t} \oiint_{\Sigma} \overline{f}_{ik}(t)\overline{n}d\sigma dt = \oiiint_{V} \overline{\varphi}_k(\overline{r},t)dV + \int_{t_0}^{t} \oiint_{\Sigma} \overline{f}_{ek}(t)\overline{n}d\sigma dt \qquad (7.2.2.3)$$

where t_0 is, as I have mentioned above, the generation (formation) moment of MS, and *t* is the current (present) moment. The relation 7.2.2.3 stipulates that the attribute stock *k* which is contained in the inner flux (also a *k*-type) of MS at the present moment *t*, is given by the temporal integral of the influx intensity, minus the temporal integral of the efflux intensity, along the temporal existence interval of MS. Under the conditions of <u>permanent equilibrium of the fluxes triad</u> (that is the invariant maintenance of the inner stocks equal to the model ones), the relation 7.2.2.3 may be written in a simplified form:

$$\sum_k \Psi_{ik} = \sum_k \Phi_k + \sum_k \Psi_{ek} \qquad 7.2.2.4)$$

where Ψ_{ik}, Φ_k and Ψ_{ek} are Euler distributions of the input and output *k*-type fluxes at a certain *t* moment, distributions on the surface Σ in case of the input/output fluxes and on volume *V* in case of the stored fluxes.

The inner fluxes stored inside the system are the ***vital*** (functional) ***fluxes*** of MS, by which the newly arisen MS is different from the reference medium which has generated it (the medium which contains the generating set of the structural elements of MS). When these fluxes vanish, the system vanishes (dies) as well.

The common properties of all MS are the ones resulted from the general model of MS - the *fluxes triad model* (3**F** model). This model settles that any MS has a finite inner volume which is separated by the outside domain through a real bounding surface (RBS), which contains the closed fluxes of MS. RBS is crossed in its both directions by the other two flux categories of the model - input and output fluxes. The existence of fluxes as distributed <u>motion</u> processes determines the inseparable existence of a fundamental property of MS, which represents the motion - *energy* - and the existence of the stored fluxes (more exactly, of the contained stocks) is a major factor for other fundamental properties of MS - *spatial structure* and *inertia.* These fundamental properties shall be analyzed later on and, for the time being, we shall be dealing with RBS because it is very important that this concept to be understood.

7.2.3 Real bounding surfaces

The existence of fluxes Φ_k in a limited volume *V*, and non-existence or their lowest existence of the outside, means that the flux density inside a MS is <u>higher</u> than the flux density outside MS (reference density of the initial medium from which the system has arisen during its generating process). Due to this reason, a gradual transition from a density to another shall exist.

Definition 7.2.3.1: The spatial transition zone from the inner flux density of MS to the flux density of its outer medium is the **real bounding surface** (RBS) of MS.

A real bounding surface is a fundamental part of the structure of a material system, it is "the separator", the boundary between the system which owns it and its external medium. All the fluxes exchange between the system and the outside are passed by RBS, and this surface may be also, in most of the cases, a closure barrier of the fluxes stored in the inside. As we have previously mentioned, as compared to a virtual surface (theoretical, computing one) used in the mathematics field, RBS shows few essential differences:

1) Permeability (transparency, transmittance) p_k to a *k*-type of flux (given by the definition 7.2.1.1) is always subunitary ($p_k<1$), whereas this permeability for the virtual surfaces is always unitary ($p_k=1$ because it does not exist in case of the material fluxes, being only an imaginary, computing surface). The subunitary transmittance of RBS makes that an incident flux (coming from the inside or outside) to not be totally transmitted, always existing a deviated (reflected) component of this flux. The existence of this kind of flux coming from the incident fluxes - *reflected flux* - is a basic property of MS, even one of the identification (certification) criteria of its materiality, as we are about to see in chapter 8. Also, subunitary permeability allows the retention (confinement) of the inner fluxes inside RBS.

2) The tangential components of the incident, reflected or transmitted fluxes occur in case of RBS, these are components which lead to other mathematic relations, unconceivable for the virtual surfaces (as regards RBS, fluxes which simultaneously have the curl and divergence different from zero, the tangential component could have a non-zero curl and the normal one, a non-zero divergence).

As I have previously mentioned, RBS is not a surface under the meaning known in mathematics, but a <u>mathematic model</u> of a part from a MS, part which separates the inner spatial domain of MS from the outer spatial domain. Under the flux density terms, RBS is (as it is shown in the definition 7.2.2.1), a spatial zone (a space placed between two confined virtual surfaces) located outside of a MS, hosting the transition from the flux density inside MS, to the flux density of the external medium.

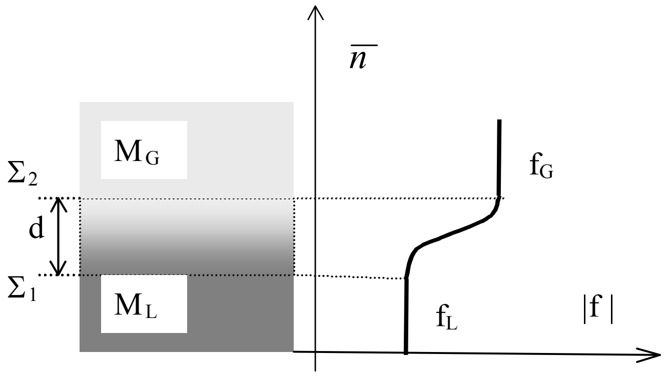

Fig. 7.2.3.1

Figure 7.2.3.1 shows an example of cross section running through this kind of RBS ($\overline{n}$ is the normal line on the bounding surface), which separates two phases: liquid (M_L in the lower section) and gaseous (M_G in the upper section) of a medium (such as the oceans water, from water vapour of the proximity atmosphere), where the grey density color suggests the elements density.

If the two media are supposed to be isothermal in the proximity of RBS, the water molecules from the bounding surface, with an energy higher than the liquid's cohesion energy shall escape from the liquid by forming the gaseous phase of the water, the vapour from the proximity of RBS, whose scalarized state attribute is the vapour pressure (see annex X.9 for details about the *scalarization* term). The spatial area with *d* thickness placed between two theoretical surfaces Σ_1 and Σ_2 (placed orthogonally along the figure's plane), where the gradual transition from M_L to M_G takes place, represents RBS which limits the two media. The thickness of this area may take values from couple of molecular diameters in case of the gas bubbles in the mineral water, up to several meters in case of the ocean's tumultuous surface.

The transition from one medium type to another (according to the example with the water transition from the liquid phase to the gaseous one), means the transition from a density of the molecular flux[35] (stochastic at the medium level and coherent at the molecule level) which is more reduced ($\overline{f}_L$ in L phase) to a higher one ($\overline{f}_G$ in G phase). The horizontal axis from the figure 7.2.3.1 (which has no connection with the left figure but only with the normal line) is the modulus of this flux density. If in case of the gas bubbles, RBS is very close to a virtual surface (the human eye is not able to detect the unevenness, it appears to be a perfectly smooth surface), in case of the ocean RBS, it is much more different as compared to what is usually understood by the word "surface". However, we are dealing with the same model in both cases: a transit spatial zone from a distribution type characteristic to a medium, to another distribution type which is specific to other medium. The fluxes which try to cross through this uneven distribution area, regardless the part they came from, shall be decomposed in multiple components, as we are about to see next.

7.2.4 The fluxes transfer through RBS

The transfer processes of the fluxes through real surfaces are much more complex than the transfer through the theoretical surfaces. A mathematic model of these processes may be conceived, as I have mentioned above, by taking into consideration the real surface of a medium as a zone (space) placed between two parallel theoretical surfaces, at such distance, so that all the dynamic transfer processes to be able to occur in the interval between them.

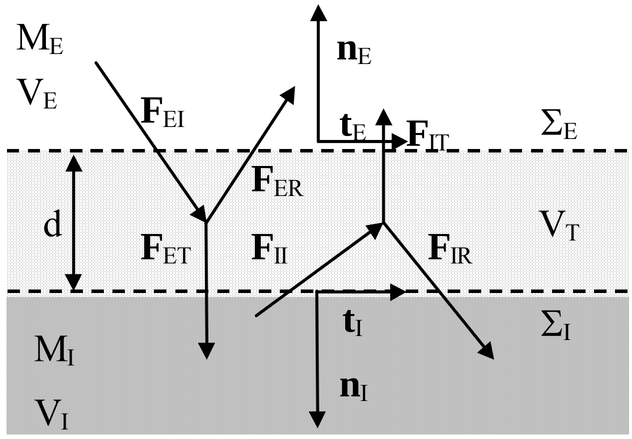

Fig. 7.2.4.1

We shall take into account the medium M_I placed inside the system which have RBS, with an inner volume V_I. The real surface which limits V_I is considered to be composed from two theoretical surfaces Σ_I and Σ_E, which are parallel at the distance *d*, with the normal lines $\boldsymbol{n}_I$ and $\boldsymbol{n}_E$ (figure 7.2.4.1 displays only a small fraction from RBS, so that we may assume that the two virtual surfaces are plane and orthogonal on the figure plane).

Volume V_T (transition space of the real surface) shall be placed between these surfaces, with its sizes imposed by the distance *d* and with the mean statistic attributes which are gradually variable, so that the parameters of the external medium M_E to be found on the surface Σ_E and the parameters of the internal medium M_I to be found on the surface Σ_I. This construction shall be the reference against which an *interior* of the system (volume V_I) and an *exterior* (volume V_E) shall be defined. Through this RBS, the fluxes exchange between the medium M_1 and the outer medium shall occur. For the description of these fluxes, a notation scheme with two indexes *x* and *y* ($\mathbf{F}_{xy}$) shall be displayed, thus:

- *x* may take one of the following values: *I* (interior) or *E* (exterior);

[35] The molecular flux is defined by the molecules motion, and the density (since we are talking about a discrete distribution) of this flux is even the density of the individual flux of a molecule.

– y may take one of the following values: I (incident), R (reflected) or T (transmitted).

We shall have therefore six types of fluxes $\mathbf{F}_{xy}$ ($\mathbf{F}_{II}$, $\mathbf{F}_{IR}$, $\mathbf{F}_{IT}$, $\mathbf{F}_{EI}$, $\mathbf{F}_{ER}$, $\mathbf{F}_{ET}$) and two normal lines $\mathbf{n}_x$ ($\mathbf{n}_I$ and $\mathbf{n}_E$ assumed to be collinear) on the two virtual surfaces. The sign convention (and accordingly, the normal lines direction) has the following configuration: for each of the media M_E or M_I, *there are positive fluxes which have the direction of that normal line* (in other words, in case of the external medium, the fluxes with $\mathbf{n}_E$ direction are positive because these fluxes lead to a stock increase in this medium, similarly with M_I). One may notice that the surface Σ_E may be considered as the theoretical surface of the medium M_E, therefore, the positive fluxes through this surface generate a stock increase in M_E, as well as Σ_I, which may be considered as a theoretical surface for M_I, with the same sign convention.

Although the fluxes are distributions, due to simplicity and clarity reasons, they have been displayed through a single vector which represents the entire vector distribution on the effective flux section (the displayed vector is therefore the resultant vector of this distribution, more exactly, it is the resultant vector of the flux's coherent component along that particular direction). Under these conditions, the six possible fluxes are:

– $\mathbf{F}_{EI}$, incident external flux (with the denomination used in this paper that is external **influx**);

– $\mathbf{F}_{ER}$, reflected external flux (with the denomination used in this paper that is external **reflux**);

– $\mathbf{F}_{ET}$, transmitted external flux (immergent flux, import, afflux, with the denomination used in this paper that is external **traflux**);

– $\mathbf{F}_{II}$, incident internal flux (internal **influx**);

– $\mathbf{F}_{IR}$, reflected internal flux (internal **reflux**);

– $\mathbf{F}_{IT}$, transmitted internal flux (emergent flux, export, efflux, with the denomination used in this paper that is inner **traflux**).

The incident external fluxes (outer influxes), $\mathbf{F}_{EI}$, shall enter into the transition space V_T and they will be subjected to the *de(composition)* processes. A part of these fluxes will traverse volume V_T by leaving its source medium and will penetrate the medium M_I (outer traflux $\mathbf{F}_{ET}$), the rest of the flux being reflected (outer reflux $\mathbf{F}_{ER}$) and remaining into the source medium. One may notice that there are two types of incident fluxes - internal or external - according to their origin coming from the inner or the outer medium. The transfer processes for the inner incident fluxes are absolutely similar, only the indexes being different.

The six main fluxes which occur on the RBS of a MS may be also divided in two components each:

– Normal component (with the normal line direction $\mathbf{n}_E$ or $\mathbf{n}_I$);

– Tangential component (according to $\mathbf{t}_E$ or $\mathbf{t}_I$ included in the two tangent planes).

Each component shall be associated to a coherent flux towards a particular direction. Finally, the mathematic model of the flux transfer through RBS of a MS shall therefore include twelve fluxes for each type of flux from the panoply of k fluxes of a certain MS.

It is worth mentioning that this decomposition and re-composition of fluxes take place in the entire volume V_T, being actually a vector fields composition - the fields which represent the incident fluxes and the fields which represent the reaction fluxes of the medium inside the transition space.

The total amount of k types of different qualitative fluxes, incident from the outside on a RBS belonging to a MS, makes-up the *external influxes set*, which shall be noted with $\{\mathbf{F}_{EI}\}$, (the set of all the open fluxes which are outside of the system, crossing the spatial domain occupied by the system). After the contact of these fluxes with RBS, other two sets of fluxes are generated - the set of the external refluxes $\{\mathbf{F}_{ER}\}$, and the set of the external trafluxes

$\{\mathbf{F}_{ET}\}$. Another triad of the fluxes set shall be developed on the inner side of RBS: $\{\mathbf{F}_{II}\}$, set of the inner influxes, $\{\mathbf{F}_{IR}\}$, set of the inner refluxes and $\{\mathbf{F}_{IT}\}$, set of the inner trafluxes (towards outside of MS).

The set $\{\mathbf{F}_{EF}\} = \{\mathbf{F}_{ER}\} \cup \{\mathbf{F}_{IT}\}$ makes-up the set of the ***fluxes efferent*** to MS. The fluxes which compose this set would not be able to exist if MS with its RBS would not exist. Due to this reason, these fluxes are a basic indicator of MS *existence* (at its spatial location), respectively of its materiality, as we are about to see in chapter 8.

Comment 7.2.4.1: As for the fluxes reflected by a MS, various comments on its origin (source) may be made; indeed, a radiant flux such as an electromagnetic wave released by the aerial of a radar has clearly its source in this aerial (more precisely, in the radiator from focus of the aerial), but we might say that the beam which is reflected by an object (target) has the source in that object, because that flux comes from out there. If the reflecting object with its RBS would not have existed at that location, a reflected wave would not have existed either. Therefore, we may assert that if the radar aerial is the source of the incident flux on the target surface, the target itself is the source of the reflected flux.

Unlike the refluxes, which are not able to exist unless some influxes are present, the fluxes $\{\mathbf{F}_{IT}\}$ coming from inside the system can exist for a limited period of time even in the absence of the input fluxes, but only until the depletion of the fluxes which are stored inside (of the flux resources). This duration, which depends on the amount of the inner *k*-type flux stock, is called ***a relative life span related to the k-type flux*** of the system (see also the annex X.16).

Definition 7.2.4.1: The spatial-temporal distribution deployed outside a MS, of FDV for the *k*-type flux from the set of the efferent fluxes $\{\mathbf{F}_{EF}\}$ of MS is called **k-type field** of MS.

We may note that a MS generates so many field types, as many flux types are coming from its interior, or as many are reflected by its surface. Since these are open (active) fluxes, they can produce actions on other external MS, as we are about to see in a future section of this paper.

Comment 7.2.4.2: Not only the inner trafluxes of a MS are field generators, but also the outer refluxes. When we see the light reflected by a body, we are able to capture part of this photonic field generated through the reflection on object's RBS, of a photon flux released from the source. The major difference between the two fields is mentioned above: the reflected field exist only in the presence of an incident flux, whereas the field generated by an inner traflux is able to exist without any external contribution, and the most important fact, coming from the inside, is that it carries to the outside, information about the inner state of the releasing MS, information which are for those who know how to interpret it.

The efferent fluxes from a MS are carriers of some properties of MS where they come from (source MS) and they can be used as a information support for the systems able to intercept and process these fluxes - information processing systems - which shall be described in the following chapter.

Comment 7.2.4.3: For example, in case of the bio-systems belonging to the class of herbivorous mammals (but not only) there is an emergent molecular flux running through the epidermis pores - perspiration - that is a flux which is spread in the air as a result of the vaporization of the water from its composition. The concentration of these molecules which are dispersed in the support air, depends on the direction of the air motions and on the distance towards the issuing animal, the spatial-temporal distribution of this concentration making-up the odorous field of that animal. The chemical composition of this flux is perceived by the olfactory organs of the nearby animals, mostly by the carnivorous animals, for which the herbivorous animals are the main food source. This composition depends on the inner processes deployed by the issuing animal, therefore, it releases to the outside information about the age, health condition, current "psychic" state (fear, aggressiveness) of the source, which are essential information for predatories in order to choose their next victim. The perception of the odorous field of animals is for the carnivorous animals the main source of remote information regarding the nearby presence of a potential prey, and the sight sense is used only at a short range (for guiding the hunting process). Due also to this reason, (so that their presence cannot be traced), some carnivorous animals (such as the canines, felines) have reduced to the lowest level their own odour flux by blocking the involuntary perspiration (through the skin), this process being mainly produced through the oral cavity (voluntary).

7.2.5 RBS types

We have noticed in the previous sections that RBS is a spatial zone with a non-even distribution of the flux density, zone which is found at the boundaries of a MS. The figures 7.2.3.1 and 7.2.4.1 have shown some cross sections running through these zones. If due to simplicity reasons, we shall consider that the surface Σ_I of the inner medium M_1 has a spherical shape, then, the section from this figure might be seen as a fraction of a radial section running through RBS. In this case, the unevenness of the flux density distribution from the transition space is radial (the normal lines $\mathbf{n}_I$ and $\mathbf{n}_E$ being collinear with the radius of the inner domain). According to the definition 7.2.2.1, for each RBS there is a certain p_k value of its transmittance, which is specific to a certain *k*-type of flux which tries to cross it. The numerical value of this transmittance may be dependent by means of a relation f_k which is characteristic to each *k*-type flux, by the value of another attribute (which is considered to be independent). For instance, in case of a S-type distributed MS, made-up from atoms, which has an invariant spatial distribution[36] against its inner reference system (that is also a spatial one), the relation:

$$p_k = f_k(r,\theta,\varphi) \qquad (7.2.5.1)$$

defines, under polar coordinates, (more appropriate for the spherical shape) the distribution of this transmittance for a certain type of flux. If we are dealing for instance, with an atomic or molecular outer influx (an atomic or molecular beam), at which the RBS transmittance of the above-mentioned S medium is insignificant (we may consider it null), in case of a spherical RBS, $p_k = 0$ for any value $r \le r_I$ (where r_I is the radius of the surface Σ_I) and $p_k = 1$ for any $r \ge r_E$ (r_E being the radius of the theoretical surface Σ_E from the figure 7.2.4.1). However, in case of a neutrons flux, the distribution is much more complex; fortunately, due to the scope of this section, we are not interested in the accurate distribution relations of p_k, but rather in the fact that these distributions really exist, and accordingly, we need to know what is the independent amount (distribution support). As also regards the S-type spherical medium (e.g. a bearing ball), the value of RBS transmittance for the atomic or molecular fluxes is null for any kind of domain (even an elementary one) of the surface; in this case, we may state that the *surface spatial distribution of* p_k is *even*. If on a RBS, there are sections with different permeability at the same flux type, a *non-even* surface distribution (of the permeability) may exist.

Comment 7.2.5.1: At the same type of molecular flux (e.g.: air flux), the above-mentioned ball has a null transmittance which is evenly distributed on the entire area of RBS, whereas a bio-system which breaths (e.g.: a human) has specialized zones from RBS (the oral cavity is one of them), whose permeability against this type of flux is controlled from the inside, which can be one (during the mouth breathing) or null (when the mouth is voluntarily closed). The non-even surface distribution of the transmittance on RBS is specific (as we are about to see in the following chapter) to MS which are controlled from the inside by an information processing system (IPS).

So far, we have briefly discussed about the spatial distribution of RBS transmittance of a S-type of medium, distribution which is invariant in case of this kind of medium. If the value p_k (from the relation 7.2.5.1) applicable for the *k*-type flux remains invariant, namely, there are no observable modification *processes*, we may state that for this kind of flux, RBS permeability *does not depend on time*, or it is *permanent* (temporal equipartition).

Comment 7.2.5.2: The bounding surfaces of S-type media (this category includes the solids, as well as the bio-systems, or the artificial systems), have a permanency character of the transmittance if the intensity of the incident flux does not exceed the dissociation threshold of the medium's elements, or the medium type change (phase transformation). In case of the bio-systems, the form of the outer RBS (plasma membrane of cells, or the epidermis of the evolved organisms) is generally variable (the bio-

[36] According to the relation 7.2.5.1, *k* is the index of the flux type and not the index of the distribution element which was mentioned in chapter 2. Due to simplicity reasons (for not using two parameters) it may be considered that the relation f_k for *k*-type flux is a continuous function.

systems are MS with controlled deformability), but this aspect does not impair the value of RBS transmittance, which remains permanently null for all the unwanted[37] fluxes, and variable (non-permanent) for the desired fluxes, but this may be achieved only through the sections which belong to the specialized transfer zones.

Much more complex, but also much more interesting, are RBS problems with *non-permanent* transmittance (with uneven temporal distribution), which are those RBS which own a time-variable transmittance. Let us consider as an example the case of a spherical-shaped, solid body with diameter *d* which deploys a circular revolution motion, in a normal plane on the revolution axis *xy* placed at a distance *r* towards the body core (see fig.7.2.5.1), subjected to the incidence of a coherent **F** flux, with its direction parallel with the axis *xy* and with an even spatial distribution. As a result of the revolution motion, the body generates a toroidal volume with the interception surface of the flux $2\pi rd$ (on a normal plane on *xy*).

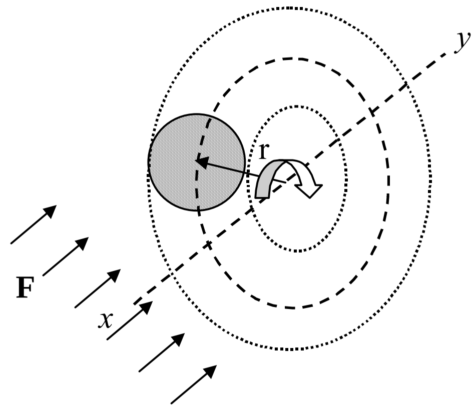

Fig. 7.2.5.1

By assuming that RBS of the rotating body is impermeable to the **F** flux, as a result of its revolution motion, the flux which crosses the orbital plane shall be different from the incident one on this plane (lower). The motion of the solid body across the circular pathway means a flux which is distributed in a toroidal volume, which is a constant effective section flux, existing only under the limits of the toroid surface. But this fact means that there is a flux inside the toroidal surface and not in its exterior, therefore, we are dealing with a non-even spatial distribution of the flux density on this surface which, according to the definition 7.2.2.1, means that this particular surface is a RBS, but one with a non-permanent transmittance. Let us consider the case of $r = d/2$ (in order to cancel the gap from the ring core) and a revolution period $T = 2\pi/\omega$ (ω being the angular speed of the body revolution motion around the axis *xy*).

In this case, for a flux **F** with its effective section equal to its cross section of the ring surface ($2\pi rd$ on the flux direction), the lower is the transfer velocity *v* of the flux, at the same angular speed, the incident flux shall be scattered (reflected) by the rotating body at a greater extent, otherwise speaking, the toroidal RBS transmittance along the direction *y* shall depend both on the flux's transfer rate, and on the revolution velocity of the rotating body. If the flux's transfer rate increases, then, the toroidal RBS permeability shall increase in proportion to this rate, but it will remain permanently subunitary (the flux scattering is maintained). This is the RBS case whose permeability to a specific flux type depends on the flux's transfer rate[38] and on the rotational speed of the generating body (temporal distribution of RBS).

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[37] Fluxes whose intensity does not exceed the RBS destruction threshold.

[38] Attention! In this case, the dependence is only related to the speed and not to the flux intensity which also involves the density of the attribute distributed on the support objects which are set in motion.

Comment 7.2.5.3: The fact that a non-even distribution of a flux generates a RBS becomes obvious for the human eye if the incident **F** flux from the figure 7.2.5.1 is a photon flux from the visible range. In such case, the eye is able to see a part of the scattered photon flux, and if the body's rotational period is shorter than the eye inertia (about 0.1 s), we would be able to see a diffuse toroidal surface and not the spherical body, as if a toroidal object would be found at that position.

An interesting case for this kind of "revolution-type" (non-permanent) RBS is the one when the **F** flux continues to be parallel with the axis *xy* (for simplicity), but it is corpuscular, with its effective section equal or less than the cross section of the rotating spherical body and it occurs *periodically* (pulsating). In this case, a dependence of the toroidal RBS permeability is generated not only by the transfer rate but also by the frequency and the phase of the periodical flux; by assuming that the revolution frequency and the flux frequency are equal, if the moment of the flux occurrence coincides with the moment of the body presence, the transmittance is null, increasing according as the displacement reaches the boundaries of the circular object and it is unitary during the remaining period. This clearly shows that as regards the revolution-type RBS (or oscillating) there is the possibility that under specific conditions[39], their transmittance to be equal to one (because RBS does not really exist for that temporal range). Does it not seem to you that this fact resembles with the tunnel effect?

These RBS types whose permeability has both a spatial and a temporal distribution belong to ***RBS class with a spatial-temporal distribution.*** Other two sub-classes are included in this class:

1) RBS with a deterministic (coherent) spatial-temporal distribution, which also comprises the above-described example of the rotating body with determined and invariant orbital parameters (body size, spatial position of the rotation axis, of the plane and orbital radius, of the orbital frequency etc.). This RBS type has a permeability which depends both on the transfer rate of the incident fluxes, and also on the frequency distribution of these fluxes (in case of the periodical fluxes);

2) RBS with a ***stochastic*** spatial-temporal distribution, at which the surface permeability has a random value which is both spatial and temporal, with only statistical mean values of its transmittance. This surface type occurs when there is an interaction (an intersection) of the fluxes whose carrier material objects are spatial-temporally spread and accordingly, their bounding surfaces are not contiguous or conjunct (the moving objects do not make-up a compact object). The stochastic RBS is that spatial area which contains inside all the impact points (interaction) of the objects which belong to the opposite fluxes. A general property of the stochastic RBS is that their permeability <u>can never be null</u>, because the flux objects are scattered (there are spaces with unitary permeability between their elements).

Comment 7.2.5.4: When we have presented the state's RBS and its defense system, we were talking just about this kind of RBS, because in case of an external aggression, (an outer unauthorized influx which tries to penetrate that particular RBS), the defense system also fights back with a flux, but an opposite type of flux, which by means of composition (interaction between the flux objects) must stop (in the first stage) the aggression flux and then, it must reject it (the reflexion's equivalent) to the outside. If we take as example an air-borne assault during the second world war, the outer influx was made from an escadrille of bombardment aircrafts, and the inner influx consisted in a set of projectiles which were shot by the anti-aircraft artillery or by the hunting aircrafts. The impact between the elements of those two opposite fluxes had a partly deterministic character (the missiles's aiming and guiding systems), but also a major random weight (either due to the weather conditions, or due to technical malfunctions or gun crew ability). Finally, the entire interaction process of the two fluxes took place on a RBS with stochastic distribution, with a couple of km thickness (the zone of the air combat), with the equilibrium surface placed inside it (this will be a concept developed later on), which was able to move depending on the flux resources of the two parts, either outward (aggression fight-off), or inward (aggression success).

The stochastic RBS may be widely found inside DS (more clear at G-type ones), where every element of the medium "is competing" with its nearby neighbors for the division of an indispensable resource - space - more precisely, its vital space in which the outer kinetic flux

[39] Inter-correlation conditions between the temporal or frequency distribution of the flux and the temporal or frequency distribution of RBS transmittance.

of the element is confined (that is the space required for the element's individual motion, which is in relation to its energy amount taken from the total energy stockpile of the medium from which it belongs to). This volume which is statistically computed by comparing the volume of medium to the number of elements, is an abstract volume (a mean calculus value); in fact, the elements which temporarily own a higher energy amount (the ones placed on Maxwell's curve of the velocity distributions towards high speed values) shall have a higher available space (that is the equivalent of a palace in the people's world (#)), whereas the elements with energy resources less than the mean values, must get content to a much less space. Relevant for our discussion is the fact that on this stochastic RBS which settles the specific volume per each element, the sum of the outer kinetic trafluxes of the nearby elements at a medium, under an equilibrium state, must be equal to the traflux (also kinetic) of the element from the inside, which means that inside this elementary stochastic RBS to exist the equilibrium surface of the two opposite fluxes, and this surface to be invariant (obviously, on average basis as well).

The RBS classifications which were mentioned so far have been made according to the distribution type criterion of its transmittance. RBS can be also categorized according to the organization level (on the abiotic scale) of the objects which are set in motion, and which in this way, will generate the unevenness of the motion distribution which is required for the occurrence of a RBS. If we are starting from EP level, it is obvious that the material systems belonging to this class have an external RBS (which intervene for instance in case of the collisions between particles). The transfer processes of the fluxes which make-up the electric, magnetic, nuclear or gravitation fields (towards and from EP) are located through this RBS, as well as the kinetic fluxes of the neighbouring EP, or of the photons which cross through this surface. At the moment of a bi-particle system formation, system made-up from two EP with opposite charges, the motions of the two system elements shall be two fluxes confined in the volume occupied by the system (for example, the volume of a hydrogen atom). These closed fluxes shall produce two RBS with spatial-temporal distributions as it was mentioned above, RBS with deterministic (periodical) distributions, which are spatially disjoint or conjunct, out of which, an internal one (generated by the proton's motion) and an external one (generated by the motion of the peripheral electron). We have already noticed that in case of RBS with spatial-temporal distribution, so that a flux transfer between elements can be possible, the two distributions must be inter-related, but most of all, to exist a inter-correlation at the phase level of the flux frequency. Otherwise speaking, MS made up from EP must have an inner coherency of the flux frequency at the phase level (we shall see later on that this coherency must be in a co-phasal state, or as it is also called, with positive reaction). We are not going to minutely describe the atomic structure, but we shall only find that the union of the real bounding surfaces generated by the proton and neutron motions will lead to the formation of nuclear RBS, and the RBS union generated by the motion of the peripheral electrons shall make-up the electronic outer RBS, divided also in layers with spatial-temporal distributions specific to the individual electronic orbitals. These electronic RBS which have became spatially conjunct as a result of the atoms assembling (through chemical bonds), shall make-up the molecular RBS, and further on, RBS of NM (permanent in case of liquids or solids, stochastic for gases).

Comment 7.2.5.5: The RBS of MS are very different, mostly due to the organization level of the material system which owns them, but absolute all of them are in accordance with the above-mentioned mathematic model. For example, the atmosphere of a planet with its radial-uneven distribution (its density varying exponentially with the radius), makes-up a RBS with different attributes according to the effective section of the incident fluxes; in case of corpuscular fluxes with the size grade of the effective section equal or less than the cross section of the gas molecules (for example, high energy EP or photons), the atmosphere will behave like a stochastic RBS, whereas for the compact isotomic fluxes with large sections (e.g.: meteorites or comet nucleus) the same atmosphere shall be a RBS with a permanent and quasi-even surface distribution of the transmittance. In case of these latter fluxes, and depending on their intensity, incidence angle and effective section, a transmission (by hitting the earth crust) or a reflexion (through deflection to the cosmic space) of that flux[40] might be generated. A RBS can be also considered as the outer limit of the terrestrial magnetosphere, which by means of its uneven distribution of the magnetic flux (stored inside the magnetosphere) is able to deflect the coherent flux of the solar wind (made-up from ionized atoms and EP) which cross through this magnetosphere, by protecting in this way the terrestrial biosphere against the harmful effects of these ionizing radiations.

7.3 Action and interaction

Definition 7.3.1: The state change of a MS produced as a result of the ingress and storage of an immergent flux (import flux, outer traflux) inside its real bounding surface is named **action.**

Definition 7.3.2: The flux which generates an action is named **agent flux.**

Let us consider the more simple case of a MS with a single type of stored flux (*k=1*), that is the kinetic flux (whose FDV is $\rho\bar{v}$, where ρ is the mass density). Before the action of an outer flux (of the same kind), the system has a specific inner flux which is stored inside the inner volume defined by RBS, that is the source where the emergent (with losses) flux of MS is coming from. The flux which is stored inside MS has a specific *state* (defined both in the chapter focused on processes and in the chapter about fluxes), both against the inner reference of MS, and against an outer reference, state which will determine the behavior (motion types) of MS against the outer reference. If the internally stored flux has a common component, with FDV $\rho\bar{v}_c$ against an outer reference, MS shall have a global motion of velocity $\bar{v}_c$, and if this common component is null, MS shall have an invariant position against the outer reference. At the moment of the incidence of an external flux (that is also kinetic) on RBS of MS, the component of this flux which is conveyed through RBS (outer traflux) shall be composed with the previously-existent inner flux, that is a composition of two vectorial fields, which will generate the new state of the stored flux.

This *process* of state variation is produced by strictly complying with the causality law, which means that the flux which is internally stored as a result of an action, shall be an effect (a result) of the existence and accumulation of the immergent (inflow) flux which is added to the previously stored flux. Consequently, an immergent flux (agent flux) shall produce first of all changes in the inner medium of MS (modification of the inner state) and then, an external state change ("visible" from the outside) shall take place. The outer state of MS is given by the ***common component*** of the individual states of MS elements, states which were modified as a result of this action (composition of the immergent flux with the previously stored flux).

Comment 7.3.1: For example, at the collision of two inert gas atoms (e.g.: neon gas), each atom which is moving is the equivalent with an open flux of constant effective section - the overall kinetic flux (impulse) - generated by the coherent T component (translation motion of the atomic inner T reference), which is the common component of all the motions of the atom's inner elements. In other words, the translation motion with an even velocity is the outer state of the two atoms before the interaction occurrence. The two MS shall interact at the level of the atomic RBS made-up from the outer layers of the atomic electrons. Here, the two external incident fluxes shall be composed and decomposed according to the transfer rules by means of RBS, resulting pairs of incident, reflected and transmitted fluxes against the local reference (normal line and tangent plane at RBS in the impact zone of the two fluxes). Each flux conveyed to the inside of each atom, shall produce state changes first into the outer electronic medium (compression of the electronic medium from the impact area), and afterwards, it will change the state of the atomic kernels (followed by their motion towards the direction of the kinetic flux generated by this composition). The atoms ensemble shall be moving after the collision (the "visible" external change) just after the completion of these transitory flux transfer processes exerted on the entire atomic inner structure. Finally, the motion generated as a result of the atom's collision interaction (the new fluxes resulted from the interaction process) shall be composed from two coherent kinetic fluxes (of the atoms after the collision). We have selected in this example two inert gas atoms due to regularity (spherical isotropy) of

[40] The same problem is at the landing of the current space ships, case in which it is very important to maintain an optimum angle at the moment of the entrance into the atmosphere (incidence angle), the deviation from this angle might lead either to the thermal destruction of the ship or to its reflection back into the cosmic space.

the electronic RBS for this kind of atoms, fact which simplifies the interaction process, the tangential components being reduced in this case (the equivalent of the elastic collisions between two balls).

If more external fluxes of the same kind exert a simultaneous impact on MS, the change of the external state shall be produced in the same way as the above-mentioned one, namely according to the direction of the common component of these fluxes (the resultant vector direction); if this common component is null (so-called equilibrium state), there is no external component which was generated for the output fluxes. Even maybe it is not necessary, we must remind that: in order to produce an action, the agent flux must be an open flux, whose flux lines would intersect RBS of the driven MS, and RBS to be permeable to that type of flux.

Definition 7.3.3: The material system which makes-up, or it is the source of the agent flux is named **the agent object** (or system).

Definition 7.3.4: The material system which is subjected to an action is named **driven object** (or system).

Any flux has a source - that is the stockpile - where it came from. As regards the emergent fluxes from MS (the ones who produce *fields*), the stock is represented by the fluxes internally stored. Since these emergent fluxes are open, they will be able to exert actions on the outer MS.

Definition 7.3.5: The mutual, bilateral process deployed between two MS whose emergent and identical fluxes are agent fluxes for the couple partner is named **interaction.**

Comment 7.3.2: The definition 7.3.5 contains the semantic value of the interaction notion in the "more sensitive" case of the remote interactions, through the fields generated by two MS. However, the same definition is also valid in case of the direct interactions (e.g.: by means of collision), therefore, we are dealing with a reciprocal flux exchange between two MS.

Definition 7.3.6: The two fluxes of the same type involved in the interaction process are named **interactive fluxes**.

Comment 7.3.3: Because it is always about a pair of fluxes, the utilization of the notion's singular (that is interactive flux) does not make sense, so neither does the interaction notion when we are dealing with an isolated MS.

Therefore, there is a double and simultaneous action process deployed in the interaction process, in which each of the MS that is part of this couple is at the same time an agent object on its partner and object driven by the pair partner. Any interaction process, no matter how complex it is, may be decomposable in bilateral interactions between MS couples.

Comment 7.3.4 This way of defining the concepts of *action* and *interaction*, which is specific to the objectual philosophy allows a proper understanding of all the interaction types which are found in the real world, both regarding the "physical" interactions between the abiotic systems, and the informational interactions between the biotic systems, ending with the complex political, military, economic interactions deployed between the state systems or (why not?) between the planetary social systems. If the first interaction types (the "physical" ones) have almost exclusively the energy fluxes as agent fluxes, in case of the bio-systems and systems made-up from bio-systems, the interactions are generated both by the energy and structural fluxes, and mostly by the informational fluxes which are made-up from the information support systems (ISS which shall be minutely approached in chapter 8).

In the current language, there is a difference between the abiotic and biotic world also concerning the notion of *state change* as a result of an action. If within the abiotic field, this change meant the variation of a physical state attribute (motion, temperature, pressure, etc.), according to the biotic field, the successive, external, "visible" state variations of a bio-system (the driven object) make-up its *behavior* as a result (effect) of the agent flux action, behavior which is characterized both by the physical components (motions, form and temperature changes, etc.), and by psychic components (changes in the field of the information fluxes which are stored inside the bio-system's IPS, which lead to changes of *psychic state*).

As for the "visibility" of the state change, the aspects are similar both for the abiotic MS and for the biotic MS: "visible" (observable by an outer IPS) may be considered those actions which produce changes in the *efferent* fluxes of the driven object, these fluxes being the unique support of the information on that particular object. There is also the additional request that the fluxes efferent to a MS to be included in the perception range of IPS, but all of these issues shall be minutely presented in chapter 8.

7.4 Interaction of the material systems

Taking into account a simple case, a group of two material systems MS_1 and MS_2 which are displayed in the figure 7.4.1, in which the circles represent the real bounding surfaces of the systems against the outside medium M_e, the arrows pointed on the circles are outer influxes, the arrows pointed on the outside are inner trafluxes (emergent, export fluxes), and the bent arrows from the inside represent (symbolically) the fluxes of each material system which are internally stored.

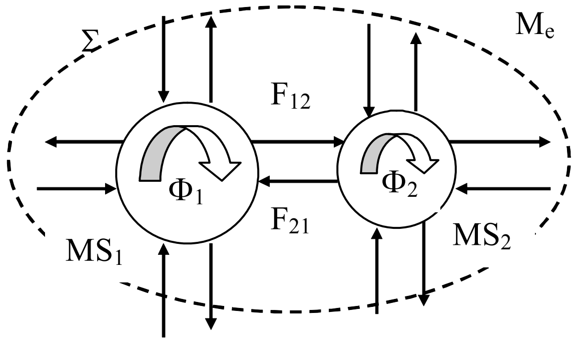

Fig. 7.4.1

For simplifying the figure, the arrows which symbolize both the outer influx and the inner traflux (emergent fluxes), must be considered as resultants along the direction of respective continuous distributions on RBS, of the FDV specific to the incident fluxes on RBS, and also emergent through RBS. From all the external influxes, only a fraction shall penetrate inside MS, the rest being reflected (returned to M_e). This part from the outer incident fluxes, the transmitted fluxes (import flux, external traflux) shall be added (vectorial summarization) to the initial stockpile of inner fluxes and, according to the sign of this sum, this stockpile shall be increased (compensating in this way the losses produced by means of the export fluxes), or shall be decreased.

Definition 7.4.1: The interaction which conserve or increase the inner flux stockpile of the interacting material systems (despite the losses due to the emergent fluxes) is named **constructive interaction.**

Obviously, there is also a situation when, as a result of the interaction, the inner flux stockpile of the involved MS drops, that is why we are dealing with a *destructive interaction.* Next, we are about to see that, for the formation of a stable MS, the interactions between its elements must be strictly constructive.

By analyzing the figure 7.4.1, it might be noticed that a specific MS is under the incidence of fluxes coming both from the outside of the unit (namely, from the outside of the theoretical surface Σ which surrounds the unit) and from the neighbour system. In this way, flux pairs reciprocally provided by MS may be observed. Due to simplicity reasons, we may consider that the fluxes released by the two MS are of the same kind ($k=1$), and RBS transmittance for this flux type of the two MS involved in the interaction processes are equal and of same value p. Therefore, we shall have:

- $\mathbf{F}_{12}$, emergent flux (export) of MS_1 and incident on MS_2, out of which $p\mathbf{F}_{12}$ shall be transmitted inside MS_2;
- $\mathbf{F}_{21}$, emergent (export) flux of MS_2 and incident on MS_1, out of which $p\mathbf{F}_{21}$ shall be transmitted inside MS_1.

The flux $p\mathbf{F}_{12}$ shall be composed (vectorial summarization) with the flux $\mathbf{\Phi}_2$, and the flux $p\mathbf{F}_{21}$ with $\mathbf{\Phi}_1$, that is a composition which must met several rules:

1) The composition of some distributions means the individual composition between all its constitutive elements (which makes-up interactive couples) of the two distributions, which means that the flux which is recently transmitted must be assigned (distributed) to all the elements of the previously stored flux.

2) The external state of MS (the action component which is "visible from the outside") is given by the common components of the flux resulted from the composition. Otherwise speaking, the driven MS is an object with an inner RS, and the outer state of this object is actually the state of the inner RS against the outer RS. Because the inner RS is unique for a MS, the state attributes of this RS shall be evenly distributed on all the MS elements, which means that they would be common attributes of these elements.

The flux composition conditions, correlated with the fact that the internally stored flux has a set of material objects which interact one another (a DS or CS) as its material support, tell us that a finite temporal interval is needed for this composition process, and that during this interval, the external state of MS does not change (the state before the inflow of the flux agent is maintained)[41]. The fact that the external state of a MS cannot be instantly changed, that it must be preceded by the internal state change and that a finite temporal interval is needed for this process, is a basic property of the material systems which is very clearly revealed by considering the flux triad model, more precisely, by the compulsory existence of the fluxes which are internally stored for each MS. Another very relevant aspect is that during the period necessary for the inner state change, the driven MS withstand to the agent flux, by means of an opposition manifested through a contrary flux deployed against the agent flux - *reaction flux* - which shall be described later on in this paper (see also annex X.7).

7.5 Inertia

The temporary opposition and the delay in the state change, currently known as *inertia*, is mainly due to the fact that an overall (external) state variation may occur only after this variation is transmitted (distributed) to all the system's elements which are found inside RBS. Since these elements interact one another, it must that the state variation to be propagated (to be transmitted from one element to another) along the entire set of the inner elements, propagation which always requires a finite time. But, since the SM model is obviously the same, regardless of their structural level, the inertia and implicitly, the opposition to change is also applicable to the elements with lower organization levels which are in the composition of a system. As it was mentioned above, within the opposition interval against the state change, MS responds to the action of the flux agent with a flux which is contrary to the agent one - the *reaction flux*.

Definition 7.5.1: The property of the material systems of changing the outer state (the action's external effect) only after the completion of the composition process between the traflux agent and the previously stored flux inside MS (that is the action's internal effect) is named **inertia**.

Comment 7.5.1: If we kick a ball with the foot, or a pool ball with the cue, in both cases, the incident flux is a coherent kinetic flux of the foot or of the cue, which are transformed at the impact with the driven object (which was initially considered motionless), in a coherent/stochastic flux (a pressure shock wave starting from the kicked area). Despite of this incident flux, the driven object would not be moved (but it would be locally deformed), up to the moment when the incident shock wave would have not been propagated towards the opposite wall of the impact area, propagation which means a distribution of the

[41] The external state of the driven MS shall be changed only after all the elements of the internally stored flux would have been composed (vectorial summarization) with the agent traflux, namely, after the change of the inner state of MS is completed.

immergent flux over all the elements of the inner medium of the driven object (transmitting motion), distribution which requires a finite temporal interval for its completion (as any other real process). The definition 7.5.1 is also valid with no restrictions for the actions in which information fluxes are involved, actions which are frequently found in the biotic world. In case of the bio-systems, an immergent data flux (we shall see in chapter 8 that that particular flux must be included into the perception domain of the inner IPS), shall initiate a processing of the information contained in that flux (process equivalent to a composition of fluxes), processing which means the comparison of this information with the already-existing (saved) information stock, and only after the completion of this process, the decision regarding the outer state modification may be taken, the behavior act released as a response to the incident flux (stimulus). As regards this temporal interval needed for the information processing (mostly concerning the processing which involves the central system - brain), as a result of the evolution, the advanced bio-systems have preserved for some information fluxes which show an imminent danger, requiring a fast response, a way of avoiding the normal information processing (which is time consumer, with high inertia level), by means of pre-programmed behavior acts, released by specific stimulus (reflex acts), which requires a much shorter time for its initiation, with only a low number of neurons involved.

At a first analysis, taking into account the general structure of a MS produced by the flux triad model, the result is that the quantitative value of the inertia property of a MS as compared to a *k*-type agent flux is:

– In direct ratio to the system's isolation degree as compared to the *k*-type external agent flux (the isolation degree regarding *k*-type flux is in inverse proportion with RBS permeability against *k*-type flux, and with RBS area). The higher is the isolation degree for an outer incident flux with specific density, the lower is the immergent flux and accordingly, the lower state variation will be;

– In direct ratio to the proper inertia of the inner elements of MS and to their number;

– In inverse ratio to the intensity and the temporal distribution of the interactions between the inner elements of MS (in case of the powerful and permanent interactions, the inner propagation rate of the state variations is higher, so the response is faster). If the number of the inner elements of a MS is known, as well as their type, and if they have their own inertia, in case they make-up a G medium and because this medium type has the lowest interaction rate (mediated throughout time), and therefore, the lowest propagation rate, MS inertia will be also higher as compared to the cases when the inner elements would make-up L or S-type systems.

Comment 7.5.2: As for the information interactions between people, it may be noted that the informational inertia (determined by means of the temporal interval between the impact of an information flux received by a person and the external behavior changes produced by that particular flux), is related to "the permeability" of the driven person to the information flux. A man which is cursed in its native language may have a fast and violent behavior reaction; the same man which is cursed in a language who does not know it, and in the absence of other visible hostile gestures, has an infinite inertia (lack of behavior reaction) which is due to a total isolation, because when a language is not known, this is the equivalent of a null permeability at the semantic component of the information flux released in that language. The state variation (behavior) at the same incident flux is different depending on the amount of the stored information fluxes (related to the education level and to the life experience), but also depending on the temper type of the individual (which may be equivalent with the type of inner interactions deployed between the organism's elements - nervous, hormonal ones - determined by the genetic legacy). If we are still referring to the information inertia domain, a rumor with the same interest degree (an agent information flux with the same intensity) shall be distributed on a set of human individuals which are engaged in a information interaction (possible communication), and it will generate a general opinion of the individuals (outer state) regarding the rumor's semantic content, in different ways, depending on the existing community type. Thus, in a rural settlement where the population is spread and the communication between families takes place only occasionally, the rumor propagation is much more slower (as well as the formation of a general opinion), as compared to the case of some company's employers which have closer and more frequent information interactions. These examples of information inertia in the field of the human bio-systems, which are much easier for the reader to understand them, have also a precise goal: if the agent information flux would be substituted by an energy flux, and the human individuals would be substituted by abiotic MS, we could better understand the explanation given for the "physical" inertia of these systems, stated by the objectual philosophy.

7.6 Energy

In order to reach to the energy definition, we shall be using a set of assertions which were built-up with the basic concepts from the objectual philosophy which were already introduced (premise-type assertions), followed by a reasoning - that is the definition.

7.6.1 Deduction of the energy definition

I) A MS is (according to the issues mentioned in chapter 3) an *object*, that is a collection of properties which are distributed on a single support domain (a finite interval belonging to 3D Euclidean space, limited by RBS of a MS), invariant[42] distributions, defined (determined) against an inner *reference system* (RS).

II) The systemic organization principle postulates that in the domain of abiotic MS, any MS is a compound object (that is decomposable), the object's components being also abiotic MS, but with other organization levels and with other support spatial domains (as a result of the division of the reference MS domain, by means of decomposition); these objects have specific inner RS which are related to the inner RS of the compound object, so on.

III) *The spatial position* (with quantitative values within its infinite existence domain - space) of a MS is a qualitative property, whose existential attribute is relative (determined by means of a relation) against an external RS, representing the inner RS position of a MS against the outer reference. The *n*-ranked variation of this position (motion process of MS) is also a property (derived from the first one) which is relative against the same outer RS. The spatial-temporal distribution of this motion property of MS is called *flux*; a state of this flux at a certain *t* moment[43] is an Euler distribution (a vector field).

IV) The inner motions of a MS are the position variations of its elements against an inner reference, variations which are maintained inside RBS of a MS (closed fluxes). As compared to an outer reference, the entire MS is moving only if its inner reference is moving. In this situation, (existence of a motion against an outer reference) we are dealing with two cases:

a) Position of the inner T reference of MS against the outer T reference is invariant; in this case, the inner translation motions of MS elements takes place so that the common component of all these motions is null (along the time interval when the position of the inner *T* reference is kept steady). In order to have a null common component, the inner T motions can be divided in two groups:

1) *coherent* but deployed on closed pathways (e.g.: circular, elliptical or oscillatory), in such case, the motion processes are periodical. The common T component of the inner motions is null if its computation interval is a multiplex, an integer of periods of any inner periodical process;

2) *stochastic* (non-periodic, but random as regards the velocity direction and modulus). As for this case, the outer T component is null if its computation is made for a temporal interval which is long enough so that the mean value of SEP directions to be null in that interval (scalarization of the motion SEP).

b) Position of the inner T reference is variable; in this case, the inner motions would have a common (coherent) component against the outer reference - motion of the inner

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[42] When we are referring to invariant distributions, they must be understood as distributions of specific attributes which can be invariant, flux distributions (such as for instance Euler distributions of the stationary fields, spatial distributions of the atomic orbitals etc.).

[43] According to the objectual concepts, *t moment is the inner reference of a temporal finite interval* Δt, interval with a size allowing the motion process, but at the same time, the inner distribution of the motion process density to be considered as uniform.

reference - which shall be added (vectorial summarization) to the inner preexisting motions (it shall be evenly distributed on the set of the MS's inner elements).

Definition 7.6.1.1: The qualitative property of „to move" owned by a MS (to have a velocity different from zero) against a RS is named **the energy** of a MS against that RS.

Comment 7.6.1.1: As I have also mentioned on other occasions, according to the present paper, any property of an object has two components: *qualitative* component, which is conjointly associated with the *quantitative* component (attribute quantity which is contained by the object). The above-mentioned definition is valid for the qualitative component of the *energy* property, otherwise speaking, if there are two bodies out of which one is moving against a common external RS and the other one is motionless, we know that the body which moves has energy (against that particular RS) and the steady body does not have energy, without being able (at least for the time being) to specify the amount of this property for the moving object. As it was pointed out at the third assertion, a distributed motion is a flux, therefore, a MS flux is inseparably related to the existence of the energy distributed on the MS set, and their energy is conjointly related to the existence of their motion. On the other hand, definition 7.6.1.1 clearly underlines the significance of the reference system against which the energy is evaluated (as any other property); as compared to an absolute reference, the energy of a MS is made-up from the energy of all the motion types of the material system which can be determined against such a reference. This fact also means that for any distinct motion type of a MS, we would be able to assign (merely formal) an energy type, although these energy types are only facets of the same property given by the definition 7.6.1.1. If there is also a common velocity (group velocity) of a compound MS, an energy related to that velocity exists as well, and it is distributed along all the elements of the MS (if the elements are identical, there will be an even distribution).

We have seen that any MS has a triad of material fluxes in its structure. But, the *material flux* means the motion of MS and their motion means energy. The energy necessary for maintaining the fluxes (energy demand) cannot be created "from nothing", but it can be taken either from its storage zones (the energy of the stored fluxes inside MS at the moment of its formation), or from the outer open fluxes which are already found outside MS (the photon fluxes coming from the Sun and falling down on the Earth surface, thermal fluxes inside the planet, water fluxes (rivers, streams, tides), air fluxes (wind) so on.

The release processes of the energy stored inside MS means the conversion of a part from the inner fluxes (the external inactive ones been closed fluxes) into active open fluxes which are able to transfer their energy to other MS. This conversion takes place either at the atomic level by means of the chemical reactions, or at the nuclear level, by means of the nuclear reactions, or at the level of complementary equal-mass EP, through the annihilation reaction. Dissociation of a specific type of MS with a certain structure may be found at the basis of most of these processes, followed by the formation of other MS with a lower energy stock from its components. In chapter 3, we have discussed about the *generating processes*, stating that no attribute of an object can occur (which means that it must have a non-zero quantitative attribute) unless a specific generating process is produced. The energy of a MS is a property, so that it must also have its specific generating process.

AXIOM III (axiom of the energy source of a MS): The property of a MS to move (of having an external energy) is exclusively obtained through the action of a flux on MS (by taking over the energy from other MS which already own this property) and it is also lost as a result of an action (by transfer of this property to other MS).

Comment 7.6.1.2: Axiom III is founded under various forms to most of the materialistic philosophies (non-creationistic) and according to the current physics, it is also known as the *principle of energy conservation*. It tries to avoid some basic questions which have not been answered so far: If the energy cannot be generated from nothing, being possible only the redistribution of an already-existing energy, how did this energy (which is considered invariant in some conditions) occur? What is its generating process? Which is the reference system against which this constant energy stockpile can be evaluated?

Therefore, the energy of a MS is considered as an exclusively transmissible attribute, which means that, in case of a given object with an intact and stable inner structure, that particular attribute may be generated only from the outside, from other objects which already have it (outer fluxes) and which will be transmitted in a certain ratio to the driven object, if those fluxes cross through RBS of the object.

In the present paper, the energy transfer from one MS to another shall be named *transaction*. This term (minutely described in annex X.10) has the same semantic value (meaning) within the value fluxes field, as the word *interaction* within the field of energy or information fluxes. The bilateral transactions, as a property (attribute) exchange between two partners, require the existence of two situations (states) of the attribute amount owned by the two partners: 1) *before* the transaction, and 2) *after* the transaction. Let us presume that in the *before* situation (state), the two objects Ob_A and Ob_B have an inner distribution of the quantities e_{A1} and e_{B1} of the attribute E (energy). After the transaction (of the exchange, interaction process) completion, the two objects shall reach the quantities e_{A2} and e_{B2} of the energy attribute. Depending on the specific quantitative energy variation during the transaction, the energy stockpile of one of the two objects may be higher or lower than the initial one, after the transaction completion; if the energy stockpile is higher, this means that the transaction was *favorable* (constructive) for that object, and on the contrary, *unfavorable* (destructive). The principle of energy conservation (which shall be analyzed later on) states that if the two objects are considered to be isolated from other external actions and loss fluxes, the total energy (amount of the two energy values owned by the two objects) remains invariant. Because the transferred energy is carried by a flux from one object to another, the fluxes which have only the energy as their transported property (which concerns us and which shall be transmitted to the objects with whom the flux interacts) shall be named ***energy fluxes*** (EF).

Comment 7.6.1.3: Even if a flux carries a set of properties, only the transmissible qualitative attribute called *motion* (with its existential attribute[44]- that is *velocity modulus*) is relevant for EF. In case of a flux which carries more properties of some MS, we might say that this flux has always an *energy component*.

Based on the assertion that the outer energy of a MS which was already formed and in stable state may come from the outside only, the validity domain of the energy conservation principle from the current physics may be therefore estimated: *The total energy amount of a set of material objects may be conserved if only the set (system) is completely isolated from external influences (fluxes)* (which may extract from, or supply energy to the system), and if the *emergent fluxes* (losses through fields) *from the set are null.* A particular likely case of energy conservation (but only of the energy stored in the system) is represented by the systems where the input energy fluxes are equal to the output ones (such as the perfect equilibrium between system and external medium). Another additional specification is required in this case, namely, only the inner energy of the system is conserved and only during the existence of the equilibrium state.

7.6.2 Energy types

There are a lot of "energy forms" depicted in the nowadays scientific literature. We should discuss a little bit about the term of "energy form" because, at least apparently, there is a contradiction between this term and the assertion specific to this paper which states that all the known energy forms have a common component - that is the motion of MS. When we have presented the material fluxes, we saw that a flux like this implies an energy as an overall property of all MS involved in the motion process, that is a property evaluated by considering a reference system. This flux meant a spatial distribution of some MS which were moving in bulk with a common component of the velocity (if this component really exists), and with specific components of the velocity per each MS involved in this flux (evaluated against a common component as reference). The flux's overall energy means the gathering of all the

[44] Attention! We are talking about the existential attribute of the motion and not of the energy

individual energies of the flux elements, otherwise speaking, each of these elements is an *energy carrier* (there is a distribution of the overall energy on the elements involved in flux).

Well, since these energy carriers can be all kind of MS (with various organization levels) the fluxes in which these objects are involved shall have different denominations. On the other hand, the fluxes may be also classified as propagation or displacement, coherent or stochastic, therefore, for each flux with different attributes, a specific energy "form" is associated, according to the current language.

The energy of a MS is a property of a complex object, which means that it is decomposable by means of distribution on the organization levels (in an analytical sense) of this object against a reference level[45]. Let us assume that there is a motionless MS against an outer reference, let us say SM_k and that it has an analytical structure level *n* which means that it has other MS with organization levels *n-p* (*p=1, 2, ...n-1*)[46] in its inner structure, which move against the inner reference of SM_k, but their motion occurs inside RBS of MS_k. These inner MS shall have an energy different from zero both against the inner reference and against the outer one (because the inner MS moves also against the outer reference, but their motion is imperceptible from the outside of MS_k, or otherwise speaking, the coherent component common to all the internal fluxes is null against outer reference, but its specific components are non-zero). These inner fluxes which are closed in RBS of MS_k, have associated energy values whose overall sum of all its elements provides the total internal energy of MS_k, but this energy is not directly transmissible to other MS outside MS_k.

Definition 7.6.2.1: The associated energy of the closed (stored) material fluxes inside RBS of a MS is **the inner** (internal) **energy** of that MS.

Comment 7.6.2.1: The inner translation, rotation, vibration, deformation motions etc. are inner motions of MS elements; therefore, these motion types would be related to inner energy forms of MS, specific components to the elements or to the group of elements found in the composition of that MS, non-transmissible (stored) energy, under the form of closed EF inside RBS of MS. The bonding energy (such as nuclear, ionic, covalent, Van der Waals-type etc.) may be also included in the same class of the inner energy variety, being stored into the interchange (interactive) fluxes deployed between the elements of a MS, as well as the rest energy or the thermal energy in case of the thermally insulated MS. All the inner energy versions have a general feature - are energies stored in closed fluxes inside a MS.

If MS_k which was mentioned earlier shall be moving against an outer reference SR_e with a constant velocity $\overline{v}_e$, this velocity being the speed of the inner T reference of the object, $\overline{v}_e$ shall be evenly transmitted to all the inner elements of the system, therefore, it will be a common component on the set of the inner elements, and this component may be transferred to other outer MS (because it is an open flux). In this case, the individual velocity of the inner elements shall be vectorially composed with common velocity. We have seen in the previous chapters that the motion of some MS with the same velocity is associated with a *coherent flux*.

Definition 7.6.2.2: The energy associated to the coherent material fluxes is named **kinetic energy**.

Comment 7.6.2.2: For a vigilant reader, the *kinetic energy* term is a pleonasm if we take into account the definition 7.6.1.1 which is given to the energy and the etymology of the word *kinetic* (derived from the Greek term *kineticos* - which is moving). This term was kept in the present paper only due to historical reasons and for a gradual transition to the terms used in the classic physics and within the objectual philosophy. When we have defined the coherent fluxes, we noticed that these fluxes may have coherency degrees. In case of the translation fluxes defined through the common velocity of the inner T reference of the flux objects, with an even distribution of this velocity on the object's inner elements, the flux is entirely coherent (more exactly, component T of the flux is totally coherent). In this case, the energy associated to this totally coherent translation flux (known as *impulse*) is a *translation kinetic energy*. In case of some coherent rotation fluxes of an object around a common axis, the coherency degree is lower

[45] This time, we are dealing with a reference for the organization level of MS and not with a RS for the motion evaluation.

[46] MS with the unit analytical organization level, being that "basic" MS about which we do not have available information on its inner structure any longer.

(only the axis, direction and the angular speed remain invariant) but it will also be the kinetic rotation energy with a non-even distribution because the velocity is also non-evenly distributed. Attention! Since the rotation kinetic energy is associated to a closed flux, at the same time, this is an inner energy form of a MS under rotation, because all the flux lines are closed into RBS, generated as a result of the object's motion (see the example from the section 7.2.5). The partial coherent fluxes are also the propagation fluxes, the wave front moving towards a specific direction by carrying the energy variation contained in this front with the propagation speed.

Now, it is time to analyze what is happening with the stochastic fluxes, more precisely, in case of a G medium made-up from the molecules of a gas placed in a container. Inside this medium, there is a set of corpuscular and coherent elementary fluxes (coherent only at the molecular level), but which they do not have a common component at the set level (of Euler distribution of SEP in a given moment), which means that the set of objects which are engaged in an irregular motion does not have a global motion against an outer reference (the gas enclosure is motionless). During their motion, the molecules will collide both each other and with the enclosure's wall (global RBS), their flux lines being Brownian, random motions which are closed into the global RBS, the total energy which is associated to these motions is the inner energy (baric) of the gas contained in the recipient. The molecular fluxes into G-media are T+R fluxes, but the component R is momentarily let aside because it has a low influence in the interaction processes (the component T prevails because it is an open flux). The elementary (molecular) fluxes are therefore kinetic energy fluxes, but they do not have a common component, but only specific properties (directions, intensities, etc.) Otherwise speaking, the kinetic energy is found in the total set of the gas molecules, without the existence of a common motion of this set.

Definition 7.6.2.3: The kinetic energy distributed on the set of the elements belonging to a stochastic material flux which is under an overall rest[47] state against a RS, is named **the potential energy** of that flux.

Comment 7.6.2.3: The fact that, according to the objectual philosophy, the potential energy has also a kinetic energy as "its origin", but an energy which is distributed on elementary fluxes with stochastic global distribution, will help us to coherently understand "the mechanism" of the forces generation within the motionless material media, but which own an uneven distribution of the energy density on each element. This is possible even for the gravitation force, electric force etc., but with one condition - we must accept that these forces are generated as a result of a kinetic energy which is found at the level of the medium's element. Another major amendment of the concepts from the physics which comes from this definition is the one related to what (or who) owns this potential energy. According to the current physics[48], an object which is in a rest state against a RS (considered as absolute) may have *potential energy* if it is under the action of an energy field, namely, in a space where there is a stochastic energy flux with an uneven flux density. As compared to this approach, the present paper asserts that it is not the body which owns the potential energy, but the support medium of the stochastic flux placed around the body, and which, as a result of the interaction with that body, shall convey to that particular body a part from the energy stored in the medium at the initial spatial position, and in case that body is free, that energy shall be turned into kinetic energy (coherent flux). The energy transfer between the medium and the body shall continue as long as there will be a gradient of the energy density at the body's spatial position.

When we talked about the general MS model proposed by the objectual philosophy (3**F** model), we saw that any MS has a set of output fluxes (see paragr.7.2.4), fluxes efferent from MS which determine the existence of the fields generated by that MS, according to the definition 7.2.4.2. Based on this definition, the *k*-type field of a MS is given by the spatial-temporal distribution of the emergent[49] *k*-type flux from MS. But, as it was already mentioned so far, a flux cannot exist without being related to an energy, otherwise speaking, *k*-type flux has a specific field energy distributed across its entire existence range, and this energy has an uneven density which (in case of an isotropic spatial distribution against the inner RS of MS) varies in inverse ratio to the distance towards the source MS.

[47] Overall rest of a stochastic flux (against a RS) occurs in the situation when the common component of the stochastic flux's elements is null, which means that there is no global flux motion against RS (see annex X.12 which defines the global state, and Annex X.17 for the vector fields case).

[48] R.P. Feynman – *Fizica Modernă* vol. I, Editura Tehnică, Bucureşti, 1969.

[49] The reflected fluxes which are also field generators, are momentarily let aside.

Definition 7.6.2.4: The energy associated with the *k*-type emergent flux from a MS (flux whose spatial-temporal distribution makes-up the *k*-type field of a MS) represents the **total energy amount of k-type field.**

Comment 7.6.2.4: The above-mentioned definition asserts that the energy related to a field generated by a MS, field which in theory, goes to infinity, it is not finite either. Indeed, the *k*-type field of a MS is continuously supplied through the emergent k-type flux, coming from the fluxes stored inside MS, starting at the moment of MS generation, and the stored fluxes are also supplied by the input fluxes of MS (coming from the outside). As long as these processes keep going, the existence of a MS will also continue, as well as the existence of its fields. As it was mentioned in section 7.2.4, the emergent fluxes from a MS, with its associated fields, are able to exist during finite time intervals even in the absence of the input fluxes, that time interval is the lifespan of a MS concerning that flux type. If we are making an extreme simplification of a MS given by the flux triad model, we may find that a MS is nothing but a common flux converter, which turns the convergent fluxes on RBS (outer influxes) or through RBS (outer trafluxes) into divergent fluxes through RBS (inner trafluxes) or on RBS (outer refluxes).

Because the *k*-type flux is at least partly coherent (having an invariant direction - from MS to the outside) and open, some of its energy may be transmitted to any MS with whom it intersects to, therefore it can generate actions.

7.6.3 Relation between the flux type and the contained energy form

The current technical-scientific literature deals with a lot of "energy forms", forms which, according to the objectual philosophy, are associated either with various types of existing material systems which contain energy (such as EP, AT, MO, missiles, AB etc.), or with various types of individual motion deployed by these MS (translation, rotation, vibration etc.), or with the collective motion types which are specific to the objects (coherent or stochastic fluxes), or with the fluxes produced by these objects (their fields), or with the spatial zone where the energy of a MS is stored (inner energy), so on.

We shall further present some of the relations between the flux types (according to the terminology used in this paper) and the associated energy form from the current terminology, not before making some specifications on some of additional fluxes denominations. In the chapter focused on fluxes, we have seen what are the *coherent* and *stochastic* fluxes, *displacement* or *propagation* fluxes*, closed* or *open* fluxes or the flux with invariant (isotome) or variable effective section, but we still need to introduce some new terms concerning the temporal distribution of fluxes.

If the flux attributes (flux type, direction, intensity) remain invariant during a given interval of time, we may say that the flux is *permanent* or with a *continuous existence* (with an even mean temporal distribution) in that interval. If there is a flux characterized by the simultaneous co-existence of a permanent stochastic and a permanent coherent component, we shall call it *permanent coherent/stochastic* flux. If the flux attributes are periodically changed (either as a flux type or as direction and intensity) we shall be dealing with an *alternativ*e or *periodical* flux. For example, a flux which alternatively changes its type from coherent into stochastic and vice versa shall be referred to as *alternative coherent/stochastic* flux.

Here are few concrete examples of flux types and their associated energy forms:

∗ *Continuous coherent* flux (permanent) of MS displacement: *kinetic energy*. For example:

− Coherent[50] and continuous flux of monochromatic photons: *electromagnetic energy* (such as the energy of a continuous laser);

[50] Here, the "*coherent"* attribute refers to the motion coherency and not to the photon's frequency coherency.

– Coherent and continuous flux of EP into a particle accelerator, kinescope or electronic microscope: *kinetic energy* of the particles associated with the *electromagnetic energy* derived from their motion.

∗ *Continuous* (permanent) *stochastic* flux of MS: *potential energy*; only a particular case is worth mentioning here:

– Stochastic molecules (atoms) flux: *baric potential energy* (static pressure);

∗ *Alternative* coherent/stochastic flux: *kinetic/potential energy* of a local propagation or oscillatory process;

∗ *Permanent* coherent/stochastic flux (stochastic flux with a coherent component), with few particular cases:

– Permanent coherent/stochastic atoms (molecules) flux: *kinetic and potential energy* of a fluid stream (kinetic energy of the molecules flux with common velocity, potential energy of static pressure of the molecular medium;

– Permanent coherent/stochastic flux of electrically-charged particles (EP or ions): *electromagnetic energy* (the electric current with its fields), so on.

Comment 7.6.3.1: The reader has probably noticed that there was no specification on the thermal energy, which energy still belongs to the potential energy category, and that is because the objectual philosophy model for this "energy form" is much more different than the model used in the current thermodynamics. The thermal energy shall be approached in annex X.24.

After this foray through the most notorious types of material fluxes, each of them having a specific associated "energy form", this would make easier the understanding of the reason for making a generalization adopted by the objectual philosophy and expressed by means of the following principle:

Principle of the energies unification: Any form of energy existence have <u>a motion of the material systems</u> (material flux) as its material support.

Comment 7.6.3.2: This principle must be understood by taking into account the systemic organization principle, described in chapter 1, which means that for any form of energy known so far, a related organization level of NAMS (in analytic sense) can be found, so that the particular MS to be the carriers of that energy form.

7.6.4 The energy's existential attribute

When we have dealt with the distributions in chapter 2, we noticed that the cumulative attributes which are distributed on a support domain (inner domain of a material or abstract object) have a global attribute - the total attribute amount existing inside the object (stock). The energy is also such a cumulative attribute, which can be contained (stored) only inside a MS and this attribute may result only through the transfer from other MS.

As we are about to see in the following chapter, the existence or non-existence of the energy attribute stockpile of a specific MS (existential, quantitative attribute of energy) is indirectly determined by an IPS, by assessing another attribute X which is included in the perception range of its input units, which depends through a specific relation on the energy stockpile from the monitored MS. This attribute which may be directly perceived by IPS (or measurable due to the auxiliary means) is an *energy state attribute* of MS.

According to the sections 7.6.2 and 7.6.3, a lot of N "energy forms" are known so far, each of these forms being related to a specific energy state attribute X_i $(i \in [1, N])$, and the numerical value of this attribute is in direct ratio to the energy amount from a specific MS. In other words, there is a dependence relation[51] between the value of the energy state attribute X_i and the value of the energy stockpile of the object:

[51] Due to simplicity reasons, the dependence relations are considered as continuous functions.

$$E_i = f_i(X_i) \tag{7.6.4.1}$$

Few of these dependence relations of the existential attribute specific to the energy stockpile for various “energy forms” are briefly presented next.

7.6.4.1 Energy’s computing relations

1. At the acceleration of a mass body m against its inertia, from the rest state up to the velocity v, a mechanical work must be exerted which may be found afterwards as kinetic energy:

$$E_c = \int_1^2 \overline{F}\,d\overline{s} = \int_0^v mvdv = \frac{1}{2}mv^2 \tag{7.6.4.1.1}$$

2. The mechanical work exerted on a body is equal to the variation of its kinetic energy:

$$W_{12} = E_{c2} - E_{c1} \tag{7.6.4.1.2}$$

3. The mechanical work performed by a conservative force $\overline{F} = const$:

$$W_{12} = \int_1^2 \overline{F}d\overline{r} = \overline{F}\overline{r}_2 - \overline{F}\overline{r}_1 = E_{p2} - E_{p1} \tag{7.6.4.1.3}$$

Therefore, in case of the gravitation force $\overline{F} = m\overline{g}$:

$$W_{12} = -mgh \tag{7.6.4.1.4}$$

4. Each mass element of a rigid body which is spinning with an angular speed $\overline{\omega}$ around an axis, has the following translation velocity:

$$\overline{v} = \overline{\omega} \times \overline{r} \tag{7.6.4.1.5}$$

and a kinetic energy:

$$dE_c = \frac{1}{2}v(r)^2\,dm = \frac{1}{2}\omega^2 r^2 dm \tag{7.6.4.1.6}$$

The total rotating kinetic energy of a body with the volume V is:

$$E_c = \frac{1}{2}\omega^2 \int_V r^2 dm \tag{7.6.4.1.7}$$

where the expression within the integral does not depend on ω, but it is an amount related to the matter’s inertia property at the rotation around an axis, that is why it is referred to as *inertia moment*:

$$J = \int_V r^2 dm = \int_V \rho(r) r^2 dV \tag{7.6.4.1.8}$$

Finally, the rotating kinetic energy of a body is:

$$E_c = \frac{1}{2}J\omega^2 \tag{7.6.4.1.9}$$

5. The external mechanical work required for the displacement of charge q from r_1 into r_2 with the force $-qE$ against an electrostatic field complies with the energy’s theorem:

$$W_{12} = \int_1^2 \overline{F}d\overline{r} = -q\int_1^2 \overline{E}d\overline{r} = E_p(r_2) - E_p(r_1) \tag{7.6.4.1.10}$$

and by taking into account that the electric potential is:

$$V(r) = \frac{E_p(r)}{q} \tag{7.6.4.1.11}$$

resulting that:

$$W_{12} = q(V(r_2) - V(r_1)) = qU \tag{7.6.4.1.12}$$

where the potential difference U is the *electric voltage*.

6. The energy gained by a charge carrier q placed in electric field, as a result of the acceleration under the voltage U, is qU and in case of N carriers it is $NqU=QU$. By means of $Q=I\cdot t$ (where I is the intensity of the electric current) the following values are obtained for the mechanical work under an electric field:

$$W = QU = U\,I\,t \tag{7.6.4.1.13}$$

7. A plane capacitor made-up from two conducting plates with an area A, between which there is a dielectric with electric permeability ε and thickness d has the capacity:

$$C = \varepsilon \frac{A}{d} \tag{7.6.4.1.14}$$

The energy W_c stored in this capacitor, equal to the charging mechanical work, is obtained as a result of the integration from $q=0$ to Q, respectively, from $u=0$ to U and it is:

$$W_C = \frac{1}{2}\frac{Q^2}{C} = \frac{QU}{2} = C\frac{U^2}{2} \tag{7.6.4.1.15}$$

8. For creating a magnetic field generated by a coil with the inductance:

$$L = \mu \frac{N^2 A}{l} \tag{7.6.4.1.16}$$

where μ is the magnetic permeability of the medium inside the coil, A its inner area, l coil's length and N its number of spires, the current i must increase from the value $i=0$ to the final value I. The electric current i must be supplied by an external voltage source u which is in the opposition with the self-induction voltage u_i (Lenz rule):

$$u = -u_i = L\frac{di}{dt} \tag{7.6.4.1.17}$$

The mechanical work exerted in the interval dt, for this purpose, is:

$$dW = u\,i\,dt = L\,i\,di \tag{7.6.4.1.18}$$

The total mechanical work is equal to the energy W_L stored in the magnetic field, according to the energy conservation principle. The expression which results through integration after i from $i=0$ to I is:

$$W_L = \int_0^I L\,i\,di = \frac{1}{2}LI^2 \tag{7.6.4.1.19}$$

Comment 7.6.4.1.1: In the electrotechnics field, the following expression is used for defining the electromagnetic volume density, being considered as a postulate[52]:

$$w = \tfrac{1}{2}\overline{E}\,\overline{D} + \tfrac{1}{2}\overline{H}\,\overline{B} \tag{7.6.4.1.20}$$

where E is the intensity of the electric field [V/m], D is the electric flux density [As/m^2], H the intensity of the magnetic field [A/m], and B the magnetic induction [Vs/m^2], resulting w in [Ws/m^3]. By using the relation 7.6.4.1.20, we may issue the following formula for defining the energy stored in an electric capacitor (under the assumption of an uniform field):

$$W_C = \tfrac{1}{2}CU^2 = \tfrac{1}{2}\varepsilon\frac{A}{d}(Ed)^2 = \tfrac{1}{2}\varepsilon E^2 Ad = w_e V \tag{7.6.4.1.21}$$

where V is the dielectric volume.

Taking also into account that $L = N\Phi/l$, $\Phi = \mu HA$ and $H = NI/l$, there is the following result, valid for the magnetic energy from a coil:

$$W = \tfrac{1}{2}LI^2 = \tfrac{1}{2}N\Phi I = \tfrac{1}{2}\mu HAN\frac{l}{N}H = \tfrac{1}{2}\mu H^2 Al = w_m V \tag{7.6.4.1.22}$$

where V is volume of the magnetic material or the internal volume of the coil.

9. The photons energy, stated by Plank, was settled under the following hypotheses:

[52] **K. Simonyi –** *Electrotehnica teoretică,* Editura Tehnică, Bucureşti 1974

a) The radiation of an empty enclosure is given by the radiation of the oscillators which make-up the enclosure walls which are under an equilibrium with the radiation field from the inner empty space (defined by the Maxwell's equation).

b) The oscillator's energy is quantified according to the following relation:

$$E_n = nh\nu \ \ (n=0,1,2,...) \tag{7.6.4.1.23}$$

c) The oscillators emit radiations only at the variation of their energy state. On this occasion, energy is either emitted or absorbed from the radiation field, under the form of amplitude quanta:

$$\Delta E = h\nu \tag{7.6.4.1.24}$$

10. The state equation of the perfect gas is:

$$pV = nRT \tag{7.6.4.1.25}$$

where p is the pressure, V the enclosure's volume, n the number of gas moles, $R=8.31451$ J/mole·K is the universal gas constant and T is the gas temperature.

11. The heat quantity required for the temperature increase of a mass body m from the initial temperature T_1 to the final temperature T_2 is determined by means of the calorimetric relation:

$$\Delta Q = mc\Delta T \tag{7.6.4.1.26}$$

where c is the specific heat (depends on the body material) and $\Delta T = T_2 - T_1$ is the temperature variation. It is required that no phase transition of the body's structural material to be produced in the interval ΔT.

7.6.4.2 Relations' objectual analysis

Only few relevant computing relations of the energy were mentioned in the previous section, their number being much higher in the technical-scientific literature. However, by considering this reduced number of relations, the existence of several relations *classes* may be easily observed.

The first class of the energy's calculus relations includes relations such as:

$$E = C_1 X^2 \tag{7.6.4.2.1}$$

in which X is the energy state attribute. This class may also include relations such as:

$$E = C_2 XY \tag{7.6.4.2.2}$$

because the state attributes X and Y are interrelated, which means that $Y=C_3X$. C_1, C_2 and C_3 are considered to be constants. The qualitative attributes X and Y have existential attributes which ranges from zero (non-existence) to a value different from zero, and, as a result of this variation, an energy accumulation (stockpile) is generated, which is placed in a specific volume.

Another class of relations used for the energy calculus comprises relations such as:

$$E = C_4 Z \tag{7.6.4.2.3}$$

where Z is also an energy state attribute.

According to the analysis of the above-mentioned energy's calculus relations, there are few remarks which can be made:

1. The first remark on the energy's computing relations is that, that particular energy is stored into a material medium:

– In case of the kinetic energy, we are dealing with a medium having a mass density ρ_m from the volume V of the moving object;

– In case of the electric energy, we are dealing with the medium having a dielectric constant ε and a volume V placed between the capacitor's electrodes;

– As for the magnetic energy, we are dealing with a medium having a magnetic permeability μ and a volume V in which the magnetic flux of N spires-solenoid is confined;

– In case of the thermal energy, we are dealing with a medium with volume V, mass density ρ_m and heat capacity c confined in a thermally insulated enclosure, so on.

2. The second remark is that the presence of an energy stockpile into the material medium with known attributes is externally represented („visible", measurable) by a qualitative attribute of *energy state*, whose existential attribute is in direct ratio to the energy amount stored inside that particular medium:

– In case of the kinetic energy, the state attribute is the velocity v of the moving object;

– In case of the electric energy stored in a capacitor, the state attribute is the voltage U between the armatures;

– In case of the magnetic energy stored inside a solenoid, the state attribute is the intensity I of the current which runs through that coil;

– In case of the thermal energy, the state attribute is the temperature T from the medium which stores up the heat.

– As for the baric energy, the state attribute is the pressure p from the medium with a volume V, so on.

3. The third observation is that, in the computing relations, for each energy type and accordingly, for each energy state attribute, there is also an associated term which does not depend on the state attribute's value, and these are the constants[53] C_1 and C_4. These constants are specific to each MS type whose energy must be determined, their value (existential attribute) depending on two factors:

– The inner volume of the energy's storage medium;

– Medium type which may be found in this volume and its energy's storage parameters.

Although they represent specific properties to each type of MS able to store energy, these constants have two common models, therefore, they are making-up two classes of abstract objects; but any class of objects must have a name. In case of the energy forms which may be computed by using the relations from the class 7.6.4.2.1, the following definition is issued:

Definition 7.6.4.2.1: The amount $K^{''}$ which is equal to the density of the second rank derived distribution of energy, on the abstract support of the energy state attribute, is named **second rank energetic capacitance**.

$$K_i^{''} = \frac{d^2 E_i}{dX_i^2} \tag{7.6.4.2.4}$$

And for the energy forms which may be computed by using the relations from the class 7.6.4.2.3, there is the following definition:

Definition 7.6.4.2.2: The amount $K^{'}$ which is equal to the density of the first rank derived distribution of energy, on the abstract support of the energy state attribute, is named **first rank energetic capacitance**.

$$K_i^{'} = \frac{dE_i}{dX_i} \tag{7.6.4.2.5}$$

Attention! According to the definitions of the energy capacitance, we are dealing with the abstract support of a distribution (domain of the energy state variable), not with the energy's material support.

[53]Momentarily, we are focused on the simplified case in which C_1 and C_4 are constants.

If we shall consider for *i* (strictly formal) the index values of the examples from the section 7.6.4.1, in case of the kinetic energy *i=1*, therefore $X_1 = v$ and $E_1 = E_c$ is the kinetic translation energy of a MS. In this case, $K_1^{"} = m$, and the energy's primary distribution on the state attribute is the well-known relation $E_1 = E_c = \frac{1}{2}mv^2$. As for the electrostatic energy stored in a capacitor, $i = 7$, $X_7 = U, K_7^{"} = C$, for the kinetic energy stored within flywheels $i = 4$, $X_4 = \omega$, $K_4^{"} = J$, and for expressing the magnetic energy stored into a solenoid $i = 8$, $X_8 = I$, $K_8^{"} = L$, so on.

As regards the energy's computing relations from the class 7.6.4.2.3, in case of $i = 11$, there is $X_{11} = T$, $K_{11}^{'} = mc$, and for $i = 9$, $X_9 = \nu$, $K_9^{'} = h$.

Comment 7.6.4.2.1: One of the most significant conclusions of this systematization of the energy's computing relations is that the inert mass is a second rank capacitance of kinetic energy storage. When the reader will understand the role of capacitance established by the objectual philosophy for the mass of a MS, then, he will also probably understand that a mass-energy equivalence is not possible, but only a direct proportion (dependence) relation between the two attributes. The ones who believe in the mass-energy equivalence are invited to analyze the equivalence between the capacitance of an electric capacitor and the energy stored inside it, or between the capacitance of a recipient and the liquid inside it, according to the comment 7.6.4.2.2 (#).

One significant observation must be made concerning the meaning difference between the terms *capacitance* and *capacity*. According to the current language, the capacity (such as the capacity of a recipient) is considered to be a maximum quantity (a stock) of a certain substance which may be contained in a recipient, whereas the capacitance, as it was above-mentioned, is a density of a distribution. Since the stockpile of a distribution cannot be mistaken with its density, neither the capacity must be mistaken with the capacitance.

Comment 7.6.4.2.2: As an example, let us consider the simple case of a cylindrical pot with a volume *V*, in which a liquid with mass density ρ_m is being introduced. The liquid quantity *Q* from the pot is given by:

$$Q = \rho_m A h \qquad (7.6.4.2.6)$$

where A is the area of the pot basis and *h* is the liquid level (the outer state attribute of the liquid stockpile). If the fluid density is constant and the maximum level is *H*, that is the total height of the pot, this means that a maximum fluid quantity can be contained in that recipient:

$$Q_M = \rho_m V \qquad (7.6.4.2.8)$$

quantity which determines the pot *capacity,* that is its manufacturing constant feature. In case of a liquid, by considering a variation of the inserted quantity ΔQ, the state attribute varies with a Δh quantity, also according to the relation 7.6.4.2.6, so that:

$$\frac{\Delta Q}{\Delta h} = \rho_m A = K^{'} \qquad (7.6.4.2.9)$$

where $K^{'} = \rho_m A$ is the variation of the liquid quantity from a pot which is related to an unit level variation, an amount known as *capacitance* (first rank) of the pot in connection with the state variable *h*.

Another remark concerns the rank of the capacitance of a MS, with the specification that the term *capacitance* can be also used for other stored attributes beside energy (as I have pointed out in the comment above). For example, in case of the electric capacitors, the energy capacitance is C (improperly referred to in the technical literature as capacity, see the comment 7.6.4.2.2). If the distributed (stored) attribute is the electric energy and the support (state) attribute is the voltage *U*, this is a second rank capacitance. If the stored attribute is the electrical charge and the support attribute is also the voltage, the capacitance C is only a first rank one (according to the relation $\Delta Q = C\Delta U$). The meaning of the two capacitance types comes from their specific definition relations: the first or second rank variation of the stored attribute which corresponds to a unit variation of the state attribute.

7.6.5 Composition of the energy fluxes

According to the description of the generic model of the real bounding surfaces, we have noticed that these objects (RBS) determine the decomposition of the incident fluxes into many components. There is a general (de)composition process of the material fluxes on RBS, which is valid for any kind of material flux which interacts with a RBS, either they are ware or people fluxes occurred at the incidence with a state RBS, or molecular or ionic fluxes in case of a RBS of a living cell (plasmatic membrane). In case of the RBS of the abiotic MS, the situation is absolutely similar, only that the number of incident flux types is much lower than the biotic MS, the structural fluxes being important in this matter (SF, which shall be presented in the following section), but moreover, the energy fluxes (EF). Due to this reason, we shall minutely review the composition of EF on RBS and as a result of this composition, we would be able to understand that most of the physical amounts such as the impulse, force, power, pressure etc. are nothing but some EF or properties of EF.

The composition and decomposition of EF on RBS of a driven MS is made in accordance with specific rules (we might even call them *laws*), which regulate the interaction (composition) processes between the outer and inner EF stored into the proper volume of MS. According to the objectual philosophy, these rules are:

1) ***The composition of EF takes place only on a RBS*** (more precisely, into the transition volume of RBS).

Comment 7.6.5.1: This assertion includes all types of RBS which were aforementioned, including the ones with uneven, non-permanent or periodical distributions. The composition process is a distributed process (just as the fluxes) made-up from all the possible interactions occurred between the elements of the two or more fluxes, interactions which are placed into the transition volume from the impact zone. It is clear that in case of the abiotic MS, the flux's composition processes on RBS of a MS with a certain analytical structural level may be also decomposed into composition processes of EF on RBS of the constitutive MS, with more reduced structural levels. The important issue is that, regardless the structural level, the fluxes are composed only on a RBS of a MS with that particular structural level, because only in that place the outer fluxes interact with the inner fluxes.

2) ***The RBS transmittance for EF can never be null.***

$$p_e>0 \qquad (7.6.5.1)$$

Comment 7.6.5.2: Even if the RBS permeability of a driven MS is null for the support material objects of EF, there will still be propagation EF on RBS (surface waves, shock waves etc.) which will always send forward a part from the incident flux energy to the driven system. Because $p_e>0$, at the impact of an EF with a MS, therefore, a conducted flux will always exist (an EF action over the system). Under the absurd assumption that the permeability p_e of a MS would be null, this means that, at the impact of an outer EF, no matter how powerful is, the state change of a MS would be null, which means that this system would have an infinite inertia.

3) ***Only the coherent and collinear components of the interactive EF are composed,*** respectively, the collinear components with the normal line between them and the collinear ones with the tangent line between them, both belonging to the outer influx and inner influx (reaction flux).

Comment 7.6.5.3: Since the fluxes are vector amounts, the addition or subtraction of the amounts (operations produced during the composition process) have a meaning only at the level of their homologous components (which are collinear), so that the flux's collinear components may be algebraically combined, because only the sense (sign) and magnitude (modulus) differences of FDV still exist.

Definition 7.6.5.1: The abstract surface (theoretical, imaginary) through which the collinear and opposite flux intensities are equal (the common coherent component is null) is named **equilibrium surface** (ES).

Comment 7.6.5.4: The equilibrium surface is a local reference for the intensity difference between the interactive energy fluxes. Since it is a local reference, its spatial position can be variable in case of the variable interactive fluxes.

In general, there are two types of mutually orthogonal component types (normal and tangential), consequently, their related equilibrium surfaces will be mutually orthogonal. Therefore, an ES will be related to the normal components (which is orthogonal on the normal line from the local reference point), and an ES will be related to the tangential components (orthogonal on the tangent line from the local reference point).

> **Definition 7.6.5.2:** If during the composition process, the equilibrium surfaces (both for the normal and tangential components) are motionless against an outer RS, that particular state is named an **equilibrium state** (of the interactive fluxes) against that RS.

Obviously, since the common component of FDV which are combined two by two is null, the result is that there is no motion of their common application point.

4) ***The composition process of the interactive FE takes place until the resources depletion of one of the fluxes.***

Comment 7.6.5.5: Because, in most of the cases, each flux has a finite stockpile of transportable[54] attribute, this stockpile representing the resource of that flux, it is natural that if one of the fluxes is depleted (its intensity is cancelled) during a composition (interaction) process, the „composition" term does not make sense any longer. In case of a MS, because its volume is always finite, the EF stockpile from this volume shall be finite as well, and therefore, during the composition processes between a field (flux with endless resources as long as the field source exists) and the stored EF into MS (reaction flux), the latter would be the first (and only one) which will be depleted. In case of the composition of two fluxes with finite energy resources (such as the collision between two MS), the first depleted components would be the resources of the body with a lower kinetic energy.

5) ***During the composition process, under the equilibrium state, the equal coherent and opposite fluxes may be converted*** (in specific cases) ***either into stochastic fluxes or into coherent closed fluxes.***

Comment 7.6.5.6: If the transition volume of the RBS from the impact (composition) zone of the two coherent and opposite fluxes is considered a finite volume in which equal energy quantities are coming through opposite directions, it is natural that the energy's conservation principle (applied only for the transition volume) to state that the kinetic energy of the two fluxes does not vanish, but it is preserved. How is it possible to conserve the kinetic energy in a motionless space (under equilibrium)? This is simple! As we have noticed in section 7.6.2, in a stochastic or periodical (coherent closed) energy flux, the only flux types which are able to store kinetic energy in a motionless medium (only under a global motionless, more exactly, the inner T reference is motionless against an outer T reference, but at the element level, there is an either chaotic or coherent, but periodical motion).

6) ***At the completion of the composition process, when the equilibrium state vanishes, the remanent stored flux can be converted*** (in specific cases) ***into a coherent flux.***

Comment 7.6.5.7: This rule is very clear in case of the elastic collisions, when the stochastic flux stored in the two collided bodies remains global motionless, until the flux resources of one of the bodies are depleted. At that moment, the equilibrium state vanishes (without the opposition of the depleted flux), and the stochastic flux stored into the contact zone (baric component) shall generate the two repulsion (deflection) forces which will set in motion in reverse direction the bodies which are under interaction. But the collision processes also imply the local heating of the impact zone, process which takes-over a part of the energy deployed by the two combined fluxes, and which will make-up the thermal component of the stored flux. It is clear that this thermal flux, even after the equilibrium vanishing, would not be converted into a coherent flux, neither do the stochastic fluxes involved in the plastic collisions.

7.6.6 Energetical action

7.6.6.1 Overview

Although it seems to be quite unusual, the term of *energetical action* has a precise meaning in the present paper, coming from the attribute type which is carried by the agent flux and accordingly, from the attribute type whose variation will generate the state change of the driven object. In case of the energy action, the attribute which is considered to be transmitted by the agent flux and received by the driven object is exclusively *the energy*. If the attribute carried by the agent flux is the *information* (contained into ISS which are the elements of the agent flux), in this case, if the object is permeable to this flux type (which means that it is a biotic or artificial IPS, sensitive to that particular flux), this object shall be subjected to a *informational action* (a state change due to the receiving of an information

[54] The exception is represented by the permanent fluxes which make-up the fields of the material systems, which were presented earlier in this paper.

flux). Similarly, if the agent flux is made-up from bacteria or viruses and the driven object is for instance a human, the state change (first and inner and then an outer change) determined by the ingression of this flux inside the body (falling ill) may be referred to as the *biological action* of that flux. It is worth keeping in mind that the action type of a certain agent flux is given by the type of the transported attribute which is transmitted to the driven object.

7.6.6.2 Quantization of energetical action

There are few main properties of the material fluxes which must be taken into account in order to analyze the energetical interaction processes of MS, resulting both from the objectual definition of the fluxes (as collective processes with spatial distribution) and from SOP (as abiotic decomposable systems):

1. The material fluxes are discrete distributions, both from the structural and energetical point of view, because the material systems carried by those fluxes are discrete as well (units which may be decomposed into finite elements);

2. The discrete character of the flux structure (of distribution) is also transmitted to the distribution of their energy stockpile, with elements belonging also to this stock.

3. The elementary energy stockpiles are obviously finite, which means that the action time domain of these stockpiles (depletion time of the elementary stockpile) is finite as well;

4. The action of any kind of apparently continuous energy flux (EF) may be decomposed in elementary actions of some elementary energy stockpiles.

Comment 7.6.6.2.1: A coherent, apparently continuous, photon flux, such as the one generated by a continuous laser, actually consists in a very large amount of energy quanta - individual photons with energy $E= h\nu$. The overall action of the flux (laser beam) means an addition of the individual and finite actions of each incident photon on RBS of the driven body. There is a similar situation in case of a gas or liquid jet which hit the surface of a body, the overall action being the result of cumulating the individual energy stockpiles of all the individual molecules wich collide on the surface of the driven body. In case of solid body collision, the total action is the same cumulative stock of all elements, each bringing its contribution by means of its kinetic energy stockpile quantum and this quantum being the result of the kinetic energy distribution of the body along its inner elements. In case of the action exerted by an energy field to a body placed in this field, the energy flux which is transmitted to the body is the result of the variation of incident elementary energy fluxes on the body's RBS, and the action's result (state change of the driven body) is due to the addition (integration) of these individual actions along the entire RBS. Each element of the medium which is the material support of the energy field owns an energy quantum, but the magnitude of this quantum does not necessarily have the same value (as in the classic quantic physics) but on the contrary, within the media with uneven energy distribution (radial fields), the energy stockpile per element of each medium is variable with the spatial position of the element against its field source.

7.6.6.3 Components of the quantic energetical action process

The action process of an energy stockpile quantum owned by a EF element may be divided in other elementary processes, either they are simultaneous or successive (see figure 7.6.6.3.1, where the vertical axis represents the amount of the energy stockpile Q, and the horizontal one shows the time; t_1 is the moment of the first contact of the incident EF quantum with RBS of the driven object). These processes are:

1. Incidence and absorption of the outer flux, process in which the finite stockpile Q_I of the agent flux gradually drops, up to its depletion (process displayed in the figure 7.6.6.3.1 with a blue dashed line). This process is distributed in the time interval [t_1, t_2], distribution which is considered to be linear, due to simplicity reasons. Within the same time interval, but under a reverse phase, the gradual growth of the stored Q_S flux occurs into RBS of the driven MS, that is a process (outlined with red-dotted line) which keeps going until the depletion of the energy stockpile of the agent flux, at the moment t_2. During the incidence, the normal component T_n of the incident flux is converted (under specific conditions, see rule 5 of the EF composition from the section 7.6.5) into stochastic flux, that is a flux stored with the stockpile

Q_s having a null T_n overall component (against the inner reference of the driven object). We may also assert that the kinetic energy of the incident flux is turned into potential energy of the medium from the transition volume of RBS.

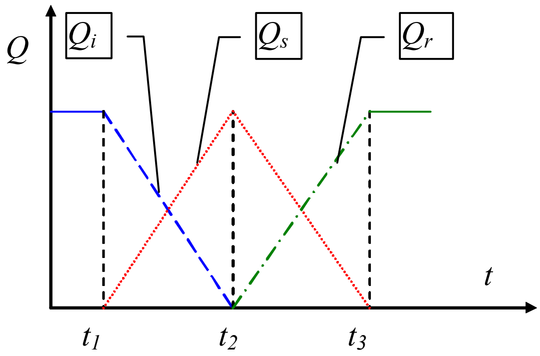

Fig. 7.6.6.3.1

A displacement of the equilibrium surface between the agent and stored flux takes place in the interval $[t_1, t_2]$, displacement which is proportional to the transferred energy stockpile Q_i=Q_s (the mechanical work of the agent flux which shall be defined later on).

2. The reflection and restoration of the stored flux, that is a process (outlined with dashed green line in the figure 7.6.6.3.1), in which part of the flux stored in the first process is expelled (released) from the storage medium which shall return to the previous state. This process occurs only under favorable conditions (see rule 6 of the EF composition from the section 7.6.5), it starts at the moment t_2 and it is completed at the moment t_3, when the entire energy stockpile Q_s shall be depleted and converted into the kinetic energy stockpile Q_r of the reflected flux. During this process, the potential energy stored into the medium from the transition volume is turned into the kinetic energy of the reflected flux's elements. The equilibrium surface between the stored and reflected flux shall be also displaced in reverse, in proportion to the mechanical work carried-out by the stored flux for the reflected flux.

7.6.6.4 Overall energetical action

In the previous chapter, we have seen what is the action of an energy flux quantum, that is a process with two distinct, disjoint but temporally contiguous phases: *incidence and reflection*. Let us further analyze the action process of some energy fluxes made-up from a large number of quanta, both as an effective section and by considering the conveyed energy stock. We have seen that the flux is a spatial-temporal distribution of a transfer process, therefore, all the quantic processes of the flux shall be also spatially-temporally distributed. This fact means that the quantic processes depicted in the above-mentioned section can be randomly superposed and added, thus giving the impression of the process continuity. Consequently, although the incidence and reflection processes are successive at the quantic level, at the overall distribution level which involves a very large number of elements, these two processes seem to be simultaneous, because there is no temporal coherency between the quantic support intervals. That is the case of the fluxes from L or G media which deploy L or G-type relations (which were presented in chapters 5 and 6) between their elements. In case of S-type media, in which there are steady relations between all the flux's elements, the two processes - incidence and reflection - can be successive, just as in the quantic case (elastic collisions). After all these explanation, it is time to analyze the general process of the energetical action of an EF on a MS.

Let us presume that we are dealing with a material body MS_k which is in a rest state against an external reference system RS_e, the position vector of the body against this reference being the invariant[55] $\overline{r}(x,y,z)$. The spatial state of MS_k is in this case a S_0 state, as long as the body remains motionless. A spatial state change of this body means a variation of the *spatial position* attribute - that is the vector $\overline{r}(x,y,z)$. However, this kind of variation represents a *motion* (translation motion, in this case), process which requires a certain velocity, and the occurrence of a velocity started by the rest state means a variation of the velocity rate reaching from zero to any value, that is an *acceleration.*

When the body was motionless, it had a null kinetic energy (against RS_e), but as long as the body is moving, its energy is non-zero, therefore, for achieving a spatial state change, the body needs energy, which is provided only from the outside, from another body which owns a transmissible energy, namely from an open *energy flux* (EF). We have seen in the previous sections that the energy is an exclusively transmissible property, coming from a MS which has it (which is moving) and which property can be delivered, through an interaction, to another material body. First, let us make a review focused only on the body which receives energy, that is the driven body, represented only within a partly section in the figure 7.6.6.4.1, displaying an outer energy influx $\overline{F}_{ei}$ [56] on the real bounding surface included between the two abstract surfaces Σ_e (external) and Σ_i (internal).

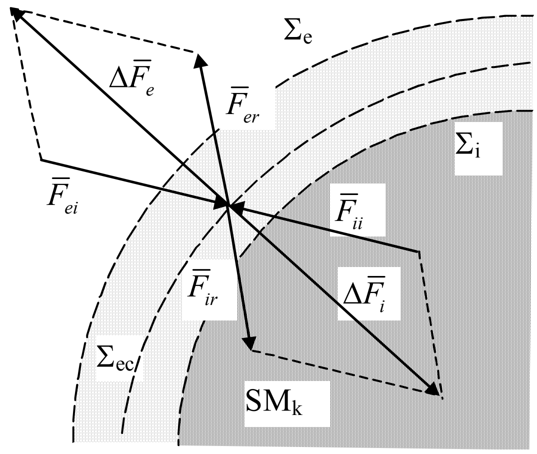

Fig. 7.6.6.4.1

At the moment of impact between the energy influx and RBS of MS_k the composition process between the outer influx $\overline{F}_{ei}$ and the inner influx $\overline{F}_{ii}$ (reaction flux, inertial, relativ, see also annex X.7) of the driven body shall be produced, and during this time, the equilibrium surface Σ_{ec} of the interactive fluxes being motionless if the interactive fluxes are equal (equilibrium state). As a result of this process, part of the outer flux shall be reflected $\overline{F}_{er}$, and a variation of the outer flux $\Delta\overline{F}_e$ (reaction of the inner flux) will therefore be generated, whereas in the inside, the reaction flux, that is a component of the internally-stored flux, shall be composed with the outer traflux, resulting a variation of the inner flux $\Delta\overline{F}_i$ (action of the outer flux). For simplicity, we momentarily let aside the tangential components of fluxes, in this case $\Delta\overline{F}_e$ and $\Delta\overline{F}_i$ are collinear with the normal line placed at the equilibrium surface. Under equilibrium terms (Σ_{ec} motionless against SR_e) we shall have:

[55] The position vector has its application point (origin) in the outer T reference, and its peak in the inner T reference of MS_k.

[56] Due to reasons of simplicity and clarity of the graphical plotting, only the resultants of the interactive fluxes were displayed and the reader must understand that these fluxes have a spatial equipartition on their effective section.

$$\Delta\overline{F}_e = -\Delta\overline{F}_i \qquad (7.6.6.4.1)$$

namely, the variation of the outer flux (reaction) must be equal and must have an opposite sign as compared to the variation of the inner flux (action). If we shall analyze strictly vectorial the outer energy fluxes from the figure 7.6.6.4.1, it may be noticed that:

$$\overline{F}_{er} + (-\overline{F}_{ei}) = \overline{F}_{er} - \overline{F}_{ei} = \Delta\overline{F}_e \qquad (7.6.6.4.2)$$

but the balance of the outer influx states that it is divided in two parts at the impact with RBS, and these are: the outer flux conveyed through RBS (outer traflux) and the outer reflux:

$$\overline{F}_{ei} = \overline{F}_{et} + \overline{F}_{er} \qquad (7.6.6.4.3)$$

The outer traflux shall determine the state change of the driven system by means of composition with inner pre-existed flux. According to the relations 7.6.6.4.1 and 7.6.6.4.3, the result is:

$$\overline{F}_{et} = \Delta\overline{F}_i \qquad (7.6.6.4.4)$$

and accordingly:

$$\overline{F}_{it} = \Delta\overline{F}_e \qquad (7.6.6.4.5)$$

The relations 7.6.6.4.4 and 7.6.6.4.5 provide us a very significant information, that is:

The variation of an incident EF on RBS of a MS is equal and of opposite sense with the fraction from EF which is transmitted through RBS.

The above-mentioned statement is valid both for the outer and inner EF, stored inside RBS. This variation of an EF at the contact with a RBS has a well-known denomination according to the objectual philosophy.

Definition 7.6.6.4.1: The overall variation of an energy flux at the incidence with RBS of a MS is named **force**.

Comment 7.6.6.4.1: Definition 7.6.6.4.1 settles that the force is an EF (variation of a flux is also a flux), but a special type of flux which solely occur at the contact of an EF with RBS of a MS. Otherwise speaking, if there is no RBS with a subunitary permeability and an energy flux stored inside it, and they both generate a reflected flux, no force can exist either. Based on the relations 7.6.6.4.4 and 7.6.6.4.5, it may be also noticed that the force also represents an EF conveyed through a RBS, but only under the presence of the other components - the incident and reflected flux. The reader will probably notice that the definition 7.6.6.4.1 is a definition which does not depend on the Newton's (inertial) force definition (F=ma) and unlike this latter definition, the definition 7.6.6.4.1 is valid in any circumstances, even for the static (passive) forces, for which the Newton's definition cannot be applied.

Both variations of EF given by the relations 7.6.6.4.4 and 7.6.6.4.5, considered as equal and opposite, represent the two equal and opposite forces, which are known in physics as the *action and reaction force*. These variations are due to the composition on RBS (more exactly, into its transition volume) of the external EF with the internal EF, that is a composition of the homologue elements, which are normal and tangent respectively, up to the moment when the resources of one of the fluxes would be depleted.

Comment 7.6.6.4.2: If an EF covers an abstract surface (computing, imaginary one), since it has a total transmittance, a reflected flux cannot exist and consequently, no force is able to occur on such a surface.

When EF was decomposed on RBS, we noticed that there are two components of the incident, transmitted and reflected fluxes, and these are the normal and tangential components. Therefore, the variations of these fluxes shall also have two components, fact which generates the occurrence of two force types at the impact of an EF with RBS: *normal force and tangential force*. We have also seen that at the incidence of an external EF, all its components determine the generation of similar components inside MS, the reaction fluxes, whose normal and tangential components will produce the *reaction forces*, with the two components: normal and tangential. According to the composition rules of EF, the existence of the interactive force pairs is provided as long as the interactive fluxes have enough resources.

Comment 7.6.6.4.3: The existence of the normal and tangential components of the forces into the MS model established by the objectual philosophy allows a clear and coherent understanding on the occurrence of the friction forces. According to the physics textbooks, a friction force is generated when two real objects in contact each other, try to move one against another. The friction force withstands to the translation motion of the objects, being proportional (approximative) to the pressure force of the objects on the contact areas, to the roughness of the two surfaces, to their adherence degree, and dependent on the material type of the two objects. Based on the objectual approach, the friction force is nothing but the tangential component of the reaction force within the medium of the real surface, that is a force proportional to the size of the cross-section area of RBS (roughness of the two real surfaces which interact), to the contact pressure (level of the baric potential energy from the transition volume of the two RBS) and it depends on the physical-chemical properties of the two media which are placed inside the transition volume.

So far, we have discussed about the interactive forces in case of their equality, manifested during the equilibrium state, when the equilibrium surface was remaining motionless against an outer reference. Let us find out what is happening in case of a disequilibrium, when the equilibrium surface is displaced.

The figure 7.6.6.4.2 shows an inner section made through a cylindrical enclosure whose volume is separated in two other equally-presumed volumes V_a and V_b by a mobile piston. A similar gas is found in the two volumes, at the same temperature and pressure, which means that the equal and opposite forces $\mathbf{F}_a$ and $\mathbf{F}_b$ will be exerted on the piston. In such conditions, the piston will stay still, the equilibrium surface between the two forces being included in its volume. Under this state, within the two G-type media found in the volumes V_a and V_b, the same baric potential energy stockpiles $pV_a=pV_b$ (p is the pressure from the two enclosures) are stored as well as the same stockpiles of potential thermal energy nRT (where n is the same number of gas moles from the volumes V_a and V_b, R is the gas constant value and T - absolute temperature.

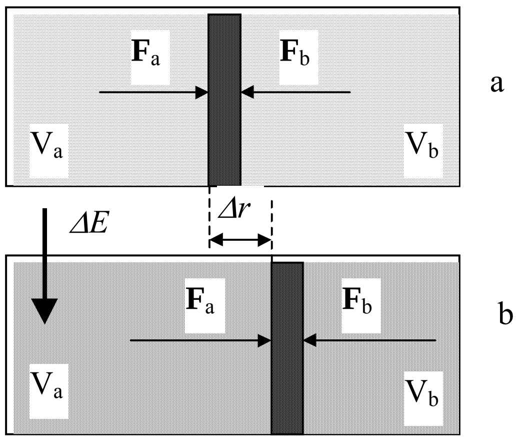

Fig. 7.6.6.4.2

Comment 7.6.6.4.4: **Attention!** According to the classic physics, in such equilibrium circumstances, there is no energy transfer between the two media from the volumes V_a and V_b; on the contrary, according to the objectual philosophy, there is a permanent energy transfer (flux) between the two media, but with equal and opposite intensity, fluxes which are represented by the two forces $\mathbf{F}_a$ and $\mathbf{F}_b$. How could not exist EF when the gas molecules are collided with the piston surface and they are reflected afterwards? The variation of their impulse (the one which gives the gas pressure) will always produce a shock wave inside the piston, wave which will transfer the energy from the gas towards the piston, and the piston reaction (the one which generates the reflection of the gas molecules) means an energy transfer from the piston to the gas.

Now, let us assume that we insert a ΔE baric energy (a gas flux, see figure 7.6.6.4.2.b) into the volume V_a, and as a result of this energy flux, a Δp increase of the gas pressure will occur into the volume V_a. Due to this flux, the pressure increase from V_a will lead to the growth of force $\mathbf{F}_a$, which now it is major than $\mathbf{F}_b$, consequently, the piston (and at the same time, the equilibrium surface) shall move by compressing the gas from V_b until the reaction force $\mathbf{F}_b$ will be equal again with the new value of $\mathbf{F}_a$. The piston displacement with Δr means a Δp compression of the gas from V_b, therefore, an input of baric energy for the gas within this enclosure. Thus, we are dealing with an energy transfer (energy flux) from the medium from V_a to the medium from V_b, the force $\mathbf{F}_a$ being an *active force* this time, and the quantity $\Delta E = F_a \Delta r$ of baric energy transferred into this process is the *mechanical work* performed by the force $\mathbf{F}_a$.

Definition 7.6.6.4.2: The energy amount transferred from the agent EF towards the reaction EF under the conditions of the displacement of the equilibrium surface placed between them is named **mechanical work**.

Definition 7.6.6.4.3: The force which generates mechanical work is named **active force**.

Definition 7.6.6.4.4: The force which does not generate mechanical work is named **passive force.**

Obviously, the mechanical work performed by the force $\mathbf{F}_a$ is a loss for the energy stockpile of the agent object (the medium from V_a) and an energy gain for the driven object (the medium from V_b).

Comment 7.6.6.4.5: Due to simplicity reasons, we have let aside both the thermal processes and the piston's mass, for not being compelled to analyze also the conversion of the baric potential energy into the piston's kinetic energy, during its motion, or the conversion of baric energy into thermal energy and vice versa. The definitions 7.6.6.4.3 and 7.6.6.4.4 allow us to identify as passive forces, both the forces which withstand to some active forces (reaction forces) and also the forces which are under equilibrium (the case from the figure 7.6.6.4.2.a).

The intensity of an EF transmitted to a MS, that is the temporal density of the energy transport process, intensity which is usually called ***power***, is given by the relation:

$$P = \left.\frac{\Delta E}{\Delta t}\right|_{SRS} \tag{7.6.6.4.6}$$

where ΔE is the energy amount passed through RBS of MS in the interval Δt. But the same intensity of an EF is also given by the following relation:

$$I_E = \left.\frac{\Delta E}{\Delta t}\right|_{\Sigma} = \int_\Sigma \overline{f}_E d\overline{\sigma} = \int_\Sigma \rho_E \overline{v}\,\overline{n} d\sigma \tag{7.6.6.4.7}$$

where $\overline{f}_E$ is FDV of EF, Σ is an abstract reference surface, $d\overline{\sigma} = \overline{n} d\sigma$ is its oriented-area element (with $\overline{n}$ as its normal line), ρ_E is the volume density of the energy from the agent EF, and $\overline{v}$ is the energy's transfer velocity through Σ.

Comment 7.6.6.4.6: The relation 7.6.6.4.7 is equivalent to the relation 5.2.1.4 or with X.8.2; all these relations which express the intensity of a flux through a reference surface are valid <u>only for the abstract surfaces</u> (theoretical, computing ones) and <u>cannot be applied to the real bounding surfaces</u>. The equilibrium surfaces intervene here and the reader is able to finally understand what is actually their role, that is in fact the role of abstract reference surfaces which allow the application of computing relations of the interactive fluxes' intensity values, surfaces which are always placed inside the transition volume of the real bounding surfaces.

Since the interactive fluxes which cross through RBS have the two components - normal and tangential - it results that their equilibrium surface shall also have two components - normal and tangential. In case of EF through RBS, the relation 7.6.6.4.7 may be written as:

$$P = \left.\frac{\Delta E}{\Delta t}\right|_{SRS} = \int_{\Sigma_n} \overline{f}_e \overline{n} d\sigma_n + \int_{\Sigma_t} \overline{f}_e \overline{t} d\sigma_t \tag{7.6.6.4.8}$$

where Σ_n and Σ_t are the normal and tangential components (projections) of the equilibrium surface, and $\overline{n} d\sigma_n$ and $\overline{t} d\sigma_t$ are their oriented-area elements.

In relation 7.6.6.4.8, $\overline{f}_e$ is FDV of EF which passes through the reference surface, namely of one of the <u>fluxes transmitted</u> through RBS, $\overline{F}_{et}$ or $\overline{F}_{it}$ respectively, from the relations 7.6.6.4.4 and 7.6.6.4.5. But, according to these relations: $\overline{f}_{et} = \Delta \overline{f}_i$ and $\overline{f}_{it} = \Delta \overline{f}_e$, namely, the flux density vectors of the energy fluxes conducted through RBS are in their turn FDV variations of the outer or inner fluxes. By using these specifications, we may write:

$$P_{et} = \left.\frac{\Delta E_{et}}{\Delta t}\right|_{SRS} = \int_{\Sigma_n} \Delta\overline{f}_i \overline{n} d\sigma_n + \int_{\Sigma_t} \Delta\overline{f}_i \overline{t} d\sigma_t \tag{7.6.6.4.9}$$

and:

$$P_{it} = \left.\frac{\Delta E_{it}}{\Delta t}\right|_{SRS} = \int_{\Sigma_n} \Delta\overline{f}_e \overline{n} d\sigma_n + \int_{\Sigma_t} \Delta\overline{f}_e \overline{t} d\sigma_t \tag{7.6.6.4.10}$$

where the relation 7.6.6.4.9 shows the power conveyed by the outer force through the equilibrium surface, and the relation 7.6.6.4.10 shows the power conveyed by the inner force (reaction force) through the same surface, under equilibrium conditions, when the equilibrium surface is motionless.

It may be observed that all these relations which express the intensity of some EF consist of two attributes: a flux density (FDV or FQV) and an oriented surface element. Their dot product means the intensity of an elementary EF, namely of an elementary force. Otherwise speaking, the intensity of an elementary force (an elementary power) is given by the product between the area of a surface element and the density by surface of an EF which runs through it. This superficial density of an EF has a well-known name in the objectual philosophy.

Definition 7.6.6.4.5: The superficial density of the variation of an energy flux, deployed on RBS of a MS, is named **pressure**.

Comment 7.6.6.4.7: According to the definition 7.6.6.4.1, we have noticed that the variation of an EF deployed on RBS is a force, and based on the definition 7.6.6.4.5, the pressure seems to be a surface density of a force. According to the current scientific literature, there is the relation F=pS, where F, p and S are scalar quantities (F is the force modulus, p-pressure and S-surface on which the pressure is evenly distributed). Since according to the objectual philosophy, the pressure is the surface density of an EF, namely of a vector field, this fact clearly shows that the pressure is a flux density, therefore, a vector. The reason why the pressure is considered a scalar quantity according to the current physics, is the *scalarization of the vector quantities* (see annex X.9), that is a process which occur if the set of the successive vectors belonging to a Lagrange distribution or the set of simultaneous vectors of an Euler distribution do not have a common component.

As for the relations 7.6.6.4.9 and 7.6.6.4.10, we shall have:

$$p_{en} = \Delta\overline{f}_i \overline{n} \tag{7.6.6.4.11}$$

where p_{en} is the normal component of the outer pressure, and:

$$p_{et} = \Delta\overline{f}_i \overline{t} \tag{7.6.6.4.12}$$

is the tangential component of the outer pressure. At equilibrium state, these shall correspond to the normal component of the inner pressure, $p_{in} = \Delta\overline{f}_e \overline{n}$ and to the tangential component of the inner pressure $p_{it} = \Delta\overline{f}_e \overline{t}$. Within the vector fields theory, there is the relation Gauss-Ostrogradski (see annex X.8), which is applicable for the fluxes deployed within closed surfaces:

$$\oint\!\!\oint_{\Sigma} \overline{F} d\overline{\sigma} = \oint\!\!\oint\!\!\oint_{V} div\overline{F} dV \tag{7.6.6.4.13}$$

where ∑ is the closed abstract surface of a spatial domain with volume V, crossed by the flux of the vector $\overline{F}$. In case of the energy fluxes running through RBS, this relation is valid only for the pressure's normal component and it becomes:

$$\oint\!\!\oint_{\Sigma} \Delta\overline{f}_e \overline{n} d\sigma = \oint\!\!\oint\!\!\oint_{V} div\Delta\overline{f}_e dV \tag{7.6.6.4.14}$$

hence, it results in general, for any pressure's normal component (inner or outer) p_n, applied on a closed RBS of a MS with the volume V, the following relation:

$$p_n = div\Delta\overline{f}_e \tag{7.6.6.4.15}$$

Comment 7.6.6.4.8: In the left side of the relation 7.6.6.4.14 we have the intensity of an EF through a closed surface $\left.\frac{\Delta E}{\Delta t}\right|_{\Sigma}$, and in the right side there is an energy stockpile from the volume *V*, more precisely, an inner stockpile variation from this volume which is related to a specific input or output intensity through ∑, in a Δt interval. This is the meaning of the *productiveness* term associated to the divergence, that is a word with a clear meaning for denoting the energy fluxes. In case of a gas confined into the volume *V* and of an even pressure distribution, the term from the right side of the relation 7.6.6.4.14 becomes pV, the well-known relation which defines the gas' baric potential energy, which cannot occur out of nothing but due to a generating process, that is even its transport process, carried out from the outside through the surface ∑.

A volume density of an amount distributed in a volume *V*, becomes, once with the initiation of the distribution motion, a surface density of that particular flux amount, through the reference surface ∑ (see the annex X.15). The definition 7.6.6.4.5 has stated that the pressure is a superficial density of an EF through the reference surface ∑, thus, we are able to draw a very important conclusion that, in case of the motionless media, the pressure is the volume density of the baric potential energy stored into the volume V, assertion which is also upheld by the right member of the relation 7.6.6.4.14. This energy is stored in an atomic or molecular medium placed into the volume V, under a stochastic flux form, whose elements (FQV) are the individual impulses owned by atoms or molecules, set in a chaotic motion.

Comment 7.6.6.4.9: The above underlined statement, which was checked at the level of the only media known so far (natural media: solid, liquid, gaseous) is also valid, according to the objectual philosophy, for the other media generations which were previously described in chapter 1 (the proximate fundamental media). In other words, if a medium consists of an amount of distributed potential energy, then, a pressure must clearly exist and where is a pressure and a MS with its RBS, a force will also be generated if the pressure spatial distribution is uneven.

7.7 The fundamental classes of inner fluxes

Based on the concepts which were introduced so far, such as *distribution, object, process, flux*, and based on the current public available knowledge, we may note that any material system has a *spatial structure* with a specific number of elements and invariant attributes, therefore, we are dealing with a complex object, with an inner RS against which the elements' properties are invariant, that is a structure made-up from other objects as well, and these objects have also an invariant inner structure, so on, aspects which have been also postulated by the *systemic organization principle* (SOP), presented in chapter 1.

Comment 7.7.1: The *spatial structure* term has a broader meaning according to the objectual philosophy, being synonym with the spatial distribution of the elements belonging to a MS. If it is clear that the geometrical S-type systems (lines, figures, polyhedra etc.) own a spatial (structure) distribution which is invariant as regards the components' position (both T and R), this aspect is no longer valid for L and G-type distributed MS. However, even in case of these latter types of MS, there are spatial distributions with an invariant character (besides the distributions of atoms, molecules or "clusters") which have invariant inner references and are also considered in this paper as objects with a spatial structure, but this time, these objects are closed fluxes (namely, objects which are in motion inside MS) and not objects with an invariant spatial position. These fluxes are closed in a limited space with invariant boundaries (enclosure which contains that particular medium), there is an invariant reference direction (local direction of the gravitational field), a masscenter and a pressure center (with invariant position if the enclosure's position and shape are invariant as well). As compared to these reference elements, the mean statistical attributes of the inner fluxes are kept invariant (if the external conditions are invariant as well), therefore, these attributes will make-up a state (inner) object of MS. In chapter 5, we have also seen that, spatially speaking, the overall state of a flux at a specific moment is represented by Euler distribution of FDV, that is a distribution which is invariant in case of the stationary fluxes. But an invariant spatial distribution means also a spatial structure, even we are dealing with the configuration of a vector field.

The invariant attributes of the spatial structure of a specific MS are also maintained due to the fact that the structure attributes of the constitutive objects are invariant (in other words, these elements are objects as well), and there are invariant spatial relations against an inner overall RS of MS deployed between the inner reference systems of these components. In chapter 4, we have noticed that the *state*-type abstract objects are divided in processual classes, that the objects with null processes have states belonging to class S_0, and the invariant attributes of the processes make-up objects from the classes S_1, S_2 so on. We have also noticed that the fluxes are processes, therefore, their invariant attributes make-up processual abstract objects, which are distributions with spatial, temporal or frequency support of these attributes. Based on the aforementioned issues and on the generic MS model proposed by the objectual philosophy, it clearly results that if there are specific amount fluxes inside a MS, this means that we shall have support objects of that particular moving amounts; since their motion occurs only inside a RBS of a MS, this motion also means some *closed fluxes* deployed in the volume occupied by MS, fluxes which must have some invariant attributes in order to form processual objects.

Comment 7.7.2: For instance, the peripheral medium of an atom, made-up only from electrons, has a rigid structure (but not at the level of the electrons' position but at the level of the orbitals occupied by these electrons), which means that it is a S-type DS (more exactly, S_R-type, in which the constitutive elements are maintained despite of the presumed repulsion deployed between them, by the powerful electric interaction with the core subsystem - the nucleus with its positive charges). The main argument which explains this stiffness is that, if it would not be so, neither the crystals, which are also S-type DS, created by means of covalent or ionic bonds (interactions) between the atoms' peripheral electrons, would be able to exist (no bonds with preferential, invariant directions would be able to exist). Within this electronic medium, each electronic orbital has (under a non-disturbed state) unique and invariant state attributes (whose existential attributes make-up the so-called set of quantum numbers), although each of these electrons performs plenty of motions (therefore, they are fluxes). This means that the quantum numbers which define the state of a specific electron are quantitative attributes of some invariant processual qualitative attributes, namely, parameters of some invariant fluxes. Since we are referring to fluxes which are objects set in motion, it is clear that the moving object's position (electron) is non-determined, but instead, we may define the invariant attributes for the object's velocity (with its equivalent that is the energy or the orbital frequency), for the spatial distribution of the flux lines (plane, radius, and orbital axis, the position of axis and orbital plane against an atomic RS, which coincides with the nuclear one), distance of the orbital plane towards the nucleus (that is invariant in case of a specific electronic layer). Therefore, if we cannot define the position of an electron, we can define instead the position of the *orbital* on which it may be placed (the orbital means an abstract object which gathers all the invariant attributes of the individual electronic flux, which were above mentioned). The reader is invited to observe that S-type systems can be also made-up from fluxes (naturally, from closed, coherent and invariant fluxes), if the spatial parameters of these fluxes (the invariant ones) are able to meet the conditions of S-type systems, characterized by permanent interaction and the restriction of free translation and rotation of the elements (elements which this time are the above-mentioned invariant fluxes).

We may note that the inner structure of a MS, based on fluxes, is generally made-up from a set of support objects of the conveying or storing properties and from an "agent" which sets in motion these objects in order to produce inner fluxes. The "agent" which generates the motion and which is called *energy flux*, according to the objectual philosophy, was minutely presented in the previous sections. Now, we are most interested in the support objects found inside a MS.

For the generation of a motion (flux) of a material object, besides the energy which is required for the motion, a space for this motion is also needed, that is a space which will confine the resulted flux. In other words, each flux from the set of inner fluxes with simultaneous existence belonging to a MS needs a spatial resource for its existence. The total amount, the union, either disjoint or partly conjoint, of these spatial resources needed for the inner fluxes (defined against the inner RS of MS) shall make-up the total space occupied by that particular MS, namely, the system's inner spatial range (domain).

Comment 7.7.3: For example, the case of the specific components of the individual (orbital) fluxes of the electrons from the peripheral electronic medium of the isolated atoms, where, as it was mentioned in the previous comment, the spatial domains of the orbitals must be disjoint because the flux's state attributes (quantum numbers) are different. It is not the same situation in case of two (or more) atoms linked through covalent bonds, in which case the electrons involved in the bond (the valence or conduction electrons of the two linked atoms) must have a partly conjoint spatial domains of the orbitals (their intersection must be non-void). If do you remember what it was said in the previous sections about RBS with spatio-temporal distribution (such as the case of RBS generated by an electron placed on a specific orbital), and about the synchronism required to a constructive interaction, then, it clearly results the reason why two electrons which are connected in a covalent bond (electrons which in the current papers are denoted as "commonly used" by the bound atoms) must have synchronic and co-phasal orbital frequencies, at least at the harmonics level, fact which determines the necessity of orbital interpenetration (conjunction). This argument is valid for any kind of molecule with covalent bonds, but it is more obvious in case of the metallic bonds, where the “massive” conjunction of the atoms’ outer orbitals makes that the electrons placed on this orbitals to be able to “migrate” from an orbital to another during the process of electric current conduction.

If the MS as a whole shall be moving against an outer reference, we shall have an overall flux (of all the inner elements of MS), that is a flux which also needs a spatial resource, a space in which that motion to be possible. Because the inner space of MS is its minimum spatial resource, which is necessary even if the MS is motionless, we may also call it as the system’s *rest space*. As we have noticed in the section focused on energy, the inner energy of a MS is stored in the rest space, that is an energy which is even named *rest energy*, in case of EP considered to be motionless against a RS.

Comment 7.7.4: **Attention!** When we talk about the rest energy of an EP, by taking into account the energy definition from the section 7.6.1, it is clear that at least one MS flux must exist in the inner domain of EP, flux which contains this inner energy of the particle inside it. The existence of this stored flux is also required by the general MS model (3**F** model), the stored flux being the source of the emergent fluxes produced by the particle (electric, gravitational flux etc.).

The debate which was made so far on the necessary spatial resources of the inner objects and fluxes of a MS is explained by the justification of the fact that <u>each MS</u>, regardless if it is abiotic, biotic or artificial, has a spatial distribution of its properties (rigid, namely invariant for the S systems and fluid for the others), and that this distribution is possible only due to the simultaneous existence of the <u>spatial distributions of the inner components</u> of MS and due to the <u>spatial distributions of the fluxes</u> which involve this components. At the moment of a MS formation, each component will contribute with its own spatial structure at the future aggregate structure of the new MS, otherwise speaking, <u>the necessity that any MS to have a spatial structure</u> requires <u>the necessity of the external contribution of some spatial structure elements</u>. Obviously, the motion necessity of these structural elements also draws the need of an energy component existence.

After all the aspects mentioned so far in this section, the result is that the total amount of the inner fluxes necessary for a MS consists of two major flux classes:

1) Fluxes of spatial structure elements, which shall be shortly named ***structural fluxes*** (SF);

2) Fluxes able to convey motion to these elements (to set them in motion or to maintain the motion in order to generate and maintain the vital fluxes), fluxes which are named ***energy fluxes*** (EF), as we have seen in a previous section.

It is clear that the fluxes triad model postulates the fact that, if the inner fluxes of a MS belong to these two above-mentioned classes, both the input fluxes (which must cover the inner flux demand) and the output fluxes (which are coming from the inner fluxes) of a MS will also belong to these two basic flux classes.

Comment 7.7.5: For example, in case of the atomic MS, the structural fluxes (made-up from protons, neutrons and electrons) are provided during the system’s formation (synthesis) process, its structure being subsequently invariant (if nuclear disintegration or ionization processes do not occur), so that the further demand for an input flux is valid only for the energy fluxes, which must maintain all the inner motion types, and to compensate the losses (exclusive energetic fluxes) through output fluxes (fields of an atom). However, there is a different situation in case of the bio-systems or artificial MS, where the structural elements of the system may be degraded throughout time (they have a shorter existence as compared to the system’s life span), consequently, the input fluxes must contain, besides the compulsory energy flows, some fluxes of structural elements as well (which shall replace the damaged ones). A non-used part from the input structural fluxes or from the structural fluxes generated as a result of elements degradation shall be discharged through the output structural fluxes (in case of the bio-systems, that is the excretion function). It is obvious that the processes which generate a new system must contain both energy fluxes and massive structural fluxes which are needed during the development (growth or synthesis) stage of the new system.

It is worth noticing that the two basic components of the inner fluxes may be found at the same type of input or output flux. For instance, the food ingested by a human contains both structural elements (e.g.: elements required for the synthesis of proteins or of other elements from the cells' structure), and a certain part of the energy fluxes contained (confined) in the structure of some organic molecules, fluxes which will be released as a result of the enzyme decay of these molecules inside the cells, by providing in this way the intracellular energy resources.

7.8 Formation laws of the natural material systems

First of all, an explanation on the title of this section is required. Beside the natural MS, there are also the artificial MS, whose components are the natural MS (which comply with the laws in question), but which are regulated by additional rules beside the formation laws of the natural MS, in order to achieve the functionality of the artificial system. These types of artificial MS are not self-composed depending on the medium conditions (they can be self-decomposed though), but they are composed by a material system which owns an IPS. However, in case of the natural MS, the objectual philosophy proposes an invariant set of rules, coming from a series of experimental facts described by the technical-scientific literature, rules which establish both the formation conditions (synthesis, composition) of MS and also their destruction (decay) conditions.

I. **A MS may be formed (synthesized, born, made-up) under specific conditions of the environment[57] which are *favorable* to this formation, and it can be destroyed (decomposed, dismembered, pulled apart) under *unfavorable* state conditions of the same environment.** *Favorable conditions for the system formation* means *unfavorable conditions for the singular elements* (from which the system may arise). Unfavorable environment conditions for the singular elements means a low density of necessary fluxes (offer) found within the medium, so that the outer traflux achieved through RBS is not able to cover the element's flux demand. Therefore, the favorable conditions for the material system formation are characterized by a flux density of the environment which is lower than the offer of flux provided by an element with which an association is possible, and the density of elements which may be associated in the area of the system formation exceeds the threshold required for this formation (so that the probability of the elements interaction to be higher enough). *Unfavorable conditions for the system's formation* means a flux density within the environment which is higher than the flux offer of an associated element.

Comment 7.8.1: In order to show the validity of this law, only two examples will be given, one from the field of abiotic MS and one from the biotic field. *Example 1* - The material systems belonging to AT class are able to create, by means of association with an extremely large number of elements, distributed systems, which in this paper are named *natural media* (NM). In their turn, these NM make-up large spheroidal aggregates which are the astronomical bodies (AB) - stars, planets, large satellites etc. Based on the knowledge level reached so far, we know that within this AB is a non-even radial distribution of the pressure and temperature, distribution which starts at very low values (the ones reached at the upper limit of the AB atmosphere), but which reaches very high values in the centre of AB. Since the pressure and temperature are attributes which depend on the flux density of some energy fluxes, the higher their values, the unfavorable are the formation conditions of MS made-up from atoms. At certain depths, the melting (destruction of the crystalline systems) of the surface solid NM is initiated, together with the atomic dissociation (ionization with the occurrence of the electric conductibility), and in the center of very large AB (such as the stars), the medium's energy flux density is that high so that even the atomic kernels are decomposed. Therefore, the high outer flux inputs of the environment encourage the existence of the singular elements (non-associated), whereas the deficit (lack) of energy flux encourages the association of elements within systems. Due to these reasons, at the periphery of the AB, where the flux density is low, the non-dissociated atoms are linked one another, by making-up the non-dissociated S and L-type media. Within these peripheral media (more exactly in L-type media) a generation of biotic systems has occurred (also as a result of conditions which were favorable to their development). *Example 2* - The unicellular animal *Dictyostelium discoideum*, an eukaryote which lives in the moist forest ground as a motile cell also

[57] The environment of a MS_K (considered both as a reference for the analytic organization level and as a spatial reference for its proximity) is made-up from the set of MS which may be found at a specific moment into a limited space in the proximity of MS_K, with equal or different organization levels as compared to the one of MS_K, that is a set which may interact with MS_K.

known as *amoeba* who is feeding with bacteria and fungus, has a division cycle of several hours, under food abundance conditions. When the food resources are low, the division is blocked and the organisms are associated in worm-shaped structures with about 1..2 mm in length, made-up from about 10^5 specimens. Each structure behaves totally different as compared to the free amoebae: it is extremely sensitive to light and heat and migrates towards these sources (in other words, it turns into account any available energy source). During the migration, the cells are differentiated by producing an organism which resembles (in terms of shape) with a plant (also known as *fruiting body*). This new organism contains a large amount of spores which are able to live in hostile environment conditions for long periods of time. The spore cells are covered by a protective cellulose layer and afterwards, all the organism's cells, except the spores, are dying. The spores germinate, if only favorable conditions for the amoeba[58] existence occur again into the external medium.

II. **The material system is made-up in order to achieve at least a partial coverage of the flux demand of its elements, by providing in this way the fulfillment of the flux demand under better conditions than before the system's formation, by means of a mutual flux supply (import/export recirculation) between its elements.**

Comment 7.8.2 For a better apprehension of this law, the most appropriate examples are taken from the field of MS which release fluxes with opposite "charge" attributes (which produce the so-called charge interactions). For this type of MS, there are repulsive interactions (the formation of a new system is excluded) deployed between the systems which release the same flux type (they have the same charge), this formation being possible only between the systems which release fluxes with opposite attributes (with attractive interactions). The attractive interaction is based even on the fact that the element which releases (offer) a flux, let us say, a positive one, needs to be supplied (demand) by a negative flux. There are also two examples in this case, an abiotic and a biotic one. *Example 1 -* A classic case of a system made-up from MS with opposite-charge fluxes is the hydrogen atom, which is neuter as regards the electric flux (charge zero) for the outer systems. This fact means that the proton's electric flux (positive) and the electron's electric flux (negative) are <u>entirely</u> recirculated between the two elements, this recirculation process taking place in a volume with a spatial size grade of few Van der Waals rays of H_2 molecule. *Example 2 -* Another case of charge interactions is the one produced between the sexual bio-systems (obviously from the same species). In this case, we are also dealing with two elements types (male and female) which provide fluxes with opposite attributes against their flux demand. However, the structure of these fluxes is much more complex than the abiotic MS structure, most of them being information fluxes, therefore, the interactions deployed between the elements are mostly informational ones. The female element needs masculine hormones, spermatozoids, and protection against the external aggressions, both for her and mostly, for her offsprings, by providing, in exchange, successors and some services to the male. In this case, the charge attributes are (in most of the circumstances) quasi-null for the outside of the system (family), therefore, a full inner recirculation of the charge fluxes takes place.

III. **The <u>system's</u> global flux demand, from its outer space, shall be always less than the sum of the individual flux demand of <u>its elements</u>.**

Comment 7.8.3: The difference between the system's global flux demand and the sum of the individual flux demand of its elements which will build-up the system, but prior the system formation, it is represented by the inner recirculated fluxes, fluxes which are exchanged between the elements on mutual basis and which remain stored inside the system until the moment of its destruction. A particular aspect of this law was already presented in the comment made on Law II, that is the case of the hydrogen atom, at which the outer electric flux demand is null, even because of the total inner recirculation of these fluxes between the two constitutive complementary EP.

IV. **If an element of a MS receives from the outside fluxes which are more intense than the re-circulated fluxes, the element leaves the system.**

Comment 7.8.4: One of the most simple examples for illustrating this law is the photo-electric effect which consists in the emission of a peripheral electron of an atom as a result of the impact between that electron and a photon with a higher energy than the electron's bonding energy (that is the system's partly dissociation). The same result (dissociation) also occurs at the family systems or at other forms of inter-human association at the moment when a more favorable offer appears, which is able to surpass the constraints (that is the equivalent of the bonding energy) generated by the old agreement. Another visible consequence of this law is the increasing tendency of the number of solitary individuals into the communities with a high standard of living, due to the fact that the outer flux offer (with its value equivalent-income) exceeds the current needs of those individuals, and even provides sufficient resources for growing-up their children as solitary individuals (not engaged in a family bond).

[58] **B.Alberts, D.Bray, J.Lewis, M.Raff, K.Roberts, J.D.Watson** – *Molecular Biology of the Cell*
William H. Telfer, Donald Kennedy – Biologia organismelor, Editura Ştiinţifică şi Enciclopedică, 1986

V. **The interaction** (flux exchange) **between the MS elements** (in case that this interaction exists) **is always bilateral** (it may be decomposed in couples), regardless of the number of elements which are included within the system (that is why we are dealing with a systemic set of elements).

Comment 7.8.5: The underlining from the above adjuvant text (written with normal fonts) within The Law 5 is meant to emphasize that where an interaction takes place (on the set of all the elements belonging to a CS and on the set of the neighbouring elements in case of a DS), those particular interactions always occur between two elements. As for the contributions brought by the two participants, in case of the abiotic MS and in case of the energy fluxes, they are equal and with opposite-directions (action and reaction), or otherwise speaking, the export flux of an element towards its partner is equal to the import flux coming from the related partner. In this case, we may say that the interaction is equitable, that is a situation which may be unconditionally applied to the entire generation of abiotic MS.

VI. **Any system made-up from material systems is MS** (in other words, the materiality of a system is inherited from the lower structural levels (its elements) and is transmitted to the upper structural levels).

Comment 7.8.6: By analyzing the general MS model and as we are about to see in the following chapter, we have noticed that the materiality of a system is proved (certified) by the presence of a RBS which has the property of deflecting (to reflect) fluxes and by the presence of the emergent fluxes from this RBS. When we have talked about RBS of a specific MS, we have seen that this object (RBS) is made-up from RBS fractions which belong to the elements of that particular MS, and its emergent fluxes are also made-up from the emergent and non-recirculated fluxes between MS elements. In other words, if the MS's elements would not have their own RBS, the existence of a global RBS of MS would not be possible either, and if the same elements would not have emergent fluxes, neither the global emergent fluxes of MS would be able to exist.

7.9 Conclusions

The objectual philosophy proposes an universal model for any material system, that is a model based on the notions which were already introduced in the previous chapters: *distribution, object, process, flux* and *medium*. Based on these notions, a new concept is defined, that is the *real bounding surface*, as a spatial zone placed between two abstract parallel and concentric surfaces, that is a zone where a gradual transition from a medium with a flux density to another medium with another flux density takes place. A RBS is different from an abstract surface by means of two main properties:

1) Permeability (transparence, transmittance) p_k in case of a k-type flux is always sub unitary ($p_k<1$). The sub unitary transmittance of RBS makes that a flux which is incident on it, either from the inside or the outside, to not be entirely transmitted and to always exist a deflected (reflected) component of this flux.

2) Because RBS has a non-zero thickness, the tangential components of the incident, reflected or transmitted fluxes can be found on it.

The spatial distribution of RBS permeability allows their categorization into RBS with even or non-even spatial distribution, and as regards the temporal distribution, we may have RBS with even, non-even or periodical temporal distribution. In general, RBS have spatial-temporal distributions of the permeability, which are divided in two classes: RBS with *deterministic* distributions and *stochastic* RBS.

A MS is made-up from a closed RBS Σ which is the boundary between two complementary spaces - the *inner* one with volume V and the *outer* one. By using this RBS Σ, we may define three flux classes (a triad):

1) Fluxes $\mathbf{\Psi}_i$, open *input* fluxes through Σ;

2) Fluxes $\mathbf{\Phi}$, fluxes closed into the inner volume V of the system;

3) Fluxes $\mathbf{\Psi}_e$, open *output* fluxes through Σ.

There can be various types of fluxes which build-up a triad, based on the attribute (property) type which is carried by the flux, but they belong (in case of the abiotic MS) to two fundamental flux classes: *structural fluxes* (SF) and *energy fluxes* (EF); in case of the biotic MS and for some artificial MS, another basic flux class is added, that is the *information fluxes* (IF).

The total amount of N types of different fluxes, which are outward incident on RBS of a MS makes-up the *set of the external influxes* $\{\mathbf{F}_{EI}\}$. After the impact of these fluxes with RBS, other two flux sets occur - the set of the external refluxes $\{\mathbf{F}_{ER}\}$ and the set of the external trafluxes $\{\mathbf{F}_{ET}\}$. On the inner side of RBS, there will be another triad of the flux sets: $\{\mathbf{F}_{II}\}$ the set of the internal influxes, $\{\mathbf{F}_{IR}\}$ the set of the internal refluxes and $\{\mathbf{F}_{IT}\}$ the set of the internal trafluxes. The set $\{\mathbf{F}_{EF}\} = \{\mathbf{F}_{ER}\} \cup \{\mathbf{F}_{IT}\}$ makes-up the set of efferent fluxes to MS. The fluxes which compose this set would not be able to exist if MS would not exist as well, and due to this reason, these fluxes are a basic indicator on the existence of that particular MS and of its materiality. The set $\{\mathbf{F}_{EF}\}$ also determines the amount of fields produced by MS.

Because the fluxes $\mathbf{\Phi}$ are closed into the inner volume V of MS, any external traflux of the same type as an existing internal flux, shall be composed (vectorial summarization) with the internal flux, process which is named the *internal* state change of MS. Once this change is completed, the common attributes of the resulting flux shall represent the *external* state change of MS. The temporal interval which is required for this external state change is a measure of the inertia property of MS, and the external state change of a MS is called the *action* of that flux, referred to as *agent flux*. The agent flux source is called the agent object and MS subjected to the action exerted by the agent flux is referred to as a *driven object.* We may say that an *interaction* process occurs between two MS which deploy a mutual double and simultaneous action process. If, as a result of this interaction process, the inner attribute stock (transferred by fluxes) of the two objects is maintained or is increased, that particular interaction is *constructive.*

The qualitative property of a MS of moving against a RS is called *energy*, and the energy quantity (stockpile) owned by that MS is given by a relation between the *energy capacitance* of a MS and an *attribute of external energy state* of MS.

Because the flux means a collective and specific motion process of a set of elementary objects, any material flux requires the existence of an energy distributed on the flux's basic material objects. If the flux is coherent open, this distributed energy is a *kinetic energy*, whereas if the flux is totally closed into a finite volume, the distributed energy is an *internal energy* from that volume, and if the material flux is stochastic and motionless, the energy contained in that flux is referred to as *potential energy.*

The energy carried by a material flux, detached from the other properties of the carrier objects represents an *energy flux* (EF). The elementary energy amount contained by a material flux element is an *energy quantum.* There are some composition rules between the incident (agent) EF and EF stored inside the MS (reaction flux) which are applied at the impact of an EF with RBS of a MS:

1) EF composition takes place exclusively on a RBS;
2) RBS transmittance for EF can never be null;
3) Only the coherent and collinear components of the interactive EF are being composed;
4) The composition process of the interactive EF takes place until the depletion of the resources of one of the fluxes;
5) During the composition process, within the equilibrium state, the coherent equally and opposite fluxes can be converted (in some circumstances) either into stochastic fluxes or into closed coherent fluxes;

6) At the completion of the composition process, when the equilibrium state vanishes, the remanent stored flux can be converted (in some circumstances) into a coherent flux.

The abstract surface included into RBS volume, on which the agent and reaction flux have equal and opposite flux density vectors (FDV) is named *equilibrium surface,* and if this surface is motionless against an outer reference, the state of the two antagonist fluxes is an *equilibrium state.* The global variation of an EF incident on RBS of MS is called *force*, and the density by surface of this variation is called *pressure.* Under disequilibrium conditions occurred between the agent and reaction EF, the energy amount delivered by the agent EF to the driven system is proportional to the equilibrium surface displacement, and it is named *mechanical work*. The force which generates a mechanical work is an *active force*.

For achieving the natural formation and destruction of a MS, the objectual philosophy proposes the following laws:

1) A MS can be formed under environmental conditions which are *favorable* to this formation and it can be destroyed under *unfavorable* conditions of the same environment.

2) The material system is made-up for at least a partial coverage of the flux demand of its elements, by providing in this way the fulfillment of the flux demand of these elements under better conditions than the ones before the system formation, by means of a mutual flux delivery (import/export, re-circulation) between the elements.

3) The system's global flux demand, from the outer space, shall be always less than the sum of the individual flux demands of its elements.

4) If an element of a MS receives fluxes from the outside which are more intense than the re-circulated fluxes, that element leaves the system.

5) The interaction between MS elements is always bilateral.

6) Any system made-up from MS is a MS.

Ch.8 INFORMATION PROCESSING SYSTEMS

8.1 The importance of information processing

Let us consider the following experiment: we take two abiotic bodies B_1 and B_2, with masses m_1 and m_2, placed at distance *d*, out of which B_1 is steady (it is motionless against the reference), and B_2 is free starting from the moment *t* (without the initial velocity). We know that the two bodies will be attracted one another with a gravitational force $\boldsymbol{F}_G$ (for the time being, the calculus relation of this force is not relevant), and as a result of this attraction, the body B_2 shall be moving towards the body B_1 until the two bodies are met (merged). If we are making an analogy between the gravitational attraction and the attraction felt by a bio-system (a male B_2, for instance) in relation to another bio-system (for example, a sexually responsive female B_1), which means that in case of the bio-systems, a motion of the male towards the female will take place until the two bodies are touching each other, under the impulse of an "attraction force".

Because in case of the bio-systems, there is the term called *behavior* for describing the modification of the external state of an *object* (bio-system type), subjected to the influence of a flux, we will also use the same term for describing the state modification of an abiotic object. The advantage of this "unification" of terms is even the possibility of revealing one of the major differences between the abiotic and the biotic objects.

As for the two above-mentioned bodies (B_1 and B_2), B_1 shows a passive behavior (by convention, it is motionless) and B_2 is an active one (it moves towards B_1).

Now, let us imagine another experiment which involves three bodies: B_1, B_2 and B_3 which have equal masses *m* (fig. 8.1.1). The bodies B_1 and B_2 are steady during the whole period of the experiment, they are placed at a distance *d* one another, and B_3 is placed at a distance d_0 on the median of distance *d*, and it is motionless (with no initial velocity) until the moment *t*.

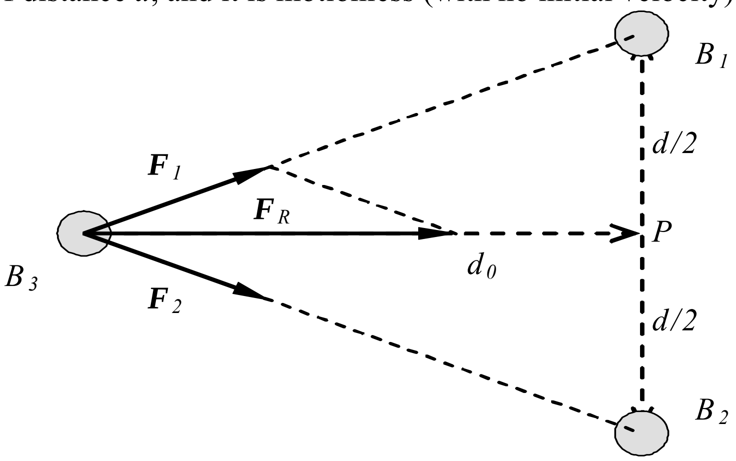

Fig. 8.1.1

The body B_3 is attracted both by the body B_1 and by the body B_2 with equal modulus forces $\boldsymbol{F}_1$ and $\boldsymbol{F}_2$, but the body B_3 is not able to make a distinction between them. The only thing which body B_3 is able to "feel" is the vector sum of the two forces, the resultant $\boldsymbol{F}_R$, that is a force which will finally determine the motion of this body, but not towards one of the existing bodies but towards a virtual (non-existing) body with a mass approximate *2m*, placed in point *P*. According as the approach to point P, the body B_3 "feels" how the virtual body is shrinking, and this body will vanish in the point *P* (the resultant of the two forces being null).

This "stupid" behavior, we might say, is even due to the inability of the natural abiotic systems to "detect" the multiple and simultaneous existence of two or more objects, and to be able to separate them. For instance, in case of an astronomical body able to "perceive" only the gravitational field, the entire external universe is made-up from a single object which is placed on the direction of the sole resultant of the accumulated attraction forces of all the external bodies. The situation is however similar for any kind of abiotic MS and for any other force generated by another field type; in all of these cases, there will also be an unique resultant for the multitude of outer forces, therefore, an inability to distinguish MS number which acts upon it.

By returning to the above-mentioned example regarding the bio-systems' behavior, and under similar conditions, when B_3 is a male and B_1 and B_2 are two similarly "appealing" females, under the assumption that B_3 is not the Buridan's donkey, the male is aware that there are two objects of interest in front of him and he will "solve" both of them one at a time, after a random or motivated choice. But the male bio-system owns the ability of making a distinction between objects, that is a capacity provided by a basic material system - *information processing system* (IPS) - which capacity the natural abiotic systems[59] do not have it.

The existence of IPS is absolutely necessary to all the bio-systems, and without it, none of the vital functions (processes) are able to exist: feeding, individual and species preservation, reproduction etc. Based on this system (IPS), the bio-system may perceive a part from the outside world which is placed beyond the bio-system's bounding surface and it can differentiate from this world the "good" systems (useful, necessary), the "bad" systems (which may cause damages or even the bio-system's destruction) and the "neutral" ones (which are neither useful nor dangerous).

8.2 Real objects and their properties

If we are analyzing the properties of the surrounding real objects, we shall observe that these properties are found in a finite number, moreover, some of their properties are common to a group of different objects. We might say that the set of the attributes (properties) of the real objects is finite inside a specific language (for instance, the natural language). This finite set of attributes may be found inside that particular language under the form of a finite set of words - the lexical fund which defines the objects' attributes. We may also notice that, according to our sense organs, the objects' properties may be divided into the following groups:

- *Visual properties*: shape, color, spatial position (against the eye's inner reference, against the inner reference of the human body and against the inner reference of the aimed object), motion velocity, surface state (gloss, texture etc.) etc.
- *Tactile properties*: hardness, surface roughness, spatial position of the area with pressure contrast against the inner reference of the body's position etc.
- *Auditory properties:* noise produced by an object or by the motion of hand or of other object across its surface, noise produced by the bursting or breaking of the object, direction (spatial position) of the noise source etc.
- *Thermal properties:* warm, cold (as compared to the skin temperature, that is the thermal sensors zone), spatial position of the area with a temperature contrast as compared to the inner reference of the body's position etc.

[59] There are abiotic systems which own IPS (such as the robots, for instance) but they belong to the class of artificial abiotic MS (AAMS) which are synthesized by the superior biotic systems.

– *Kinesthetic (proprioceptive) properties*: shape, weight, spatial size grade, relative position against the body's inner reference etc, which are properties given by the spatial distribution of the constriction and straining degree of the muscles "from the endowment" of the bio-system.

– *Gustatory and olfactory properties,* stereo-chemical structure attributes of some molecular fluxes with liquid and gaseous support which are generated by the object etc.

Comment 8.2.1: Besides the above-mentioned properties, which may be referred to as *direct* sensory properties, there is also a non-specified number of indirect properties, which are obtained by means of the artificial flux converters, extension means of the perception thresholds beyond their natural domains (photon domain IR, UV, X, γ, or of the temperature which is lower or higher than the domain of the thermal receivers, infra or ultra acoustic domain, electric or magnetic properties etc.). The aspect which must be underlined is that any indirect property is converted into a direct property (sensorial), the only access way to the inner IPS specialized in relations with the outside (the somatic nervous system). There is another extended class of processual (behavioristic) properties which may be applicable both to the abiotic MS, but mostly to the bio-systems, which differentiate the systems based on the way in which they behave during some specific processes. For example, properties such as flexibility, malleability, ductility etc. refer to the way how that particular material behaves during some specific processes: bending, deformation, drawing etc. As for the humans, these behavioristic attributes are more numerous than the direct attributes, denoting character types (choleric, sanguines, phlegmatic etc.), psychic moods (cheerful, sad, cool, excited etc.), and many more. However, all these behavioristic attributes are complex objects, made-up from successions (temporal distributions) of direct properties which are monitored on long periods of time during the body's lifetime. Some sense organs have been voluntarily omitted, either due to their limited role into the human perception (such as the vomeronasal organ), or due to the fact that they have no connection with the perception of the outer fluxes (such as the vestibular system or the perception system of the body's inner states).

Now, let us analyze each of these properties groups in order to notice what are their causes (which is the material support of the properties). Based on the current knowledge level, we know that the visual and thermal properties are provided by means of the photon fluxes emitted or reflected by the perceived object; if the photons have wavelengths included in the visible domain (400…800 nm), they will be perceived by the sight sensors (as a visual sensation), whereas, if they have wavelengths reaching the infrared domain (900 nm….1 mm), they will be perceived by the thermal sensors (as a thermal sensation).

The auditory properties of an object are provided to us by means of the pressure waves generated into the medium (air, water etc.) which separates us from the object, by the processes which take place into the emitter object. These waves are propagated through that medium (therefore, we are dealing with a propagation flux as well), a part from this flux being captured by our sense organ. In this case, it means also a perceptible frequency domain (20…20000 Hz).

The tactile and kinesthetic properties are also provided to us through fluxes, but this time we are dealing with stochastic (pressure) fluxes. The tactile sensors perceive the pressure produced at the direct contact between skin (sensors' area) and RBS of the perceived object, whereas the kinesthetic sensors also perceive a pressure (stretching, straining) of the muscular fibre.

The gustatory/olfactory properties are transmitted by means of molecular fluxes coming from the perceived object and they are either airborne, in case of the olfactory sensors, or carried by a liquid medium (water-based solutions, suspensions or emulsions), in case of the gustatory sensors.

The following conclusions may be drawn based on the above-mentioned issues:

1) Any real object is identifiable (recognizable) only by means of the reunion of its properties perceived by our sense organs and stored in our memory, properties which are distributed on the object's finite spatial domain.

2) The object's properties (attributes) reach to us through specific fluxes which are efferent to the object (from the object towards our sense organs) - photon fluxes for the visual and thermal sensors, molecular fluxes for the gustatory and olfactory sensors, stochastic (pressure) fluxes for the tactile and acoustic sensors, etc.

3) The fluxes perceived by our sense organs are either produced by the object (emergent from its inner section) or inflected (reflected) by it, therefore, these fluxes would not be able to exist in the absence of the source object.

4) The presence of an efferent flux from an object, whose intensity exceeds the detection threshold of the specific sense organ, may be considered for the perception system as an information which certifies the object's *existence* (at the moment of perception).

5) The above-mentioned sensorial properties are basic (elementary) properties of the objects from the real (material) world, therefore, these properties and their associated processes make-up the basis of all the upper level properties (more complex) of any real object.

6) Each sense organ is specialized in the receiving (detection, perception) of a certain type of material flux (either it is coherent or stochastic, propagation or displacement type), therefore, each distinct property of a real object is due to a certain type of flux, to its intensity, spatial, temporal or frequency distribution on the spatial domain occupied by the object.

7) We have seen that the variation (change, modification) throughout time of certain properties associated to an object is called a *specific process*. Because each elementary property is based on a certain flux type, each specific process of that particular property is based on a process through which the support flux undergoes, as well as the source object of that particular flux.

8.3 The principle of the material systems existence

We have noticed in the chapter focused on the general model of MS that these systems are characterized by a triad of the fluxes, made-up from input, output fluxes, as well as fluxes stored inside RBS of MS. By considering these three basic flux types, we have seen that the stored fluxes, as well as the ones which are generated by the stored fluxes (output fluxes) would not be able to exist without MS. On the other hand, the stored fluxes are permanently kept inside RBS (they are confined into this surface) so that they produce no effect (action) into the external medium.

Unlike the stored fluxes, the *efferent* fluxes (composed from the emergent fluxes and the ones reflected by RBS) are open fluxes which may have an impact on MS with whom it intersects to, fluxes which would not be able to exist in the absence of the source MS. A special type of MS which shall be temporarily referred to (only for the beginning) as ***receiver MS***, able to capture a part of these fluxes and to establish the spatial position of their source, will also be able to perform an extremely significant operation - that is the *attestation* (validation, establishing) of the *informational existence* (with its synonym - *subjective existence*) of the sender MS placed on that position.

The principle of (subjective) **MS existence:** A source MS **exist** for a receiver MS, if that particular MS is able to determine the intensity and direction of an efferent flux from the source MS.

Comment 8.3.1: We have seen in the introductory section of this chapter that the natural abiotic MS are not able to distinguish the direction where the incident fluxes are coming from, this kind of system always moving towards the direction of the unique resultant of these fluxes. Only this resultant is valid for such systems, whose direction does not usually match to the direction of a real object. The term of *informational existence* is in many ways similar to the *subjective existence* from the traditional philosophy, but in this context, it explicitly underlines the necessity of an IPS for its attestation. The existence principle which is mentioned herein may be disputed by the traditional philosophers who claim the *objective existence* of a material object, regardless of our knowledge degree. The objectual philosophy does not dispute this possible existence either, but it considers it only as a virtual, imaginary object, belonging to the absolute reality, which shall be approached in chapter 9; however, the existence of a real object, which is able to cause us a joy or a trouble, will be established only after it has been experimentally validated (through the perception of an efferent material flux belonging to the object) by our IPS (the human nervous system), and under the possible estimation limits of the lifespan of that particular object. When we shall be dealing with the term *existence*, later on, in this paper, it must be understood that it exclusively refers to the informational (subjective) existence which is valid only for an IPS, or for a system made-up from IPS.

By taking into account the finding that the fluxes which are efferent to a MS would not be able to exist without the prior existence of the stored fluxes, therefore, of the entire MS, by capturing a part from these efferent fluxes, the existence of a flux source can be validated. It is also very important that this validation to be done in a remote location, far from the source system, because the concept of flux means (as we have seen in chapter 5) the transport of an amount from a zone in space towards another zone. We have also seen in the same chapter that there are more flux types, therefore, the efferent fluxes from a MS must comply with the same rules.

Definition 8.3.1: The amount carried by a specific flux type, that is efferent to a source MS, represents a **transmissible property** of the source MS.

Comment 8.3.2: The definition 8.3.1 must be carefully interpreted because it may lead the reader to a wrong conclusions. For example, the photons reflected by an object (for example, a building) make-up a flux which carries to our visual organ more properties which belong to this flux: color, intensity, direction etc. Many of these properties belong not to the aimed object but to the effective photon source (the light source where the photons are coming from), such as the initial color (the frequency distribution of the incident flux) and the luminous intensity. The direction of the photons which are reflected by the object and the color of its surface are properties which however belong exclusively to the aimed object. The selective properties of the object's RBS determine that only specific sections from the photon flux to be reflected, so that an additional identification method of the properties of the reflecting object must also exist, and these properties are thus becoming transmissible (but indirect).

Definition 8.3.2: The intensity of the efferent flux which is the carrier of a specific directly perceivable qualitative property, captured by the receiver MS, is named **direct** (synonym - **primary**) **existential** (quantitative) **attribute** of that particular property.

Comment 8.3.3: The definition 8.3.2 refers to most of the properties which are directly perceivable by the input units of IPS, such as the bio-systems characterized by the intensity of a sound, flavor, taste, radiated or reflected light, heat intensity etc., but there are also transmissible qualitative properties such as the color, size or position of an external object, whose existential attributes are not determined directly, from the intensity of the received fluxes, but by means of calculus, by processing the information contained into the derived distributions of the primary sensory distributions (see annex X.18). In case of these properties, it is not the flux intensity which is the main issue (which must be only perceivable), but the most relevant aspect is the positions of the intensity's contrast elements (which shows the object's boundary) against the inner reference of the sense organ.

The non-zero intensity of an efferent flux from a source MS is considered for the receiver MS as a "confirmation" of the existence of source MS, and as we are about to see next, in case that this intensity does not exceed a specific threshold (perception threshold of the receiving MS), then the source system does not exist for the receiver MS. This attribute (intensity of the efferent flux) is therefore considered, in case of the receiver MS, as an estimation method of the existence of that received property at the source MS, as well as an estimation of the object which owns it (that is why it is referred to as an existential attribute).

Definition 8.3.3: The qualitative properties of the efferent fluxes from a source MS (type of the transported amount, type of its primary distribution etc.) represent **direct** (synonym - **primary**) **qualitative attributes** of that particular MS.

Comment 8.3.4: As we have already underlined in the comment 8.3.3, besides the direct attributes which are both quantitative and qualitative, there are also indirect attributes, assessed by means of an upper-rank information processing. If the primary attributes are related to the properties owned by the primary distributions of the fluxes emerging from objects, the indirect attributes (secondary, derived) are determined by the properties of the derived distributions (temporal, spatial or frequency) of the primary distributions.

The inherent habit of the people to associate properties to the directly perceived objects (through the sense organs) is based on the fact that each sensory organ is specialized (as I have previously mentioned) in receiving a specific flux type.

Comment 8.3.5: The more and more increased differentiation of the fluxes attributes takes place inside each sensory organ, each flux being either a space-temporal or a frequency-temporal distribution, the sensory organ is requested to analyze the distribution type by means of its decomposition into elements (with even distribution). For example, the photon fluxes from the visible domain are decomposed into frequency intervals which correspond to the basic shades (red, green, blue or R, G, B), by the specialized receivers (cones) from the retina, each interval with its existential attribute (flux intensity from that particular domain). Three cones, R, G, B which are spatially adjacent on the retina make-up a retina-sensitive element (a pixel) which is able to receive an elementary photon flux. In the fovea section, where the cones are mainly found, the effective area of a pixel is an elementary area, which cuts-off the possibility of revealing the spatial irregularities of the incident flux, this area will therefore receive an elementary photon flux. The spatial distribution of the elementary photon fluxes which are incident on the retina is point to point conformal with the spatial distribution of the flux point sources outside the eye (the appropriate transformation is made by the crystalline lens), and thus, we are dealing with a retina representation (an image) of a spatial distribution of a property belonging to the external object (visually speaking, its spatial configuration), alongside the properties of each source point (color, reflection degree etc.). For us, the most relevant aspect is to keep in mind that each property (quality) of an observed object is due to a specific flux type for which we have specialized sensors. We are about to see next that other qualitative properties of the real objects are also due to specific space-frequency-temporal distributions of the external fluxes which we are able to perceive them, if not under direct sensorial means, at least through some auxiliary means (such as the equipment used in the scientific research), which are means able to convert some of the fluxes which cannot be directly perceived into directly perceived fluxes.

Besides the type of the transported amount, the open fluxes have also specific properties which are common to all the fluxes - amount (modulus) and FDV direction. These last properties make a local characterization (in a specific spatial point) of the flux efferent to a MS, but since they are common to all the fluxes, they are also considered as a criterion for the evaluation of a generic property of the flux sources.

Definition 8.3.4: The direction and intensity of a flux from a point[60] with an established spatial position are considered as **local properties** of the flux in that particular point.

As we are about to see later on in this paper, the local properties of a flux (see the annex X.15) can be used for the determination of the spatial position of the flux source (provided that FDV direction to be invariant on the distance between source and receiver). In other words, these local properties are also some transmissible attributes of a generic property of all the flux sources - *spatial position* - of that source against the spatial position of the receiver MS (the reference).

Definition 8.3.5: The total amount of the invariant transmissible properties which are validated at a specific moment t_k, at a specific source MS, by a receiver MS, represents the **information** associated to the source MS by the receiver MS at a moment t_k.

Definition 8.3.6: The receiver material system, able to detect the efferent fluxes from a MS, as well as to validate (certify) their existence, to make a qualitative differentiation and able to associate them with a source MS, is named **information processing system (IPS)**.

A vigilant and good-memory reader has been probably observing that the definition 8.3.5 shows constitutive elements of the generic definition for describing the *object* notion (presented in chapter 3). So it is, because the object is nothing else but a generic denomination for a finite and distinguishable amount of qualitative and quantitative information. Based on the same definition, there is an inseparable bond relation between the information notion and MS concept to whom that information belongs to. Consequently, the objectual philosophy makes the following assertion:

AXIOM IV (axiom of the information support): The information cannot exist in the absence of a material support (a MS) to whom it is related to.

Both the definitions 8.3.5, 8.3.6 and the axiom IV could be better understood by the reader later on, when the generic IPS model shall be presented, and moreover, after we shall

[60] Attention! The point which is in question is the inner reference of a support interval of SEP (vector) which represents the flux element. Since the state of a flux at a certain moment is an Euler vectorial distribution, the local properties of the flux are the properties of an element belonging to this distribution, placed in the position of the determined point.

analyze the basic functions of this kind of MS. For the time being, in order to draw up a general model, there are few particular types of information processing systems which need to be briefly analyzed.

8.4 Natural information processing systems

Unlike the abiotic material systems, which show a passive behavior at the variations of the environmental conditions, there is also a class of MS - bio-systems - which reacts actively, sometimes, even with anticipation, by modifying its internal and external state depending on the environment conditions, so that the effect of the external variations on the inside to be as low as possible.

The bio-systems existence, as well as of any other MS, is not possible under any environment conditions, but only <u>under favorable conditions</u>. The term of *favorable conditions* must be momentarily understood as an union of admitted intervals for the attributes of the external medium which are able to allow the existence of an already developed bio-system (we are not talking about the environmental conditions which have led to the bio-systems occurrence). These conditions refer to the environment's physical-chemical parameters, such as the pressure, temperature, chemical reactivity (pH), concentration of useful and/or harmful substances, or to its biological parameters, such as the presence of other bio-systems in the proximity, bio-systems which can be either a source of food or danger. For being able to survive (to avoid the unfavorable conditions which might shorten their life, which is limited anyway) and to exert their characteristic functions, the bio-systems are able to unfold specific processes, which are not found at the abiotic systems.

Such a process is the *information acquisition and processing*, process which alongside other processes (feeding, excretion, reproduction etc.) make-up the group of the fundamental processes (model-like) of the bio-systems classes (described in the annex X.11). This process is achieved by a specific part of the bio-system, called *information processing system* (IPS). The information processing system was possible due to the occurrence of an internal specialized class of systems (material as well), whose structure (configuration) is direct and univocally dependent on the external environmental conditions, more exactly, on the distribution of the external fluxes density on the bio-system's RBS. The state of these systems which are specialized in the storage and transport of the information perceivable by certain components of IPS is named *internal information*, and those systems are named internal *information support systems* (ISS).

The environment conditions are very important in order to achieve the functions which are specific to the bio-systems, as it was previously mentioned. The bio-systems must avoid as much as possible the unfavorable conditions and to initiate the feeding and reproduction processes if these are favorable conditions. For achieving this goal, the bio-systems have the capacity to make the difference between a *present* state of the environment and a *previous* state of the same environment. It is clear that the comparison operation of two different environment conditions, assessed in two different moments, may be reduced to the internal comparison of the structure (configuration, state) of the two internal systems which carry the information received in those particular moments. As a result of this operation (information comparison), another ISS arises, whose state represents the difference between the two compared information. The information contained in this latter ISS, together with the reference information stockpile, shall determine the reaction, the modification of the internal and external state of the bio-system against the new environment state. Similarly with the abiotic systems, where the modification of the internal state as a result of the penetration of a flux Y shall be referred to as the *action of the flux Y* on the system, we may also call the bio-system's reaction to the new environmental conditions as the *action of the information flux* on the bio-system. Do not confound the information action (produced by the stimulus), with the physical action, produced by the external energy fluxes on the bio-system's abiotic support. As I have mentioned at the beginning of this chapter, this external modification of the bio-system's state as a result of the action of an information flux is known under the more generic term of *behavior.* This obviously means the "visible" (external) state modifications from the outside, observed by another bio-system; the internal state modifications which occur before the external ones, are not perceptible from the outside, because they are found in the extremely complex domain of the bio-system's internal fluxes.

Based on the knowledge gathered by the mankind so far, we know that the bio-systems[61] comprise two IPS types:

– Structural synthesis IPS, that is a system which processes the genetic information whose main ISS is the huge DNA molecule which guides the synthesis processes of a new bio-system, or the structural and functional maintenance processes of an existing one. This system (synthesis IPS) is distributed at the level and inside each constitutive cell of the bio-system, but there is a general correlation between these cells through the fluxes which recirculate between the proximity cells or through the blood and lymphatic communication system.

– Relational IPS, which guides the bio-system's behavior and its physiological functions depending on the environment conditions, system which, as I have already mentioned, consists of an amount of specialized cells (neurons) which make-up the nervous system of the superior bio-systems.

For the purpose of the present section, we are only interested in the relational IPS (more exactly, the one which maintains external relations outside the bio-system) because it is responsible for the perception of the fluxes deployed in the external medium of the bio-system's real bounding surface. As for this type of natural IPS and for an advanced class of bio-systems (with neuronal IPS), its basic components are given below:

1) *Sensory organs*, which are responsible for the receiving of the external fluxes, differentiated according to the flux type, therefore by types of transmissible attributes;

2) The *ensemble of neurons* which make-up the information processing units coming from the sensory organs;

3) The *ensemble of nerve endings* which controls the effector organs (muscular system and the organs with internal and external secretion);

4) The *ensemble of nerve fibres* (nerves) which makes the connection between the sensory organs, neurons and the effector organs, ensemble which represents the *internal communication system* (of IPS);

Besides all these well-known components which may be found in the current scientific references, we may add the internal IPS medium made-up from the set of internal ISS, which are systems considered as the objects of the internal information fluxes (even intracellular ones), which store the information and which run through the internal communication system.

As any other MS, the natural IPS (the neuronal one) has a RBS which separates inside the bio-system the parts which are involved in the structure of the above-mentioned IPS from the rest of the bio-system's components. Otherwise speaking, the internal ISS fluxes are forced to remain (are closed) inside this RBS. The only access "gates" for the input or output fluxes are the sensory organs (for the input fluxes) and the nerve endings (for the output fluxes). The external sensory organs have a section of their bounding surface which is common to the bio-system's RBS, making-up a specialized RBS section which has an outstanding property - its permeability is different from zero only in case of a specific flux type, and the value of this

[61] We are talking about the advanced bio-systems which own a neuronal system. In case of the cellular bio-systems, the differentiation between the two IPS is not clear yet, but we certainly know that the intracellular information processing systems are also at the basis of the neuronal processing systems.

permeability may be controlled by IPS. For example, the tactile sensors are sensitive at kinetic stochastic fluxes (pressure), the thermal ones are sensitive to thermal photon fluxes, the visual ones are sensitive to photon fluxes from the visible domain, the gustatory, olfactory and pheromonic ones are sensitive to molecular fluxes, and the acoustic sensors are sensitive to sound fluxes (pressure waves) etc.

The flux type to which the specialized RBS is permeable defines the property of external MS to which that particular organ is sensitive to. Inside the sensory organ, the conversion of the intensity and spatial distribution of the immergent flux through RBS takes place on the structure of the internal ISS, that is a conversion which is repeated at certain regular time intervals. This process occurs simultaneously for all the elementary information channels which are found within the biotic IPS (all the sensory cells belonging to all the sensory organs from the bio-system's "endowment"). Inside IPS, a specific structure of ISS, generated at a certain moment by a specific sensory organ, is perceived by the bio-system as a certain sensation felt by the specialized domain of that particular organ.

The total amount of the inner information stored on ISS provided by the sensory organs is processed afterwards into specialized units - neurons - a parallel and synchronic processing within the set of the neurons which make-up the central nervous system. This processing operation is also focused on the set of internal ISS, any operation performed on the information contained inside them representing an intervention on the structure (configuration) of these ISS. One of the most frequent processes of information processing which was previously mentioned is represented by the comparison between the ISS structure associated to the current state of the external medium (barely provided by the sensory system) and the ISS structure associated to a previous state of the same medium, which is also provided by the sensory system and memorized (stored) within a spatial position adjacent into the ISS neuron input medium. The result of this comparison, which is materialized on an ISS as well, but on an ISS with another structure, shall represent the final information (difference between the medium's states), information which will determine (as a result of other processing operations) the reaction, bio-system's behavior modification, through the output ISS flux sent to the nerve endings which control the effector organs. We do not insist on the information processing operations, because we are only interested in the composition, structure elements of biotic IPS, by making a special remark: any information processing operation takes place on the internal ISS structure when some of them remain non-altered (as much as possible) during the entire bio-system's lifetime (by making-up its so-called "life experience", the informational reference), and the others shall be used within temporary processing operations by considering that reference as a comparison standard.

8.5 Artificial information processing systems

When we are talking about artificial information processing systems (AIPS), most of our readers would probably think to computers. Well, it is not the computer which is the first system of this kind but… the instruments for the measurement of different sizes (mass, length, time, angle etc.), and these instruments are operational for thousands of years, indeed, under primitive yet functional forms. Let us not forget that the pyramids, the Egyptian, Greek and Roman temples, all the wonders of the Ancient times have been built based on such instruments. Besides, who can ever imagine the trade without one of its basic tools- the balance- whose Roman version may be even found nowadays.

You will probably ask yourselves, what is the relation between the weighing machines and the information processing? Although it is not obvious at all, there is one link, however: all the measuring instruments operate with ISS, but this time, we are not dealing with internal ISS (of the human IPS), but with the external ISS. For example, the angle between the lead-weight wire and the edge of a wall was an indicator of the deviation of that wall edge from the vertical direction; this wire was therefore a verticality reference, an ISS of the local vertical direction information, on which the mason was perceiving it with his visual sense, being able to use it afterwards as an element in the decision to continue the wall construction or to rebuild it. The angle of the pointer within a weighing machine against a bench-mark is also an external ISS, more precisely an indicator of the information that the two weights placed on its scales are not equal. The perception of the information which is contained into the external ISS is made in this case with the visual system. In fact, most of these external ISS are meant to the visual perception system, that is the system through which the human receives an external information amount which is much higher than the one captured through his other senses.

However, let us return to the information processing. It is clear that the measuring systems which were previously mentioned were not making the information processing by themselves, but they were only converting an attribute which was beyond the human's direct perception range into another directly perceptible attribute. The information processing was also made by the human brain, but based on the information contained into the external ISS. The only common element between the above-mentioned instruments and the artificial processing systems is the presence of external ISS, material systems which make-up the basis of any IPS, as we have seen in the previous paragraph. The next step on the way to the artificial information processing systems (AIPS) was the invention of the instruments which were using the *memorizing* (storage) process of ISS, process which is indispensable for the instruments which are based on a counting (numbering) of a periodical process. For example, this kind of process is specific to the mechanical clocks (with pendulum or balance wheel) which are designed to count the cycles of a very stable periodical process (oscillation of the pendulum or of the balance wheel) and to display this number, either as an angle of some pointers or digitally. This counting process has an universal algorithm: the increment by an unit of an ISS which keeps stored the number of the already finished periodical processes, starting from the instrument's escapement setting moment. In case of the mechanical clocks, that particular increment is made at the angular position of a gear wheel, at every oscillation of the pendulum, by advancing tooth by tooth and afterwards, the clock's mechanism (ISS) shall convert this rotation in order to display minutes, hours, etc.

Therefore, the time measuring devices presented so far operate with ISS and use the storage and increment of an ISS value in order to achieve their specific functions. But the increment (modification) of the value of an ISS is already an operation of the information processing contained by that ISS, which is a basic operation, with no result-based reaction, but which is still an operation. From the mechanical clock, that is an AIPS with a single operation, up to AIPS (mechanical as well) which is able to perform mathematical computing, there was only one step….

Nowadays, AIPS systems are electronic (most of them, but there are also other versions: fluidic, photonic etc.) which similarly with the natural IPS, they have a structure with few types of elements which may be found at all the AIPS versions. The essential elements, and these are the *internal* ISS which in case of the electronic AIPS are free electrical charges from conductor or semiconductor materials, charges whose group attributes (intensity of the electrical or magnetic field) are the attributes perceptible by IPS as an associated and transmissible information. These internal ISS are able to circulate across specific pre-established routes (*the internal communication thoroughfare*) as specific internal fluxes of ISS, fluxes which carry the associated information towards all the AIPS components. Just like the natural IPS, the fluxes are also confined in a global RBS, all the AIPS components being included inside this surface, and the same as in case of other MS, its role is to isolate the system from the unwanted fluxes (disturbing fluxes) which might disturb the system's operation, and to provide the closure of the internal fluxes. On this RBS, there are *specialized zones* which allow the admission of external fluxes, or these fluxes may come out, and in case of AIPS, these zones are referred to as "ports", and similarly with the natural IPS, they have selective permeability for a specific flux type, permeability which is controlled from inside of AIPS. In case of AIPS, these input or output fluxes are also internal ISS fluxes (electric charges as well), therefore a transfer of SSI between AIPS is possible, unlike the natural IPS which are not able to communicate each other through internal ISS, but only through conversion fluxes. Thus, a first advantage of AIPS against the biotic IPS occurs, that is the possibility of their interconnection[62] in order to make-up complex AIPS (systems which are distributed or centralized AIPS).

By returning to the AIPS structure, the ISS input fluxes reach through the communication thoroughfare to one or more *information processing units*, the only types of AIPS components able to perceive the structure of the internal ISS and to change this structure according to the information processing rules. This processing unit (known as *processor*, within the current systems) has a finite set of elementary operations which are designed by construction, operations which can be organized in finite sets known as *programs*. All the operations performed by the processing unit have the internal ISS as their operands (objects subjected to the operations), which are either recently admitted into the system through one of the ports, or they are already stored (memorized) ISS at locations (addresses) known in various types of internal memory.

All the operations which are possible to occur in the processing unit take place sequentially (time phased) based on an *internal clock* (tact generator), whose internal information makes possible the differentiation by the processor of the evolution trend of a process and henceforth, of two state types of an ISS - the present and the previous ones.

8.6 General IPS model

After this extremely brief presentation of the generic structure of two IPS types, the natural neuronal[63] and the artificial ones, no matter how bizarre would seem to be, we must notice that there are common elements between these realizable IPS classes which can form a general model of these MS types. However, a very significant specification is needed at the beginning: both the natural and artificial IPS are a subclass of the material systems, therefore, they are systems with the materiality acquired from the support abiotic systems, with all the specific attributes of the abiotic MS, at which the specific attributes of IPS is added. From the complexity point of view (structural level), IPS are however extremely complex systems as compared to the systems which make-up their generating set - the abiotic systems.

Based on the structural descriptions of the two above-mentioned IPS types, we may now draw out the common components of the two system types:

1) Existence of a RBS (just like for any MS) which defines (separates) the *internal* and the *external* side of the system.

[62] When we are talking about the impossibility of biotic IPS connection, we are referring to two or more neural IPS belonging to the same number of distinct organisms. But, inside a neural IPS of a specific organism, the neurons interconnection in networks is however a normal situation, even mandatory, for increasing the information processing abilities. This interconnection, achieved by means of synapses, which preserve the spatial separation of the neurons is made through unidirectional neuromediators fluxes.

[63] The neuronal IPS are the most notorious natural information processing systems but we must take into account that these systems operate based on the fundamental information processing mechanisms inside the cell, which are insufficiently known so far. Due to these reasons, we did not include the description of the intracellular IPS into the above-mentioned presentation, but we shall start from the premises that the basic elements of the general structure of an IPS may be also found at this organization level.

2) There are *specialized transfer zones* on this RBS which have a defined area and an invariant location against the internal spatial reference, through which controlled flux transfers can be made. *Specialized zone* means a RBS portion whose permeability (transmittance) is selective at a specific flux type and this permeability can be controlled inside the IPS. These zones belong to the *input/output units* of IPS.

3) Inside IPS, there is a special class of MS, namely the internal *information support systems* (ISS), systems whose properties may be detected by IPS, strictly depending on the properties of the fluxes received by the input units.

4) Also inside IPS, there is a sub-system known as the *information processing unit* which has the following specific features:

a) Capacity to detect (perceive, determine) the specific property of an internal ISS (property which is the representation of a property perceived from an external IPS object) and to distinguish between two different values of this property.

b) Capacity to modify this property according to specific rules, by also modifying the information contained into ISS.

c) Capacity to perceive a temporal succession (distribution) of the values associated to two input ISS, otherwise speaking, to make a difference between a *previous* and a *present* value.

5) Another essential sub-system of IPS is the *storage unit* of ISS (IPS memory), to which the processing unit has access to. This unit stores the entire information amount received during the functional operation of IPS.

6) An ISS circulation (fluxes) is required between all the IPS's internal sub-systems, therefore, some *communication ways* for guiding these internal fluxes must exist. For avoiding the losses along the route, these fluxes must have a constant effective section (isotom fluxes).

7) The maintenance of the internal ISS fluxes and of the functional fluxes belonging to IPS components, which is a *sine qua non* condition for its operation, determines the need for an additional energy supply over the normal energy demand of the abiotic support from which the IPS sub-systems are made of. This additional energy is obtained from the second level supply fluxes (the first level is for the supply of abiotic MS), and these are fluxes provided by the host material system (in case of the bio-systems) or by special supply systems (in case of AIPS).

According to the above-mentioned issues, the general model of IPS which is proposed by the objectual philosophy, valid both for the natural and artificial IPS, is made-up from the following material sub-systems:

1) ***Input units***, which convert the incident external fluxes from the specialized zones of RBS into corresponding internal ISS fluxes;

2) ***Output units***, which make the reverse conversion, from the internal ISS fluxes into emergent and transmissible fluxes outside IPS;

3) ***Internal communication system,*** which provides the canalization of the internal ISS fluxes;

4) ***Information processing units***, able to perceive the internal ISS structure and to operate with this structure according to the information processing rules specific to a certain IPS;

5) ***The organized set of the internal ISS***, the generating set of information carrier ISS[64], organized as an invariant object named ***memory***;

6) The second level energy ***supply units***.

[64] Inside IPS (mostly at AIPS) existing another fraction of ISS's set, free (void) of information (unwritten SSI, memory reserve).

The understanding of this IPS general model cannot be clearly achieved without to explain what are the information support systems, this MS class without whom the existence of any information processing operation would not be possible.

8.7 Information support systems

As we have seen in the definition 8.3.5 and in the axiom IV, the information, as an invariant collection of properties of the surrounding objects which are owned (stored) by an IPS, cannot exist without some support material objects (so as no distribution can exist in the absence of its abstract support). During this stage of the information support analysis, we must admit that any material system is an information support (for an IPS able to receive it), but it is a support for its natural information: structure (form), external position, mass, types of released fluxes etc. However, if it is necessary that the support system to contain (to include, store) a certain information, this MS cannot be made-up only by the rules of the natural formation of the abiotic material systems (with a strictly energetic formation criteria), but by also additional rules which are added to the fundamental laws of natural abiotic MS (similar to the case of artificial MS).

In the previous sections, we have seen that for achieving the perception of an object's property by an IPS, that particular property must be transmissible, which means that it must have a temporary support along a specific open, material flux, efferent to the source object, and this flux type must be included into the IPS's perception range. In case of an IPS which detects that property, the efferent flux from the object represents the material support of the perceived attribute, that is ISS, along the path between object and RBS of IPS. At the impact of the flux with the section of IPS specialized in capturing this flux type (input unit), a conversion *external flux - internal flux of inner ISS* deployed on a fraction from the incident flux is about to take place.

We must settle right from the start that ISS can have various forms. Based on their location against RBS of IPS, considered as a reference, we might have:

1) *Internal* ISS, which may exist and circulate as fluxes only inside RBS of IPS;

2) *External* ISS, which may be found outside IPS[65], their associated information being accessible to IPS only through its input units.

According to the processual class of objects (defined in paragr.4.3) which makes-up the information's material support, there are the following types, which are given below:

1) ISS belonging to class S_0, with a spatial structure and a defined and invariant structure (characteristic mostly for the ISS of the information stored into IPS memory, but also for external storage ISS);

2) ISS belonging to classes S_k, which are processual objects with defined and invariant spatial velocity (in case of a certain type of propagation/displacement medium), characteristic for the information fluxes (both external and internal ones).

An ISS belonging to the class S_0 is a specialized material system, initially made-up in the phase of ISS *without associated information* (erased, unrecorded, unwritten), from an even and invariant spatial distribution of MS which release or reflect a certain type of flux, this flux being accessible either to the information processing unit or to a certain perception system (input unit) belonging to an IPS (in case of the external ISS). According to the version with *associated information* (written, recorded), the distribution of the efferent fluxes is uneven (there are contrast elements), the written information consisting even in the structure (spatial distribution) of these irregularities. As any other realizable distribution, there must be some elements of this distribution (elementary ISS). The basic element of an ISS is an object with a

[65] Such as the viruses for the intracellular IPS or the books and other external information storage means for the human IPS

null internal differential information (contrast), for example a pixel. This means we are dealing with an even inner distribution of a transmissible attribute. The main condition, as we are about to see later on, which is required to this structure of recorded ISS is that it must be invariant during the entire period of information storage (due to this reason, the information's support material systems stored into the memory must belong to the class S_0).

A specific structure of the contrast elements within a specific ISS is perceived by IPS as a distinct object (with all the object's attributes - internal range, distributed attribute, distribution type, internal reference and moment of existence). This structure information of ISS is related to the external information which has generated the formation of that particular structure into the input unit of IPS.

Definition 8.7.1: The external information associated by IPS to a defined and invariant structure of an internal ISS is referred to as **semantic information** (synonym - **semantic value**) of that structure.

This external information consists of the total amount of the attributes of the external fluxes perceived by the input units of IPS from the source object. Because each external perceptible property is related to a distinct property of an internal ISS (made by the sensory organ specialized in receiving that property), this means that the properties of these ISS (with a simultaneous existence for the same external object which is perceived) are an *internal representation* (a conformable representation) of the external object.

Definition 8.7.2: The internal ISS, associated to a specific external semantic value is the **representation** of that semantic value into the internal medium of IPS.

The information processing systems are also S-type MS, which means that they have a RBS and an internal invariant structure. The integrity of this system is based on the fact that RBS allow the inner access only to the fluxes which are necessary in order to maintain their functions. If the external systems have a restricted access inside IPS, it might however exist some internal representations of these systems, mostly of the "interesting" ones (in case of the bio-systems), namely of those which present a potential danger or are useful (such as food, for instance) for the host systems.

Otherwise speaking, the total amount of the internal representations (of the internal ISS with associated external information) is a global representation of the external reality for a specific IPS. Each state of the material systems found outside IPS and perceived by this system shall be related to a specific state (structure, configuration) of the internal corresponding ISS.

Definition 8.7.3: The information contained into the structure attributes of an ISS is named **syntactic information** (synonym **- syntactic value**) of this structure.

For example, an 8 bits binary word has 256 different syntactic values, values which correspond to the same number of combination possibilities (spatial structure) of two symbols (0 and 1), arranged in groups of eight. According to a convention, this kind of syntactic value is related to a semantic value: a digital value, an alphanumeric character, a color, an operation type performed by the processor etc. Another example could be taken from the text-editors field in which a certain character from the alphabet owns lots of syntactic versions, such as font, size, **bold**, *italics*, underline, color etc. but the semantic value is unchanged and it is related to the same character. For understanding the definition 8.7.3, it is important that IPS to be able to accurately distinguish each of these structures, in other words, to separate two different syntactic values, because only in this way the separation of their associated semantic values would be possible.

The internal configuration of an ISS is not random, being the result of the application of some composition rules of the elements belonging to these specialized MS.

Definition 8.7.4: The total amount of rules which establish the possible structures of a specific ISS class is named **syntax** of that particular class.

If we take into consideration the same example from ISS domain used within AIPS, the 8 bits word is structured according to very precise rules:

– The word is an ordered series of reserved, disjoint but adjacent, spatial domains (abstract containers, see annex X.4), series in which any domain is related to an unique and invariant running number, starting from the internal reference position of the file (with its associated running number one);

– Each available position from this series can be occupied (or not) by an element of the word, element which is assigned with a quantitative value depending on this position, and which is related to a whole exponent of the numbering basis (that is "two" in the present example);

– The position within the series corresponds to the *qualitative* value of the element against the word's internal reference, that is a reference which was settled by convention (for example, the first element in the right side of the word). If the element is present (exists) at that position, its existence is marked with digit *1*, and if it does not exist (but the reserved position is still valid), its absence (non-existence) is marked with digit *0*[66].

– There is a strict correspondence between the element's *quantitative* value (in case it may be found at that position) and its inner position[67] (that is the qualitative value) within the word. If the running numbers of these possible positions are $n = 1...8$ (one for the reference right-side element), the quantitative value of each position is 2^{n-1}. In this context, the quantitative value of the whole word is the sum of the existent elements values at a given moment.

After all the aspects which were presented so far, the result is that there is a dependence relation between the syntactic information of an ISS and its semantic information, in other words, there is a set of assignment relations between the set of the possible structures of an ISS class and the set of its associated semantic values. However, according to the terminology of the objectual philosophy, we have seen (in chapter 2) that this kind of set of assignment relations is named *distribution*.

Definition 8.7.5: The distribution of semantic values on the support set of the syntactic values of an ISS class is named **language**.

Comment 8.7.1: Despite its simplicity, the definition 8.7.5 is applicable for any kind of language and it even suggests the existence of more language levels, due to the simple fact that each ISS class would be associated with a certain language type. According to the brief classifications of the ISS classes which were previously made, we are finding that two major language categories must exist - the *internal and external* ones - corresponding to the aforementioned internal and external ISS classes. In case of ISS which are placed outside the human body, for example for the visual-literal ISS of the natural written language, an external language would be associated (it is normal because the natural language is used for the external information communication fluxes). In case of this language, the distribution of the semantic values on the set of syntactic values is not provided by an invariant relation (as it is in case of the functions), but by a very large number of individual relations which you may find, for instance, in the explanatory dictionary of that particular language, and by a set of modification rules of these semantic values depending on the modifications allowed to be made on ISS structure (grammar rules). First, it is started with a steady and quite reduced number of elementary ISS, with a distinct syntactic value (characters of the written language: letters, digits and punctuation marks etc.) for which there is a single assignment relation between the semantic and syntactic value, assignment which does not depend on context. The association (composition) of these elements into compound objects with a strict order but a

[66] The reader is invited to observe the difference between the objectual philosophy and the traditional approach on the syntactic structure of numbers. In the paper herein, the digit zero is a marker (symbol) of the non-existence of an abstract object, but at the same time, it is an indicator of the existence of a reserved but vacant domain (abstract container) for that object.

[67] The dependence relation between the qualitative value (position within a structure) and the quantitative value of the element which is placed on that position is very obvious at the social structures. For example, within a political structure (a government, for instance), there are defined positions which have a finite number being strictly arranged into a certain hierarchical order. These positions may be vacant or not. If they are not vacant, the element which is placed on a certain position shall also receive the corresponding quantitative attributes (salary, power of decision etc.) in proportion to the running number of its place within the hierarchy.

variable length (words), then, of the words into more complex structures (collocations, clauses, compound sentences, etc.) shall lead to numerous possible syntactic values which would be related to the semantic values by means of relations which are specific to each language. We may also consider as external languages (in the human society) the natural spoken language, body language, behavior language etc., each syntactic value (phoneme series, set of movements made by specific body parts or by the face muscles) being related to defined and invariant semantic values specific for a particular social group or specific to a certain population. More surprisingly (and probably a controversy generator) is the idea of a mandatory existence of some *internal languages* which represent the distribution of semantic values (information external to IPS) on the set of syntactic values of the internal ISS. If this is an unquestionable fact in case of AIPS, the internal language being achieved by the designers of the processor and of the other programmable sub-units, as regards the biotic IPS, the existence of this language (possibly unified on the level of an entire reign, but with a "vocabulary" which depends on the species' evolution degree) is a very significant consequence of the implementation of the IPS generic model.

As for the language, mostly regarding the natural language and the association of semantic values to some syntactic values within this language, this topic shall be also depicted in the following chapter as well as in the annexes. Momentarily, we are only interested in finding how and who makes the association of semantic values within the internal ISS classes.

8.8 Association of semantic values to the syntactic values of the internal ISS

In the previous sections, we have seen that the information concept is strictly related to the existence of support MS, and that it represents the total amount of invariant properties of those systems, perceived by another type of specialized MS - information processing system - system whose general model was previously presented. If the picture is not clear by now, we are making an explicit underlining: <u>the information</u> (according to the objectual philosophy) <u>exists only for the class of IPS material systems</u>, the only systems which are able to operate with this notion.

As we have shown earlier in this chapter, in case of natural abiotic MS, the information and all the features which derive from it (such as the abstract objects) do not exist, because these systems are not endowed with IPS which is able to perceive and process this information.

Comment 8.8.1: This fact has unexpected implications on our concepts regarding some of the *abstract objects* (objects which shall be defined and analyzed in the following chapter, but momentarily, they are assimilated with the information contained within an ISS). One of the most frequently mistakes made by the people is to assign a real existence, free from their material support (ISS) to some abstract objects, due to the simple reason that our brain can operate this kind of separation between the objects properties, and it is also able to detach them from the object to whom they were initially assigned to, because each property is associated to a distinct internal ISS. But what is happening in our brain is an information processing, process which is quasi-total independent from the external world (of brain) and whose results do not always have a correspondent into the real, external world. The properties of MS, on which the human IPS perceives and stores them into our memory, are <u>nothing but properties</u> of some MS or of some real processes in which MS are involved, but they are not real, material objects with independent existence, just like they are considered in many circumstances. One of the most frequent assignments of "independent existence" is the time assignment (which according to the objectual philosophy is a property of processes) or the energy assignment (a property of the material fluxes), or of many other similar properties. We are about to see that the time is <u>only a property</u>, namely a property which is specific to the real processes (it is the support attribute of the temporal distributions), mostly of the periodical ones, where it is clearly defined, but it is a property assigned to the <u>representation</u> of the external objects (namely, of some internal ISS) by IPS, and therefore, it is its <u>internal</u> attribute.

But, let us return to the association of the semantic values on the support syntactic values. Because the information processing operations take place inside IPS, we will focus mostly on the association of that particular values on the internal ISS. We have seen that ISS have (for a finite number of elements from their composition) a finite variety of such possible structures, and IPS must be able to distinguish (to separate) these possible structures. We have also noticed that each possible structure of internal ISS (each syntactic value) must be related to a distinct semantic value - external information associated to this structure. First, let us see who makes the assignment of the semantic value to a specific syntactic value.

In case of AIPS, we have previously mentioned that this assignment between the syntactic value of a binary word and its meaning (semantic value) is artificially made, by means of convention (a set of rules), either by the processor's designer, for the instructions codes, or by the programmer, as regards the type of processed data. As for the programmer, it is his duty to find the proper semantic quantitative or qualitative value which will be assigned to a certain word, this assignment being completely indifferent for the current processors which are able to separate only the syntactic values of internal ISS. In other words, due to the universality of the computer applications, the artificial processors cannot assign semantic values by their own to the set of internal syntactic values.

As for NIPS, the problem is totally different. Since it is by far, the most notorious case, we shall talk about the human IPS. Here, "by construction" there is a qualitative differentiation of the information's input channels, firstly, according to the general properties types (fluxes) which are detected (the so-called sensory organs), and then, according to specific properties to each sensory organ. The separation based on the detected property type is mainly achieved through the internal structure of the sensory cells (therefore, through genetic differentiation), able to receive only a specific flux type, or a specific flux property (such as the direction or the frequency) and then, through the position of these cells, first, against the organ's internal reference, and second, of the organ against the body's internal reference. The most relevant aspect is that, in case of NIPS, all the sensory cells of all the sense organs operate simultaneously (in parallel), so as the neuron chains at which they are connected. The reason why they must operate under parallel and synchronic conditions shall be described later on.

Comment 8.8.2: If a comparison would be carried out on a common current AIPS which is able to operate with words of no more than 256 bits (the word being made-up from the number of bits which the processor is able to simultaneously process), then, the human "processor" operates with words counting several hundred of millions elements (elements which have also an internal structure which represents the intensity of the elementary flux received by a single cell). Even in case of the nowadays supercomputers with tens of thousands processors set in parallel, the operations parallelism has as its sole purpose, the rise of the processing speed and not the semantic separation of the information fluxes.

According to the specific terminology used in this paper, we may say that in case of neuronal NIPS, there is an invariant spatial distribution of the elementary input units on RBS of IPS (see the annex X.18), that is a distribution defined against the body's internal reference system.

This general distribution of the elementary input units into NIPS is divided in classes specialized on a certain type of detected properties (fluxes), classes which will form the specialized sensory organs, therefore, there is a defined distribution (invariant as well) of the received semantic values, distribution which is maintained until the entrance inside the brain. Here, due to the interconnective access between neurons (of the re-circulated fluxes between them), ISS exchanges may occur between the semantic domains (which are disjoint until the entrance inside the brain).

8.9 Information processing

The fact that there is a strict dependence between the structure (syntactic value) of an ISS and its semantic value, it means that any alteration (modification, variation) of this structure shall lead to the alteration of the contained semantic information. This alteration of the structure of an ISS may be either natural (such as the physical-chemical damage of the ancient writings, oblivion of some details from our past life), or "intentional", in case of the operations carried out on the internal ISS by the information processing unit. Now, let us briefly find out what are these modifications of the ISS internal structure, according to the notorious case of AIPS.

For AIPS class, these changes on the syntactic value of internal ISS, performed on an ISS element (bit) or group of elements (word) are named *operations.* An operation is a *process* (because we are dealing with a property variation of an object) in which there are one or more initial objects (the elements or the words which are not modified yet), which shall be named *operands*, the modification rule of the operands structure which shall be named *operator*, and the element or the modified word, called *result* of the operation. We notice that the alteration type of the syntactic value (operation type) which is required to an operand type is given by the operator type, therefore, each distinct operation would be related to a specific operator, which is included in the instruction list of the processor, provided by its manufacturer. The operations included in this list are elementary operations[68] (non-decomposable, also known as *instructions*), which however are able to form series, (sequences) no matter how long but yet finite, known as *programs*, which are also made-up from sequences with an invariant composition of operations, named *algorithms*. Even if it is probably not necessary, however, due to safety reasons, we are underlining once again: <u>the operands, operators and the result are internal ISS of AIPS.</u>

The operand meant to a certain operation and the operation's result are specified (distinguished, separated) by the amount of the other internal ISS by means of the internal spatial position (location) of them against the internal reference system of IPS, also defined by construction (the registers addresses, first address of the matrix structure memory etc.). Therefore, the spatial position of a distinct ISS is an internal qualitative attribute which can be distinguished by the processor.

If you remember what I have mentioned in chapter 3 about the reference systems of the compound objects, you have already observed the existence of a hierarchy of these reference systems, which is also valid for the ISS objects inside AIPS. There are elementary ISS (bits) with spatial domains and defined positions within the word (against the word's internal reference), and then, there is a spatial reference against which the position (address) of the word in a certain block may be assessed, followed by the block reference, all of them being assessed against the main reference (internal reference of IPS). The specification of a certain operand means, besides the operand's syntactic value, also the specification of its spatial location (address); in this case, we are dealing with a first example of association between two properties of a single object, the address becoming the second property (besides the syntactic value) of the word.

The *association* operation of this new property is therefore a simple joining (generation of a new object by means of external composition, as we have seen in chapter 3) of the two ISS[69]- the one which contains the syntactic value and the one which hosts the address (a syntactic value as well) of that value into the internal spatial domain of IPS. This new object made-up from the permanent composition (association) of two ISS with simultaneous existence shall be completely determined (distinguishable) in the entire set of the internal ISS from IPS because its memory location is an unique specific attribute.

After we clarified what is an operand, let us see what kind of operators may be found at AIPS, by mentioning that we are making only a review of the most common ones usual within some generations of processors, regardless of their manufacturer:

− Transfer operators (since we are talking about transfer, it is clear that we are dealing with a flux initiation) from one location to another (both specified), transfer which can be either conditioned or not;

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[68] These operations are elementary only for the programmers (processor's users), but inside the processor, they are still decomposable in the so-called micro-operations.

[69] Similarly with the association of one person's name with his/her address from a locality, or with the association of the date and place of birth, all of these with a sole purpose to clearly identify (separate) that particular person from a set of persons.

- Replication (copy) operators;
- Replacement (substitution) operators, with a particular case - erasure;
- Logical (qualitative) operators;
- Arithmetical (quantitative) operators.

The transfer operators do not alter the value of the operand but only the value of its location, likewise the replication and logical operators. The replacement operators do not alter the location.

Among the above-mentioned operators, the most important ones (from the point of view of the objectual philosophy) are the transfer and comparison ones, the latter being included both in the category of logical and arithmetical operators. The logical (qualitative) comparison implies the analysis of ISS structure of the two operands and to distinguish the difference between these structures, and the result can only have two values: *equal* (in case of the identical structures) or *different* (non-equal). The arithmetic (quantitative) comparison is applied to the quantitative values of the two operands (a difference as well), out of which, one is considered as a reference, and depending on the sign and value of this difference, we shall have three possible results: *less* (negative sign), *major* (positive sign) or *equal* (the difference value is under the perception threshold of IPS, regardless its sign, and considered to be zero, namely, the non-existent difference).

After this brief foray into the field of the common information processing operations characteristic to AIPS, let us see what we know about the operations carried out by NIPS, mainly by the human one. If we consider the above-mentioned list of AIPS operations as a reference, we may certainly assert that in case of the neuronal IPS, there are appropriate ISS transfers (fluxes), but, for the time being, we do not know precisely if they are commanded (just like in AIPS case) or they have a natural existence, as any other vital flux. The fact that our brain is able to access at a certain moment a massive amount of information when making an evocation, this may confirm us that it is also likely to exist a commanded transfer. Another fact which is also certain is that there is no explicit erasure operation within the neuronal IPS, the cancellation of unnecessary information is inherently made, by omitting to make a refresh (mostly in case of the short-term memory). On this occasion, we have also defined an operation performed within the neuronal NIPS - that is the refreshment - which, in case of AIPS, is equivalent with the refresh made within the dynamic memories, operation which is similar with the replication and replacement achieved at the same location. In fact, the replication at NIPS is extensively present, starting with DNA replication within the cell division and continuing with the information replication from DNA segments within the transcript of the genetic information into RNA sequences.

As for the quantitative operations, we may only say that they are absolutely necessary for the evaluation of the intensity of the fluxes which are carriers of external information, that the result of this evaluation must be proportional to the input values, and that the generated amount must determine the amplitude of the IPS response, and of the host bio-system to that final information. For all of these, there must be support for at least three operations: logarithmation, addition and subtraction. The logarithmation (which was experimentally found in some input units) is necessary for covering a very wide intensity range of the incident fluxes, with a much more reduced range of syntactic values. The addition and subtraction are required in order to achieve other information processing operations, out of which, one is of the greatest interest for us - that is the *comparison*. So as this operation could not miss within AIPS, it does not miss either at NIPS because ***the comparison is a fundamental information processing operation***, which may be found at any type of IPS.

Comment 8.9.1: For those who know something about the automatic control systems, it is well known that a mandatory operational block within the universal model of these systems is the comparison block, which is a block meant to compare the input information (command) with the output information (reaction proportional to the adjusted amount), the result (difference) being applied at the input of the regulator. Since most of the elements belonging to the vegetative system (neuronal as well) are extremely complex control systems, it is self-understood that the comparison operation must be mandatorily implemented into the neuronal IPS. The existence of two neuro-mediators classes - exciters and inhibitors - is considered as a proof for the existence of the two operations - addition and subtraction - of the intensity of fluxes transmitted through the synapses.

As we have seen in case of AIPS, where we have analyse in detail the comparison operation, its essence consists in the simultaneous existence of the two operands at the moment when the operation is in progress, out of which, one is considered as a reference and it is previously stored into IPS memory. However, we have noticed in chapter 3 that a reference must be an invariant object during its entire existence as a reference. Consequently, we shall have:

AXIOM V (memory's axiom): For making possible the comparison between an information received in the present with an information received in the past, the previous information stored into IPS memory must be invariant (the internal structure, syntactic value of ISS must be invariant).

Comment 8.9.2: The fact that a memory is able to store non-alterable information only with condition that the support of this information (ISS) to be also non-alterable throughout time, has a major impact on the analysis method of the cognition processes, stated by the objectual philosophy. The first consequence of this axiom is that only the objects may be stored into a memory (ISS with an invariant structure after storage) but not processes as well. We are reminding that an object is an invariant collection of invariant attributes, distributed on a common, as well as on an invariant support. An indirect method is being used for the processes storage, that is the storage of a series of sample objects (which are invariant once they were stored), which were sampled at successive time intervals and which contain the value of the variable attribute existing at the moment of sampling (objects which were minutely described in chapter 4 and which are called *states*). These samples are stored in successive and adjacent spatial locations, so that a temporal difference Δt would be related to a difference of spatial position (location) Δr. Therefore, the processes shall be stored into the short-term memory of an IPS as a system of objects (a series of invariant successive-adjacent elements)[70]. Even the fact that people have selected the notion of *state* for describing an evolution of the attributes of specific objects may be explained by the fact that our brain is not able to operate directly with processes. Another consequence of this axiom is that any ISS, either it is internal or external to an IPS, and regardless if IPS is artificial or natural (biotic), it must be a S-type MS (from the point of view of the detectable attribute by IPS) during the period of the information storage. Because any information found inside IPS may be used sometimes as a reference from a comparison operation, it results that all ISS which are carriers of internal information (written, recorded) must be invariant during the existence of that particular information. A last but not least significant consequence is even the fact that information (mostly quantitative determination) means invariance, the greater is the invariance degree, the greater is the information amount (accuracy) and vice-versa. If you, my dear reader, were patient enough to read up to this section, you will better understand the definition 8.3.5 which was used for describing the information concept.

So far, we have used notions such as *simultaneous, previous, present* etc. with the meaning known by each of us from the school or from our own experience. These words are common because each of them is related to specific values of a special attribute - that is the *temporal attribute* (the time).

AXIOM VI (time's axiom): The time is an attribute totally independent from any other attribute, which is continuous and evenly variable, exclusively used by MS from IPS class, and by means of association of its quantitative value to the perceived objects, these systems (IPS) are able to achieve their fundamental tasks:

a) validation of the multiple and simultaneous existence of the objects;

[70] This process of successive storage of some series of objects with variable attributes (successive as well) is mainly specific to the short-term memory (STM) in case of the biotic IPS, until the short-term prediction on the evolution of the on-going processes and the systemic review of the recently acquired information would take place. This kind of process may be also found at AIPS which are designed for the processing of the continuous signals received from the outside, where the sampling and memorization is the only storage method of these variable signals.

b) evaluation of the attributes <u>variations</u> (processes), by comparing the <u>present</u> information with a <u>previous</u> information stored into memory;
c) short-term <u>anticipation</u> on the evolution of a process.

Comment 8.9.3: The perception of the direct reality (which shall be subsequently defined) by an IPS (for instance, a human one) is made through the channels of sensorial information. The total amount of the external objects whose efferent fluxes are captured by the sensory channels, in parallel and at the same time, are considered to have a <u>simultaneous existence</u>. Therefore, the simultaneous existence of the objects requires <u>an unique moment for all these objects</u>, even if those particular objects have an infinite number (absolute reality in case of an IPS with infinite performance). The perception of a property variation of an object from the real world (such as the spatial position) is made by comparing that property which was perceived at a present moment with the property of the same object perceived <u>and stored</u> at a previous moment. The difference between the two values will be even the attribute change characteristic to a motion process of the object. It is clear that, in order to unfold all these operations, IPS must be equipped with an unique clock and the information generated by this clock at a specific moment to be associated with all ISS which represent external objects with a simultaneous existence. Under the assumption that there are more IPS which communicate one another and are able to perceive more, but the same objects with a simultaneous existence, the individual simultaneity of the existence of these objects becomes a collective simultaneity. For the synchronization of the collective perceptions felt by a group of individuals, an external unique clock is required - that is the collective temporal reference. Nowadays, the mankind has such an unique clock (which defines the universal time) which synchronizes the external time of each member of the community, used for the description of any kind of process, but it is valid only for humans and for the artificial IPS created by them. The other bio-systems which do not communicate with people keep their own clock, and the abiotic systems simply do not care about the universal time which some people think it is real. The alleged reality of the time comes from the uncontrolled nouning of the properties of objects or processes, through which the properties are separated by the support material object, by granting them afterwards an independent existence, as if these properties would be able to exist without the support on which they are distributed. Obviously, there are a lot of periodical processes deployed into the external material world, but their counting (which provides the result of the quantitative value of the temporal attribute) is an <u>information processing operation,</u> which is non-accessible to the abiotic MS, as any form of information.

The temporal attribute indicated in the axiom VI is the virtual time (mathematic, ideal), with support values taken from the set of the real numbers {R}. The independence of this qualitative attribute is an abstract independence (by convention, by definition etc.), under the meaning settled when defining the *independent* attribute, therefore, it is assumed that there is no process whose variations to be able to determine variations of the time running rate. However, the realizable time (as it was mentioned at the beginning of this chapter), is a counting of a very stable, real periodical process, the numerical value stored in this counter (increased by an unit at each completion of the cyclic process) being considered as an existential attribute of the time (of the present moment).

Comment 8.9.4: The stability of the repetitive process counted in case of the realizable time derives from its isolation degree; the better confined are the variable fluxes which make-up the repetitive process and consequently, non-influenced by the external processes, the more constant will be the frequency of that particular process. Because the total isolation cannot be achieved, because both the process elements and the isolation elements belong to the same medium - PFM (ether) - no absolute stability is possible either. Moreover, any variation of the motion of this ensemble through PFM shall induce variations into the flux stockpiles and therefore, into the process frequency. In other words, the realizable time cannot be absolutely independent, as it is required by the virtual time definition.

As for AIPS, the counter of the periodical process (oscillation of a quartz crystal) is well-known and it may be found at any kind of systems like this (the processor's tact generator and the so-called real time clock), all the elementary operations of the processors being performed at regular intervals generated by this internal clock.

The location of this internal clock is still unknown in case of NIPS (which is probably placed at intracellular level) but its existence cannot be questioned because for the bio-systems as well, time is an essential attribute for the same basic functions: the perception of the multiple objects with a simultaneous existence, perception of the processes and short-term prediction of the evolution of these processes.

The *"present"* moment of a neuronal biotic IPS can be considered as the moment of the last variation perceived by an attribute. We are talking about any variation, of any perceptible flux from the panoply of *n* types of fluxes with a simultaneous perception (for humans, it may be the last sound, the last seen or felt move, even we are referring to our own heart beats or to the breathing motions. This is also the moment of the last (from the already existing series) sensorial ISS from the perception domain of that particular variation. The perception is simultaneous (synchronic) for all the elementary information channels of the neuronal NIPS. The very advanced parallelism of the elementary information channels has the purpose even to detect and distinguish by means of contrast attributes, the multiple existence of the objects from the external or internal world, and the synchronic operation of all these channels allow the validation of their simultaneous existence. The separation capacity between the multiple objects (resolution) is direct proportional to the number of the elementary information channels (see also annex X.14).

All the different objects, separated between them through boundary contrast attributes, perceived at the present moment, have associated ISS, produced at the same moment, and they will have the same position into the global register (the simultaneous fluxes of internal ISS of all the elementary information channels). The total amount of these ISS generated at the present moment shall make-up the *internal representation of the present* (direct) *external reality* from that moment. A process which is perceived to be unfolded within the *present* interval[71]is a *real process.* The processes which took place before this moment, were completed and they are stored into IPS memory as series of states, are *abstract processes* (the abstract processes shall be approached in the following chapter).

The information processing carried out during a real process and moreover, the invariance assumption of the attributes of this process (direction, speed etc.), in the absence of no disturbing factors, provides the elements of another fundamental operation for IPS class - ***prediction of the process' future evolution***. As for the biotic IPS, this prediction is vital in order to avoid processes which may lead to the destruction of the host bio-system, the prediction capacity being even a trace of the evolution level of the species to which the bio-system belongs to.

We cannot end this short foray into the information processing field without mentioning an operation considered by the objectual philosophy as a constitutive part to all the biotic IPS (including the intracellular level) because it comes from the general information organization manner into the DNA molecule. In this paper, that particular operation (which is not an elementary operation, as for NIPS its constitutive elements are still unknown) is named *objectual (systemic) analysis* and consists in the extraction of the common and specific components of the set of perceived objects. If an identical common component already exists in the long-term memory, the information is only refreshed and it is associated only with the new perceived values (specific components). If the specific components also exist, they will be refreshed as well. If there are no more common components, both classes of components belonging to the perceived objects shall be stored. In this way, an information hierarchy occurs into the biotic IPS memory, in which all the perceptions are organized on classes of objects, with their common components stored one time, and with the specific components which are individually stored. This is an organization technique known by the IT experts as a method of information compression, which is required for a more efficient utilization of a finite resource - IPS memory.

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[71] A temporal interval is considered to be present if it is the last from a series of periodical intervals and contains inside it the present moment. These intervals have a length (duration) settled by association with the periodical observable astronomic processes (years, month, days etc.), processes which, for many centuries, were the only time measuring units.

9.0 Conclusions

This chapter was focused on similar IPS, such as the neuronal NIPS of the bio-systems, and AIPS belonging to the class of the ordinary computers. The same class of IPS also include the control systems (both biotic and artificial), with the same basic components, but with more simple functions. As for the general IPS class, we can retain:

1) The information processing systems are a special class of MS, able to operate with another special class of MS - *the information support systems* (ISS).

2) ISS are an invariant spatial distribution of MS which emit or divert (reflect) a certain type of flux (attribute) detectable by IPS, distribution whose configuration (distribution type) is named *syntactic value* (or *syntactic information*).

3) Each distinguishable syntactic value of the internal ISS of IPS is related to a spatial distribution of the properties of IPS external fluxes which are also incident on it (flux type, frequency, intensity, source position etc.), distribution which is called associated external information (*semantic value*) of that ISS. The syntactic value of the internal ISS to which that semantic value is associated constitutes the *internal representation* of the semantic value.

4) The union of the syntactic value with the semantic one, associated to a specific ISS, both of them being invariant, makes-up its associated *total information*.

5) All IPS have a general model (IPS class model) which consists of the following sub-systems:

a) input units;
b) output units;
c) information processing units;
d) internal communication system;
e) organized set of ISS;
f) second level energy supply units.

6) The information processing means an alteration (change, modification) process of the ISS structure, according to internal rules specific to each type of IPS, so that the basic functions of this system to be achieved. The collection of these rules is named *syntax*.

7) As for the external relations NIPS of the advanced bio-systems, their basic functions are: the perception and validation of the simultaneous existence of the external objects, perception and evaluation of the attribute variations specific to these objects (the existence of the real processes), and the short-term prediction of the evolution manifested by these processes.

Ch.9 ABSTRACT SYSTEMS

9.1 Real objects

We have seen in the previous chapter that any object which is external to an IPS, object which emits or reflects fluxes meant to be perceived by IPS, is validated by IPS as an *existent one* at the moment of perception.

Definition 9.1.1: Any external object which is validated as existent at the present moment of the perceiving IPS is considered as a **real object** for this IPS.

Comment 9.1.1: The validation of an object's presence at a specific spatial position can be done only by an IPS. At the "present" time of perception t_k (time which is also defined in the same IPS), the external object is associated to an internal ISS - that is the internal representation of the external object. Other ISS associations will follow afterwards, which are either representations of the same object (but at a subsequent "present" time) or of other objects, but ISS associated to an object at the t_k moment does not represent a real object any longer, because it is already stored into IPS memory (it belongs to the past). According to our terminology, we might say that an ISS associated to the perceiving real object is a representation of the *state* of the existing external object. We have already discussed in the previous chapter about the *present interval* required to IPS in order to define the processes (because a process needs a temporal interval for its unfolding). We might say that the succession of the states specific to a real object makes-up a real process. But the temporal states and moments associated to an object which is declared as real, is internal ISS, specific to a certain type of IPS, and if that IPS is singular, all of these will be valid only for it. In the previous chapter, we have noticed that the principle of the objects existence implies that the object which is considered as existent, to emit perceivable fluxes or to reflect them (to withstand against the intrusion of the external fluxes). The reader is invited to remember a fact which is quite frequent in the people's world, namely, the checking of his own existence in circumstances in which he is put in doubt by the brain, such as the transition from the dream to the wake state. In such circumstances, for checking if the dream keeps going or what is happening is a real process, any human being palpates himself or the surrounding objects. But, these activities are nothing else but materiality (reality) tests carried out on our own body or on the surrounding objects, which certifies that, under successful conditions, either our epidermis (our own RBS) or the surrounding objects (with their own RBS) are not permeable to the flux of the moving fingers. Besides the confirmation of our own materiality, as well as of the materiality of the surrounding objects, this test also confirm the existence of the information processing processes deployed in our brain, therefore, of the conscious state (wake state) *Cogito ergo sum*, don't you think so? (#)

According to the theoretical models upheld in this paper, the class of the real objects is formed entirely from *material* objects defined in accordance to the class model of the material systems (3**F** model). The union of all the real objects perceived by a certain IPS as having a simultaneous and permanent existence in a certain period of time, together with the union of all the real processes to which they are subjected to, makes-up the ***direct*** (synonym - ***concrete***) ***individual reality*** existent at that present interval for that particular IPS.

If more identical IPS exist, which perceive the same real objects and processes, and these IPS are able to communicate externally their perceptions (internal representations), then, the objects and processes which are jointly perceived by IPS set shall make-up the ***direct collective reality*** of IPS group.

According as the communication means between IPS have an access range which exceeds the direct perception domain of an IPS, each IPS shall be able to access informations (obviously, external ones) about the existence of some objects and processes assumed to be real, which have been perceived by other IPS placed at long distances and collected (stored) for long periods of time. The union of these representations of objects and processes assumed to have a permanent and simultaneous existence shall make-up the ***known reality*** of the IPS group (society). This known reality is therefore made-up from the material objects and processes about which reliable data are found, taken either from its own IPS information stockpile (long-term memory), or from the community's access data base (books, magazines and other broadcast mass-media or external information storage media).

Comment 9.1.2: Now it is time to make the reader aware that the information which is taken into account in case of the different reality categories must meet a basic condition: to be true. While as regards the truth value of the information acquired during the perception process of the direct individual reality, there are few reasons of doubt (only concerning the illusions which can be avoided due to a proper education and experience level), as for the known reality, there are little chances that the entire information amount to be true.

As we have aforementioned, the known reality is an information union on the objects and processes which are presumed as permanently real by a certain IPS community (such as the community of brains existing in a specific human society at a given moment). Because this IPS set is able to perceive only the information received through the currently perceptible fluxes (this category also consisting in the fluxes perceived through artificial conversion means of the fluxes unable to be directly perceived), there are certainly material objects and processes unable to be perceived yet by this community, therefore, there is no information about the existence of these objects and processes. This means that, besides the elements of the known reality, there are also a lot of material objects and processes belonging to a potentially concrete reality, but yet unknown. The union of all these known and unknown objects, but which are presumed as having a simultaneous existence in the entire infinite space, makes-up the ***absolute reality***.

Comment 9.13: This abstract object called *absolute reality* may be somehow found in other philosophies, but under the name of *objective reality*. We did not use this name because the concepts of *object* and its fluxions are *reserved words* according to the objectual philosophy, which are meant for other utilization. On the other hand, the meaning assigned in this paper to the term *absolute* implies either a null or infinite information, attributes of the virtual objects which alongside the absolute reality belong to the same class.

This absolute reality obviously contains an infinite information amount, which cannot be owned and processed by no IPS, either it is natural (biotic) or artificial, unless this IPS has an infinite-performing character.

Comment 9.1.4: Such examples of some infinite-performing IPS conceived by people for ages are the deities which form the basis of the past or current religions. These deities are all-knowing, they know all about any person, creature and thing on the planet, at any moment from their existence; they have created the stars, planets and other astronomical bodies, people and all the plants, animals, therefore, all of these objects and creatures initially existed as a project (concepts, abstract objects) in the mind of these deities. The reader may decide by his own if this kind of infinite-performing systems are materially realizable.

The absolute reality is a virtual object towards which any type of cognition asymptotically tends to, including the human cognition, but which can never be reached. This virtual object is however useful for another global definition of the *information* concept, the absolute reality being the base for a dichotomous classification, of defining a complementarity (see the annex X.5), namely, between the *cognition* (determination, information existence) regarding the known segment of the absolute reality and *non-cognition* (non-determination, lack of information), such a wide but yet unknown field of the absolute reality. The absolute reality at a certain moment includes the total amount of the states of the material objects and of their related processes, found at that moment in the infinite spatial domain, independent from our cognition. Moreover, the objectual philosophy asserts that:

AXIOM VII (axiom of the unique reality): The absolute reality made-up from the total information about the material systems and processes to which they are subjected to, which have a simultaneous existence into the infinite Euclidean space, is unique and independent from any IPS.

Comment 9.1.5: As we have previously mentioned, very small but constantly growing domains from this absolute reality become accessible to our cognition, making-up the true known reality. We certainly know that in the range of abiotic MS, there are the terrestrial natural media (solids, liquids, gases), we know most of their macro and microscopic properties and we know how to build artificial objects by using them. We also know that beside our planet, there are other planets in our solar system, we saw them at close distance by means of the spatial probes and we are now finding that there are also planets around other stars. We also know that there are galaxies and systems made-up from galaxies which are spread up to the limit of our observable universe. In the field of biotic MS, we have certain knowledge regarding their structure by starting with the prokaryotic cells and ending with the biggest plants and animals. We know that all the bio-systems are based on the genetic code contained in the DNA molecule. These are only few benchmarks from the much more wider field of the known reality which is true and accessible to people nowadays. All these certain knowledge are obtained based on the fact that these particular systems are accessible to a great number of people, either directly, through our sensory perception systems, or indirectly, through auxiliary means (microscopes, telescopes etc.) which were constantly checked proving that they are reliable. The doubts regarding the true about some data from the currently known reality occur when those data refer to the material systems which are inaccessible to the direct or instrumental observation, either due to too small sizes for the current instruments, or due to the environment conditions which do not allow the existence of any instrument (that is the case of the internal media of AB), or because of too long distances. In such circumstances, the lack of real information is compensated by synthetic, hypothetic information "manufactured" by theorists, based on some mathematic models. However, a mathematic model is an abstract object placed in the external or internal memory of an IPS, and as any other abstract object generated as a result of an information processing system, it is not compulsory to be materially realizable, namely, to exist a correspondent MS. The neutral hydrogen atoms from our universe which can be found at a specific moment, considered as components of the absolute reality, have the same structure and spectral lines of emission/absorption for several billion years, without even care that the people have released at least tens of mathematic models for them over the years. In other words, despite of the different models, the structure and the internal processes from all the hydrogen atoms are unique, regardless of the human cognition. This oneness which is valid for a group of MS can be extrapolated to the set of all MS which make-up the absolute reality. As we have mentioned in chapter 1, regardless of the reality models imposed at a specific moment by some interest groups, the material systems which are beyond the limits of human cognition continue to live on, just as the galaxies, electrons or photons which existed back since our ancestors times, but nobody told them that (#).

9.2 Abstract objects

9.2.1 Abstract object

In chapter 8, we have seen that the total amount of structure properties of an ISS represents the *syntactic* information (syntactic value) of that particular ISS, and the total amount of IPS external properties associated to this syntactic value represents the *semantic* information (semantic value) of that ISS.

If the syntactic properties belong to some internal ISS, they will be directly perceived by the internal information processing unit, and if the syntactic properties belong to some external ISS, they will be indirectly perceived through the input units of IPS. The real purpose of this chapter is to reveal that there is a finite number of all these properties and all of them are invariant for a specific ISS. This ISS with a specific syntactic value is associated (also by IPS) to a specific semantic information, the association being made either based on personal experience, or based on education (learning) in case of IPS which own an external language.

Definition 9.2.1.1: The total amount of the syntactic and semantic information, quantitatively finite and invariant, associated to an ISS, make-up an **abstract object**.

Comment 9.2.1.1: The definition 9.2.1.1 has a general character, which means that it is valid for any type of ISS, either it is internal or external to an IPS. We have noticed that the set of the internal ISS of an IPS makes-up its memory, for which the *memory's axiom* is applicable, which postulates that only objects can be stored into a memory (finite and invariant information amounts). The same axiom is also valid for the external memory of an IPS, where the storable information is contained by some ISS with invariant syntactic value but which can be found outside IPS. In other words, an abstract object represents a finite and invariant information amount stored in a memory, either it is an internal or an external one. And because the information cannot exist without a material support, it is contained by an ISS with a specific syntactic value (a finite and invariant information as well).

9.2.2 Concrete abstract objects

Let us assume that an external material object Obx_1 from the direct individual reality of an IPS was detected with n direct (sensorial) qualitative properties. This fact means that the general property P1 (the properties set) belonging to the generic object model (defined in chapter 3) consists of *n* qualitative attributes[72]. These *n* properties are distributed (in case of the material objects) on a *spatial domain* occupied by the object, domain which represents the abstract support of all *n* distributions assigned on this internal domain. Therefore, the general property P2 (the common support attribute of all distributions) is the spatial position, and the sizes of the object's internal spatial domain represents the property P4. The general property P3 (distribution type of each property within the set) is assessed by the input unit of IPS which is specialized in receiving that property. The assessment of P3 distributions is made both against the internal RS of IPS (the general property P5 of IPS) and against the internal RS of the object Obx_1 (the general P5 property of that particular object), internal RS of IPS being the external reference for the object Obx_1. All these components have a simultaneous existence at the moment *t* - general property P6 (see the annex X.16 for details concerning the perception of objects by IPS).

It is worth mentioning that the property P6 is an internal property of IPS, and that property is assigned to its internal representation from the internal ISS medium of IPS (a *state* of the external object which is found at the moment *t* into the memory IPS). In other words, all the general properties about which we have discussed so far, belong (are related) to this internal representation of an external object, representation which has the form of a specific structure (configuration) of the internal ISS.

Definition 9.2.2.1: The abstract object which is associated by IPS to an external object from the direct individual reality is named a **concrete** (synonym - **sensorial**) **abstract object**.

Comment 9.2.2.1: A *concrete abstract object* is the information contained in an internal ISS of an IPS, corresponding to the perception of an object from the direct individual reality (an external one, for instance) by an input unit. This object (internal ISS) has a finite exclusively spatial distribution (which, in case of an AIPS, is related to a continuous domain of memory locations), all the other external distributions (either frequential or temporal) being converted into spatial distributions. ISS which contains a concrete abstract object is stored (in case of NIPS) into the short-term memory (STM). Any real object perceived by an IPS has a *representation* (a substitute, an image) inside it (of IPS), namely, an internal ISS which must contain the information associated to the real object. However, not any abstract object (that is the information contained in an ISS) has a correspondent in the real world. For example, the abstract objects which are generated as a result of the information processing operations (which are abstract processes) do not always have a potential correspondent in the real world (which means that they are not materially realisable). The most relevant and simple example is represented by ISS which contains the result of the comparison between two real objects (difference, contrast). This abstract object cannot be related to any object from the real world. Adjoining to the possibility of representing a specific real object, an abstract object may also represent a set of real or abstract objects. The *names, resultants*, *public authority, etc.* are few worth-mentioning elements belonging to this category and some of them will be subsequently analysed.

The association of a concrete abstract object (a finite amount of internal sensorial information) to an external material object is the first step, the main stage of the *abstraction* process. Due to this reason, the sensorial abstract objects have the lowest abstraction level from the internal abstract objects, being *fundamental abstract objects* (with an unit abstraction level).

Comment 9.2.2.2: Attention! When we have dealt with the analytical level of the compound objects in chapter 3, we saw that the objects which cannot be decomposed any longer based on a certain criterion show an unit analytical level, which means that they are fundamental (or elementary) objects as regards that criterion. When we are dealing with *fundamental abstract objects*, these objects are fundamental (elementary) only as regards the abstraction level (they have an unit abstraction level).

Let us assume that the concrete abstract object Obx_1 (the internal representation of an external material object for IPS) has the following structure:

[72] We are talking only about the invariant properties, namely, the *objectual* ones. Besides these invariant properties, the external objects can have other much more numerous set of *processual* properties, namely, those invariant properties of the processes in which the object's attributes are variable.

$$\{Obx_1\} = \{P_{ax}(\overline{r_i}), P_{bx}(\overline{r_i}), P_{cx}(\overline{r_i}), V_x(\overline{r_i}), \overline{r}_{e1}(t)\} \quad (9.2.2.1)$$

where:

– $\{P_{ax}, P_{bx}, P_{cx}\}$ is the set of the sensorial properties (general property P1), determined by the input units *A,B,C* of IPS;

– The common support attribute of all distributions (general property P2) is the spatial position $\overline{r_i}$ determined against the object's internal reference system[73] (general property P5);

– $P_{ax}(\overline{r_i})$, $P_{bx}(\overline{r_i})$, $P_{cx}(\overline{r_i})$ are the internal distribution types of these properties (general property P3), the so-called sensorial distributions (analyzed in annex X.18);

– $V_x(\overline{r_i})$ is the amount of the internal spatial domain of Obx_1 (general property P4), also determined by IPS against the object's internal reference;

– Moment *t* of the simultaneous existence of all the general properties of Obx_1 (general property P6);

– $\overline{r}_{e1}(t)$ is the external spatial position of Obx_1 (position of the internal RS of the object against an external RS, which can be an internal RS of IPS or a RS artificially built by IPS as well).

9.2.3 Classes of abstract objects

Let us further assume that at the moment *t*, there is another external material object which is identical with the first one, whose internal representation is the concrete abstract object Obx_2:

$$\{Obx_2\} = \{P_{ax}(\overline{r_i}), P_{bx}(\overline{r_i}), P_{cx}(\overline{r_i}), V_x(\overline{r_i}), \overline{r}_{e2}(t)\} \quad (9.2.3.1)$$

The spatial-temporal exclusion principle of the compact objects[74] postulates that the two objects with a simultaneous existence cannot be placed on the same spatial domain, which means that the second object must have a spatial position so that their internal domains to be disjoint, or at most, adjacent. Consequently, the two objects (more exactly, their internal T references) shall have different external spatial positions $\overline{r}_{e1}(t)$ and $\overline{r}_{e2}(t)$. In case of the two identical objects, their different spatial positions are the only properties which allow the distinction (separation, differentiation) of each object. As we have mentioned in chapter 3, for achieving the differentiation between two objects, there must be a property difference (contrast) between them, which may be either of quantitative or qualitative nature, or both. In the example below, the contrast is a vector:

$$\Delta\overline{r}_{12} = \overline{r}_{e1}(t) - \overline{r}_{e2}(t) \quad (9.2.3.2)$$

Definition 9.2.3.1: The properties of the abstract objects which consist of values (qualitative and/or quantitative) differences which allow the objects differentiation, are named **specific properties** (synonym - **differential properties**).

Except the external position, both the property sets and the amounts of the two support domains of the two objects are identical, otherwise speaking, there are no differences between the properties of the same type (homologue) belonging to the two objects.

[73] The object's reference system is also generated by IPS (by processing the information) based on the existence of the internal reference systems of the input units (sensory organs) and of the global reference system of IPS.

[74] Assuming that both Obx_1 and Obx_2 are compact objects.

Definition 9.2.3.2: The properties of a systemic set of abstract objects which do not have value differences, either they are qualitative and/or quantitative, are named **common properties** of that set of objects.

The common properties of the two objects Obx_1 and Obx_2, which exclude the external spatial position (specific attribute), make-up the model of another abstract object which does not have any longer a correspondent into the external world of IPS (it is a simple finite information amount associated to an internal ISS):

$$\{Obx\} = \{P_{ax}(\overline{r_i}), P_{bx}(\overline{r_i}), P_{cx}(\overline{r_i}), V_x(\overline{r_i})\} \tag{9.2.3.3}$$

Definition 9.2.3.3: All the abstract objects which have the same model make-up a **class** of abstract objects.

Definition 9.2.3.4: The abstract object made-up from the common properties of a set of abstract objects is named **class model**.

We have previously noticed that the abstract concrete object is a representation of a single external object into the memory of an IPS. Now, we are finding that the abstract object known as *class* is a representation (into IPS memory) of a set of objects.

Definition 9.2.3.5: The set of objects which belong to a specific class represents the **support set** of that particular class.

Comment 9.2.3.1: After the introduction of the *support set* notion on a class of abstract objects, we may notice that the abstract concrete (sensorial) objects always have a single object as their support (the mathematic equivalent of a set with a single element, that is a prohibited notion, because according to the objectual philosophy, the set of objects and the single object are different notions).

In general, the support set of a class of abstract objects is non-defined as a number of elements, but this number is not so important for the abstraction process (it is enough that the support set to be systemic).

As for the above-mentioned case, the support set of the class *Obx* has only two elements. Similarly with the issues presented in chapter 2, the support of a distribution as a set of the singular values which can be assigned to the independent variable, and as regards the classes, there is also a set of singular (individual, particular) objects which have the same model (the class model), but different specific attributes. A specific element of the support set (a particular object of the class) may be obtained by means of association (addition) to the class model of at least one attribute specific to that object.

Definition 9.2.3.6: A singular (particular) object belonging to the support set of a class, obtained through the association to the class model of a specific attribute of that object, is named the **instance** of that class.

Any of the objects Obx_1 or Obx_2 are instances (particular objects) of the class *Obx* obtained as a result of the association to the common model class of a spatial position specific to each object.

9.2.4 Abstraction level

As we have mentioned in section 9.2.2, the representation of an external object taken from the individual reality inside the memory of an IPS is considered as an abstract concrete object, that is an object with the first and the lowest abstraction level - the unit basic level. This abstract object has always an external material correspondent, source of the information carrier fluxes which were described in chapter 8.

Comment 9.2.4.1: When we discussed about ISS in chapter 8, we were saying that any material system is a support for its natural information (types of eferent fluxes, sizes, form etc.), information which cannot be changed without altering the structure of that particular MS. But when a MS must be the support of a certain information, the structure of this system (its syntactic value) must be easily and deterministically variable, depending on its containing information. This is the difference between ISS as systems specialized in the information storage and the information stored in any external material object which is not specialized in such a function. However, an object which is external to an IPS, either it is an external ISS or a certain MS, is considered for that IPS as a real object which is associated to an abstract concrete object.

The abstract concrete object is associated (in case of biotic IPS) to all the attributes from the generic object model described in chapter 3:

P1 - set of the qualitative properties provided by the set of specialized input units (type of the sensorial organs which perceive the external object);

P2 - support attribute type of the sensorial distributions is the spatial position;

P3 - distribution types of the attributes P1 (sensorial distributions presented in annex X.18);

P4 - size of the support domain (volume, dimension, interval);

P5 - object's internal reference system;

P6 - moment *t* (present) of the simultaneous existence of all these attributes.

All these model properties (provided by the input units of IPS) which are associated to a concrete object contain a very large information amount (mostly, the property P3), alongside the external attributes (attributes associated to the property P5 against an external reference of the object). The abstract objects Obx_1 or Obx_2 which were above mentioned are examples of such abstract concrete objects, with the specification that the two objects are identical (they have the same model), only their external spatial positions being different. If we shall consider that $\{Obx_1\}$ from the relation 9.2.2.1 is a heap of information (the set of all the qualitative and quantitative data associated to the concrete object Obx_1), and $\{Obx_2\}$ is another heap of information associated to the concrete object Obx_2, by assuming that the two objects are identical, the common component of the two information heaps is another abstract object which represents the ***second level of abstraction*** - the abstract object *Obx* - object which represents, as we have previously noticed, a model of a class of abstract objects.

Definition 9.2.4.1: The common model of a class of abstract objects is named **notion**.

Comment 9.2.4.2: As we have mentioned above, the notion is an abstract object which does not represent a real external object any longer, otherwise speaking, it is an object which may be realizable at the abstract level, but which cannot be realizable at the material level; it is nothing but a finite information amount associated to an internal ISS of an IPS. For becoming a material realizable object, the notion must be associated to the specific attributes in order to become an abstract concrete object - the only type of abstract object materially realizable - provided that its attributes to comply with the material achievement conditions which are far more restrictive than the abstract achievement conditions.

As we have pointed out in chapter 3, the common component of the two information blocks $\{Obx_1\}$ and $\{Obx_2\}$ is obtained by means of the function used for extracting this component:

$$C(\{Obx_1\},\{Obx_2\}) = \{Obx_1\} \cap \{Obx_2\} = \{Obx\} \tag{9.2.4.1}$$

as a result of this abstract process, we obtain object $\{Obx\}$ from the relation 9.2.3.3.

Comment 9.2.4.3: The extraction function of the common component from a set of abstract objects is a function which according to the objectual philosophy is considered to be implemented in all NIPS, because this function is based even on the organization method of the processes guided by the DNA molecule. If a new organism undergoes a synthesis process, this process always starts with the common components (stem cells) and it continues with the differential components (cell differentiating processes). In case of the abstraction, we are dealing with a reverse process, from differential (abstract concrete objects) towards common (the notion). In this stage of presentation, it is the moment to observe with a certain amount of surprise that the abstraction processes, as they have been defined in this paper, can also occur at other bio-systems which own a somatic nervous system (which have sensory organs used for external fluxes). The mammals, for instance, have perception systems which are very similar with the human's perception systems, which makes obvious that the first abstraction level (inherently attached to any sense organ) is present in this case, but it is very likely that a second level to be also found - that is the class model (notion). The fact that the people, unlike the rest of the animals, have associated a name to a notion within the natural language (as we are about to see later on), it does not mean that abstraction processes cannot occur at the other animals as well.

In a general case in which we have *n* abstract concrete objects, $\{Obx_1\}$, $\{Obx_2\}$ $\ldots\{Obx_n\}$, the relation 9.2.4.1 becomes:

$$\{Obx\} = \{Obx_1\} \cap \{Obx_2\} \cap ... \cap \{Obx_n\} \qquad (9.2.4.2)$$

according to the above relation, the notion *Obx* is the common model of *n* abstract concrete objects of type Obx_k ($k \in [1, n]$). Obviously, the support set of the notion *Obx* is made-up in such case from *n* objects, and the semantic information amount $Q(\{Obx\})$ which is included in the common component of *n* semantic information heaps is less than the information amount $Q(\{Obx_k\})$ contained in any of the heaps $\{Obx_k\}$, because the intersection of some sets has always a lower number of elements than any of the sets which are intersected one another.

By considering another notion *Oby*, with a second-rank abstraction level, which has *m* objects into the support set:

$$\{Oby\} = \{Oby_1\} \cap \{Oby_2\} \cap ... \cap \{Oby_m\} \qquad (9.2.4.3)$$

If the notions *Obx* and *Oby* have a common component:

$$\{Obz\} = \{Obx\} \cap \{Oby\} \qquad (9.2.4.4)$$

then, the abstract object *Obz* shall have a ***third-rank abstraction level***, and its support shall be a set made-up from two notions.

It is very important that the reader to notice that the result of the first abstraction level is a sensorial abstract object, with a single concrete support object, the second abstraction level generates a notion with *n* or *m* support abstract concrete objects, and the third abstraction level generates a notion whose support set is entirely made-up from notions. On the other hand, the notion *Obz* with third-rank abstraction level is the common component of those $n + m$ concrete objects which make-up the support sets of the notions *Obx* and *Oby*, and thus, we may observe that a notion with a third level of abstraction has as its support a set which represents the union of the support sets of its constitutive notions.

Finally, there are few conclusions which may be drawn regarding the abstraction processes:

1. There is a direct dependence relation between the abstraction level of an abstract object and the cardinal of its support set;
2. There is a reverse dependence relation between the abstraction level of the abstract object and the semantic information amount owned by that object (as a result of the repeated intersections between the information heaps). The first abstraction level (the abstract concrete object) contains the greatest information amount;
3. The abstract objects with the first abstraction level have real objects as their support; the abstract objects with the second abstraction level have abstract concrete objects as their support; the notions with upper abstraction levels have a support set which is entirely made-up from notions;
4. The notions with the highest abstraction level within a certain language belong to the *categories* class (according to the terminology used by the classic philosophy).

9.3 External language

As we have mentioned in chapter 8, *language* means a distribution of the semantic values on the set of the syntactic values of some ISS. Depending on the internal or external location of these ISS against RBS of an IPS, we are dealing with internal and external ISS and accordingly, external and internal languages. Such a language which has occurred in the human society and which uses the ISS outside the human body is the natural language.

Informationally speaking, the natural language is an external *representation* form (against the RBS of the human body) of a part from the information acquired and stored in the brain, either by means of sound sequences (spoken language), or by means of graphical symbols (written language). The information which was already acquired through the *perception* system is organized by the brain in a systemic manner, organization which allows the optimum utilization of a finite resource: *the memory*. This organization is based on the fact that each object from the real world, perceived during our own existence is mentally related to another object (obviously, to an abstract one), made-up from two fundamental components: *the common information* with other classes of objects and the *specific information* related to that object. This abstract object (which represents a particular object) with which we may operate when its *evocation* is required (process which is equivalent with the memory reading in case of AIPS), consists of a very large information amount (only the visual attributes of a real object occupy tens or hundreds of MB, without mentioning the other attributes such as the olfactory/gustatory, tactile, kinesthetic, as well as the ones achieved through artificial means or the processual attributes associated to that particular object). Although this object may be recalled every time we want to, an apparently insurmountable difficulty seems to occur whenever we want to communicate this information to somebody else.

9.3.1 The name

The social being status, that is the status of a member belonging to a form of social organization, requires by all means a form of communication between one individual and another (or others) from the group. The pressure imposed by the need to communicate has determined the mankind to discover the *external abstract objects* which were the *representatives* of some internal abstract objects, whose intensive utilization has led to the differentiation of humans from the rest of the animals. In case of the human spoken language, the abstract objects considered as external representatives consist in a short sequence of elementary sounds (phonemes), produced by the brain owner which wants to communicate and who has just recalled a certain object; in other words, it is a low-sized substitute (with a low syntactic value) for an internal semantic information heap. The above-mentioned phoneme sequence, an abstract object which is an external representation of an internal abstract object is the object's *name*.

Definition 9.3.1.1: An external ISS with an invariant syntactic value (literal or phonetic), which represents a certain internal abstract object found in the memory of an IPS constitute the **name** of that internal abstract object.

The name structure, that is the spatial and/or temporal arrangement of its elements (phonemes or letters) represents its *syntactic value*. The total amount of the information contained into the internal abstract object (which exists into IPS memory) associated to that name, represents the *semantic value* of that name.

Comment 9.3.1.1: The fact that the semantic value associated to a specific name is given by the amount of internal information which is found in the memory of an IPS, has deep implications regarding the communication between different IPS by means of the external languages. Even if, structurally speaking, more IPS are identical, the information amount which is associated by them to a certain name is different and in proportion to their previous specific experience and to the cognition level. This fact, as we are about to see further, has major implications on the amount of the information communicated by means of external languages.

The same method is also used for the processual objects, each process type which may be found at an object with a certain *object_name* is related to a *process_name*. According to the human natural language, the *object_name* are the nouns with all their flectional forms, and the *process_name* are the verbs with their flectional forms as well. Because the perception systems are similar at all the community members (the small differences are not relevant), a possible receiver of the spoken or written message would be able to recall the same object and the same process as a result of the perception and understanding of that message. The compulsory conditions which are required in order to accomplish this communication process are the following ones:

1) All the participants at the communication process must belong to the same species of bio-systems, which means that they must have the same type of IPS, the same sensory organs and the internal sensorial representations of the same external objects and processes must be identical;

2) All the participants involved in communication must have previously perceived both the objects and the processes contained in the message (namely, the abstract objects related to each *object_name* and *process_name* must be already stored into the participants'memory);

3) The sequence of phonemes or graphical symbols must be always the same for the same substituted abstract object, which means that a strict correspondence must be established between the set of syntactic values and the set of the represented objects (semantic values);

4) All the participants at the communication process must have in their minds the association between abstract internal object, with the specific phonemes or symbols sequence, so that when this message is perceived, the colligate recall may take place (in other words, all the participants involved in the communication must know the same language).

9.3.2 Language and communication

The basic role of an external language is to structure (organize) a finite amount of semantic information which is meant to be transmitted from an IPS to another, in order to mediate the communication process. However, we have seen that a transfer of an amount from one location to another is considered as a *flux*, the language is therefore, nothing else but an organization form of an information flux (IF). Since we are talking about a flux, we must establish right from the start, what its source is (emitter IPS) and what its destination is, namely, a receiver IPS. The semantic structure of an IF[75] issued by the objectual philosophy is made-up from the following fundamental classes of abstract components:

1) *Objects,* represented in the natural language by the *object_name* (nouns) and their substitutes (for example, the pronouns), with all their flectional forms;

2) *Processes*, represented by the *process_name* (verbs), with their flectional forms as well;

3) *Determinants,* which includes all the other syntactic components of the language (adjectives, numerals, articles, conjunctions, prepositions etc.); the role of these determinants is even to increase the determination degree (information amount) of the objects and processes contained into IF (the sent message).

The objects, processes and a part of the determinants are represented by *names,* and so as we have found out in the previous section, there are external abstract objects with a low syntactic value, which substitute (represent) semantic information heaps. In this way, large semantic information amounts can be sent through a low-intensity information flux (which effectively carries only the syntactic information).

The most simple information system with a complete semantic and context-free value meant to be sent to an addressee, which is made-up from objects belonging to the three fundamental classes, is the *sentence*. The compulsory elements (minimal) of a sentence are an *object_name* (subject, a noun or its substitute) and a *process_name* (predicate, a verb).

In chapter 7 we have seen what are the meanings of the *action, interaction* and what are the objects involved in these processes - *agent object* and *driven object* - even when we are dealing with the informational action or interaction. When a message exchange (IF) takes place between two or more IPS, it is clear that these fluxes are able to produce actions (on the flux's IPS receiver), if that IPS is permeable to the syntactic and semantic value of the message, namely, the receiver IPS perceives ISS (the constitutive objects of the incident IF)

[75] We are exclusively referring to the information fluxes within the natural language

and accurately understands their associated semantic content (it knows the language and is able to recall the message's semantic value).

By using the specific terms of this paper, the IF agent source is the agent object, that is the message emitter; the IF addressee is the information-driven object, whose state (first an internal and then, an external state) shall be modified as a result of the IF action. According to the natural language, this transmitting process of a semantic information amount between two or more IPS is named *communication.* One may distinguish two types of communication: unilateral (carried out in one way, from the emitter to the receiver, that is an information *action* process), and bilateral communication (carried out in both ways, that is an information *interaction* process).

The message content (its semantic value) is also focused on objects and processes, both the agent and driven objects being found in this case, that is, actions and interactions. However, a line must be clearly drawn between the objects and the processes involved in the communication process and the objects and processes involved (contained) in the submitted message.

The objects which are part of the communication are only the issuer (or issuers) and the addressee (or the addressees), whereas the objects involved in the message content are much more varied. Also, the unique external process of IPS involved in communication is the information transfer[76] (flux), whereas the processes included into the message are far more varied. Another significant property of the objects and processes involved in communication is the fact that they are real (also known as real-time unfolded), and the objects and processes from the message are clearly abstract and they are comprised in ISS which represents the information flux.

Within the natural language, the specification of one or more emitters (for instance, a chorus or an organization), of one or more addressees, is made by using either the singular or the plural. The emitter or the emitters are included in the first person category (singular and plural) and the addressee or the addressees are included in the second person category.

Comment 9.3.2.1: If the reader reminds what it was depicted in chapter 3, namely that the singular object and the set of objects cannot be mixed up in the present paper (the void set or the single-element set are not allowed when we are dealing with objects), now, he will probably better understand the reason for this restriction, because the singular cannot be mistaken with the plural either within the natural language. According to the objectual philosophy, the concept of set of objects is only applicable to more than two elements (systemic set) just as it is the plural meaning within the natural language. Another observation which can be done is that in case of the human IPS of external relations (the somatic nervous system), it is possible that the emitter and the receiver of the information flux to be the same (also the first person), in the process of thought under a natural language. In this case, there is no need for the conversion of the internal ISS into external ISS (vocal or visual), the information flux being able to re-circulate inside IPS.

The abstract objects which are involved in the abstract processes contained into the message can be singular as well (that is at singular) or multiple (that is at plural), at the first, second or third persons. The abstract objects included in the message content may be either agent objects and/or driven objects (by means of the abstract processes). Also, the abstract processes contained into the message may belong to all the categories mentioned in chapter 4 (singular, multiple, individual or collective) and they aim to all the attribute types which may be part of the driven abstract objects.

9.3.3 The quantum of the communicable information

As we have noticed so far, a certain IPS associates to a specific *object_name* or to a specific *process_name* a total amount of the semantic information stored into its memory, regarding these abstract objects. According to the common language, this total semantic

[76] We are talking about the direct communication between people carried out by means of natural language and we let aside other processes meant for hiding (secretization) of the message content (coding and decoding).

information amount associated with a certain name is also called the *notion's domain* (or the *notion's sphere*), the notion being the name of a class of abstract objects. We have deliberately mentioned that we are talking about <u>a certain IPS</u>, because even if two or more IPS which are communicating one another are structurally identical, more exactly, they have similar information processing performances, it is unlikely that the semantic information associated by each IPS to a certain name to be similar, otherwise speaking, the domains of the notions found in the memory of different IPS are different as well.

The reason why these differences occur are due to the fact that each IPS has its own temporal existence domain, lasting from its birth until the communication moment, which is a different domain as compared to other IPS, and during its lifetime, each IPS assimilates different semantic information amounts (it has, as it is saying, its own life experience, its own cognition level and an individual learning capacity). If we are assuming that we have two IPS, for instance, SPI_A and SPI_B which both know the same language, each of them will associate to the same notion *Obx* a specific domain of the notion $\{Obx\}_A$, $\{Obx\}_B$ respectively, which are quite different and their size depends on the cognition degree of each IPS regarding the notion *Obx*. In case of a communication between SPI_A and SPI_B, when receiving the name *Obx*, each IPS shall make its own recollection of the cognition domain associated to this name. Since the domains $\{Obx\}_A$ and $\{Obx\}_B$ may be different, only the common component of the two domains will be effectively transmitted in the communication process. But, this component is the intersection of the domains (notion's spheres) stored into the memory of the two IPS:

$$\{Obx\}_{com} = \{Obx\}_A \cap \{Obx\}_B \tag{9.3.3.1}$$

Because the intesection of two different domains is less-sized than any of the domains which are intersected one another, it also results that the <u>information amount transmitted through communication is lower than any of the information amounts stored into the participants'memory</u>. Only under the hypothetical assumption when the two IPS have the same notions domains, information losses don't exist.

9.4 System

9.4.1 Current definitions

According to The Dictionary of General Mathematics[77], etimologically speaking, the word *system* originates from two Greek words: *syn* - together and *istemi* - to arrange. Then, we shall excerpt from other few dictionaries some of the most relevant definitions of this notion:

The Explanatory Dictionary of The Romanian Language[78]:

– *System*: **1**. The set of elements (principles, rules, forces etc.) which depend one another by making-up an organized whole, restoring order into a field of theoretical thinking, it also regulates the material classification within natural sciences field or it makes that a practical activity to be performed in accordance with the aimed goal. **2.** The total amount of deposits formed during a geological period. **3.** Work method, way of organizing a process, an operation, work style, norm, custom.

– *Systematic*: Which is carried out according to a plan and by observing a previously conceived method; methodic, organized; activity which is carried out with insistency and perseverance.

[77] ******* - *Dicţionar de Matematici Generale* - Editura Enciclopedică Română, Bucureşti 1974.
[78] ******* - *Dicţionarul Explicativ al Limbii Române* - Editura Univers Enciclopedic, Bucureşti 1996.

– *To systematize*: To arrange the elements of a science, of a doctrine, of a description into an organized whole, into a system.

The Technical Dictionary[79]:

– *System (techn. gen.)*: Set of phenomena which are mutually conditioned or influenced by another phenomenon or by a set of associated elements, pieces, equipment, machineries, facilities.

– *Control system*: System which has the role to maintain an invariance dependence relation between the output amount x_e and the input amount x_i.

– *System of material points*: Set which is made-up from material points with specific weights which are able to interact so that the motion of each of them can depend on the position and on the movements of the other points of the system.

– *System of measuring units*: Set which is made-up from the basic units and from their related measuring units.

– *Periodic system of elements*: Structure method of the chemical elements within a table, based on the periodicity of their chemical properties.

The Physics Dictionary[80]:

– *Reference system*: Set of geometrical elements (points, lines, areas) or bodies which are considered steady, against which the position and motion of a body may be determined.

The Logics Dictionary[81]:

– *Classification system*: System of classes obtained through the application of a set of criteria on a set of objects. It may be arranged on *n* levels ($n = 1, 2, ...p$). The levels are reached as follows: 1) The set's objects are distributed into classes according to the criterion K_1, let us say that it is the level I; 2) Each class belonging to level I is decomposed according to a criterion K_2, by achieving in this way classes belonging to level II etc. The classes are arranged on the horizontal when they have the same level, or on the vertical, when they belong to different levels. There are two types of relations between the classes arranged on the vertical: a) inclusion (strict)[82] relations, b) other relations, different from the inclusion ones (such as the filiation ones). The relation $C_n \subset C_{n-1} \subset \ldots \subset C_1 \subset U$ may be applicable in the first case, or if *n* and *m* are two levels so that $n \neq m$ and $n > m$, then $C_n \subset C_m$.

9.4.2 The objectual analysis of definitions

Among the few definitions regarding the above-mentioned notion of *system* which may be found in dictionaries, let us draw-up an excerpt of the components which are common to all these definitions specialized on specific activity fields.

First of all, one may observe that the system is always a compound (complex) object, a set with at least two elements (that is a reason why we have used the term of *systemic set* for the set with a number of elements $n \geq 2$). The fact that the system is a complex object shall determine (as we have seen in chapter 3) the existence of a common reference for all the objects which belong to the system. Because for each property of the constitutive objects, a specific reference of that property is required, the set (union) of the references which are specific to the common properties shall make-up a complex object - the *internal reference system* of that complex object.

[79] *Dicționar de Termeni Tehnici* - Editura Tehnică, Bucureşti 1972.

[80] ******* - *Dicționar de Fizică* - Editura Enciclopedică Română, Bucureşti 1972.

[81] **Gheorghe Enescu** - *Dicționar de Logică* - Editura Ştiințifică şi Enciclopedică, Bucureşti 1985.

[82] First type of classification relations (inclusion) was also used in chapter 1 of the paper herein, for NAMS classification.

Secondly, between the objects which make-up the system (its elements), there are always mutual dependence relations deployed between some of their properties. Therefore, interdependence relations shall be established both between the internal objects of the complex object (more exactly, between the possible couple of elements) and between each from these objects and the common reference of the complex object. We have noticed (also in chapter 3) that these relations between objects are in fact relations between the internal reference system of these objects.

Thirdly, there is at least one invariant order relation along the set of the system's elements, as long as the system exists. This is the meaning of the *systematizati*on relations which are applied on a set of objects (either real or abstract), which will generate a system.

Fourthly, the objects which make-up the system may belong to any processual class of objects (of type S_x , $x = 0, 1, 2, ...n$), such as, for example, the fluxes or other types of far more complex types; it is important only that the system's objects to comply with the above-mentioned conditions. The constitutive objects of a system may be either real (material) or abstract (graphical symbols, words, collocations, sentences, phrases etc.) objects, and we are therefore dealing with processual objects of various ranks.

9.4.3 The system's general definition

The common characteristics of the particular definitions on the notion of *system* which were described in the above-mentioned section allow us to issue a general definition of this notion, by also using the notions introduced in chapter 2, 3, 4, and 5.

Definition 9.4.3.1: The **system** is a complex abstract object which is characterized by invariant interdependence relations deployed between the components' properties, both between its elements and between each element and the internal reference of the complex object.

Comment 9.4.3.1: The above-mentioned definition was foreshadowed since chapter 3, when the complex object has been presented, by also mentioning the necessity of an internal reference for the complex object, against which the external properties of the complex object's components may be determined. There, we have seen that the constitutive objects have internal and external properties; the first ones do not interfere in the relations between objects, being confined in each object, but unlike them, the others (external properties) may be assessed against an external reference. In case of the complex object, the external reference for the elements belonging to the complex object is even its internal reference, against which the components' external properties are established by means of invariant relations (for a specific complex object). This invariant collection of relations (which is named *distribution*, as we have previously found out) determines the internal order of the complex object, order which differentiates the system from the simple union of its constitutive objects.

9.4.4 The attributes interdependence

A system is therefore an object composed from a systemic set of objects, which deploy *interdependence* relations between their attributes. We may state that two attributes x and y are interdependent if a variation Δx_1 determines a variation Δy_1 by means of a relation f, and a variation Δy_2 determines a variation Δx_2 by means of a relation g, namely:

$$\Delta y_1 = f(\Delta x_1) \qquad (9.4.4.1)$$

and:

$$\Delta x_2 = g(\Delta y_2) \qquad (9.4.4.2)$$

The purely abstract interdependence implies a non-determination concerning the separation between the cause and effect, the two variables acting simultaneously both as causes and effects of the variations. The answer to this dilemma is possible to be given by introducing a third variable, independent to the first two variables, but on which both of them are dependent. As for the real processes, the role of such a variable is assigned to the *time*, a variable (by definition) which is totally independent from any other attribute. The time plays the role of an universal support provided to the real processes, which means that no real process is able to exist without being distributed on this attribute, distribution which cannot reach infinite density values (namely, velocity or acceleration). The existence of a defined causality means that the effect (of a process) occurs always after the cause (variation of the cause variable). In the above-written relations, Δx_1 is a cause variation for the effect Δy_1 (by means of relation *f*) and Δy_2 is a cause variation for the effect Δx_2 (by means of relation *g*). In other words, it may be written that:

$$y(t)=f(x(t-\Delta t_{xy})) \tag{9.4.4.3}$$

and:

$$x(t) = g(y(t-\Delta t_{yx})) \tag{9.4.4.4}$$

where Δt_{xy} is the temporal interval required for the realization of the variation process of the amount *y* as a result of the variation of *x* (the value of y at the moment *t* is the effect of the value assigned to *x* at the previous moment $t\text{-}\Delta t_{xy}$). If we replace *t* with $t\text{-}\Delta t_{yx}$ we shall have:

$$y(t-\Delta t_{yx}) = f(x(t-\Delta t_{xy}-\Delta t_{yx})) = f(g(y(t-\Delta t_{xy}-2\Delta t_{yx}))) \tag{9.4.4.5}$$

which clearly shows that in case of the interdependence relations, the value of an attribute belonging to one of the objects depends not only on the value of the attribute of the related object, but even on the individual value of this attribute from a previous moment (the influence of individual past actions on the present state). The interrelation of the object's attributes which make-up a system is due even to the common internal reference, against which any of the attributes directly depends on. The invariance of the assignment relations against this common reference for each constitutive object makes that any attribute variation of one of its components to determine a variation of all the other components in order to keep the invariance of the whole object (and once with it, of the internal reference position). The interdependent attribute (or their set) within a system represents the system's *formation criterion*.

9.4.5 The information associated to the system elements

We have noticed from the previous sections that a system is a complex object, it is therefore made-up from a systemic set of other objects. The total amount of the properties which are associated to this set of objects represents the total information associated to them by IPS which perceives the system.

According to the aspects established so far, this information has two components:

- *Specific information* (synonym - *differential*) *{I_S}*, which consists in the set of the attributes which are characteristic to each system element, attributes which make that particular element to be univocally determined (unmistakable);
- *Common information {I_C}*, made-up from the set of those attributes which belong to all the elements of a given system.

Therefore, the total information *{I_T}* associated to a system element is:

$$\{I_T\}=\{I_C\}\cup\{I_S\} \tag{9.4.5.1}$$

As for a couple of elements *{e_i, e_j}* where $i, j \in \{N\}, i \neq j$, it may be written that:

$$\{I_C(e_i,e_j)\}=\{I_T(e_i)\}\cap\{I_T(e_j)\} \tag{9.4.5.2}$$

Namely, the common information belonging to a couple of elements within the system is the intersection of the total information set of the two elements.

Comment 9.4.5.1: The semantic separation (splitting, isolation, discrimination) of an abstract object from other abstract objects is made by means of a *definition process*, during which we are dealing with the assignment of the name agreed for the collection of attributes and processes which are characteristic to the object (collection given by the relation 9.4.5.1). The definition is mostly made by means of the method named as *proximate kind + specific difference*. According to the terms which are specific to the objectual philosophy, the proximate kind is an abstract object which exchanges common non-zero information with the object about to be defined (intersection of the semantic domains given by the relation 9.4.5.2 is non-zero). The information specific to the defined object shall be subsequently associated to this reference information, and this association is achieved even by means of the definition process.

9.5 Virtual abstract objects

The virtual abstract objects are those objects which cannot be realized not even at the abstract level (an ISS including the entire information associated to the virtual object cannot physically exist). It comes out that people operate quite often with this kind of objects, being named *ideal* objects. Such an object is, for example, the set of real numbers {R}, but also other objects which represent some *asymptotes* (limits impossible to be reached) for the realizable objects. The realizable objects have characteristics which are more and more closed with the virtual objects, once with the increasing progress in the scientific and technological field, but they will never attain the attributes of the ideal objects. One of the fundamental roles of the virtual abstract objects, just due to their asymptote character, is to delimit the highest existence domain of a class of abstract objects.

A fundamental class of virtual objects is represented by the class of *virtual reference systems,* systems without which the assessment of the existential attributes belonging to the object's properties could not be evaluated. For example, the reference system specific to the *spatial position* attribute of the objects is made-up (in 3D space) from the three axes which represent the three possible independent directions (**X**, **Y**, **Z**) into the Euclidean space, axes which have only a single intersection point, that is the origin of the reference system. Each axis is a set of concatenated vector segments, all of them with the same direction (the common value of the qualitative attribute), and quantitatively speaking, each segment is a continuous distribution of virtual points which owns an interval from the axis of real numbers as its support (obviously, a virtual object as well). These axes (more exactly, their directions) are a reference for the *rotations* (direction variations), that is a reason why they make-up the reference system R of each object which has a spatial distribution. The common intersection of the three axes, the *origin of the spatial reference system*, is also a virtual object (zero-dimensional) where the rotations are null, this point being the reference for the assessment of the object's *translations*, therefore, T reference.

It is worth mentioning that the virtual reference systems must not be mistaken with the realizable ones. When we are drawing some axes of reference on a piece of paper, these axes are similar with any realizable object, in terms of dimensions (they have a thickness which the virtual axes do not have it), and they are sets of 2D DP (pixels) with a different color than the support paper. This realizable representation of a reference system is also required by our visual perception system (to which is directed to) because it cannot operate with virtual objects (zero-thickness lines) either. However, starting from this representation, a series of derived abstract objects (such as the contrast lines) shall be projected into the brain, and they represent some limits towards which the objects which can be represented tend to. In our case, a contrast line is an abstract object which can be achieved only by means of computing (making the difference between two attributes which belong to some adjacent-disjoint domains), this calculus being performed by the neurons involved into the visual perception. Since the contrast line is a boundary, this means that not only the reference systems can be virtual objects but also the boundaries. For example, a virtual surface (mathematical) may be considered as a boundary between two adjacent-disjoint volumes.

Another example of fundamental virtual object is the *axis of time*, entirely imaginary construction, also arranged as an axis, but against the axis of the real numbers, a single value from the axis of time being real, which is the so-called *present value* (present moment), the rest of them being considered as abstract even by the official science. Unlike the value axis of a realizable attribute (such as, for instance, the spatial position), where all the values have a simultaneous existence, in case of the time axis, the existence of two values is not possible (by definition), just for the simultaneity of the unique existence of the values belonging to all the other known attributes to be defined. The realizable time means a counting (numbering, increment) of a real repetitive process (materially realizable). As for the realizable time, the present is given by the real cyclic process which is in progress (more exactly, by the number (index) of this process against the adopted temporal reference). But, the counting is a computing process (information processing), because a *memorization* of the number of previously-deployed processes takes place, number which is *increased* by one unit every time the cyclical process is terminated. Therefore, even the realizable time is an object belonging to the *abstract process* type, process which is carried out either by people (when they count the days, months, years which went by) or by the intracellular IPS for the bio-system's fundamental processes.

Few observations may be drawn based on the above-mentioned issues:

1) The numerical values of the attributes belonging to the realizable objects tend to more and more high accuracy levels (the number of bytes of the artificial IPS is growing, as well as the accuracy of technical execution of the artificial material objects, the size of the observable universe is also increased etc.) whereas the civilization evolves. The time measuring methods tend to the utilization of more and more short cyclical processes, thus, towards higher counted numbers. These numerical values contain therefore, a more and more higher information amount. The limit towards which these values tend to (abstract or materially realizable) is the absolute accurate value (AAV), the value which contains an infinite information amount. However, this limit was already foreseen by the mathematicians who operate for a long time with the set of "real numbers", set which contains exclusively AAV (see annex X.3). This virtual object {R} comprise therefore the asymptotic limits of any realizable numerical value, regardless of the cognition or the technological progress level reached by a society. We might say that the numerical AAV are the components of the absolute reality because this virtual object also contains an infinite information amount which is both quantitative and qualitative.

2) The asymptotic character (intangible, abstract or materially unachievable) of the virtual objects is also emphasized by the synthesis method of these objects carried out by IPS. Based on the above-mentioned issues, the virtual objects are extreme generalizations of some classes of abstract objects, generalizations which consist in the extraction of the common components from a set of abstract objects. We have found out that only the association of specific components provides particularity, as well as a recognizable and finally, an achievable character assigned to that object.

Comment 9.5.1: As for the notions of *reality* and *virtual*, as they have been defined so far, now it is the moment to adopt a position regarding a very frequent mass-media collocation named "virtual reality". The reader which has succeeded to run through this paper up to this moment is certainly aware on the absurdity of this collocation which contains an oxymoron (two consecutive antonyms) which should be excluded one another, similarly with expressions such as "idiot genius", "fluid solid" etc. In fact, that collocation denotes a simulation of the reality (an illusion, a hoax on the visual and tactile sense) achieved through images and artificial sensations, generated by an AIPS, but the information fluxes are real; otherwise speaking, we are dealing with an abstract representation (through ISS) but which is abstract realizable rather than virtual. When we are able to accurately differentiate the virtual area of the abstract world from the achievable one, the reason why we made this comment will become clear.

9.6 Non-determination and information

In case of an attribute belonging to a real object, with a limited range of values of its existential attribute, an experiment is possible to be performed at a certain moment which would result in the determination of the attribute value, more precisely, out of the finite set of values, one is selected as a real value (the so-called realized value which is obviously valid at the moment of determination).

Comment 9.6.1: The *attribute's quantitative value* must be understood under the meaning of the present paper, in other words, as a finite difference against an invariant benchmark (reference), value which is permanently associated to a non-determination interval (in this case, as we will see next, this interval is ΔV_R). This is an essential specification because according to the objectual philosophy and as we have pointed out so far, there are two types of numerical values: *absolute accurate values* (AAV) with a null non-determination interval, therefore, they contain an infinite information amount (both material and abstract unachievable) and *normal values*, made-up from a relative accurate value (RAV) which is associated to a non-determination interval (truncation, approximation). The AAV, virtual objects, are the ones which form the axis of the real numbers from the mathematics.

Let us admit that before the experiment initiation, our knowledge regarding the attribute value was zero, and after the experiment completion, it is different from zero. By also assuming that the number of possible values (equiprobable as well) of the domain is a finite one, and they were all not achieved before the experiment, the non-determination is therefore total and the information is null. As their name suggests, the non-determination and determination are complementary (having the absolute reality as a basis of complementariness).

The total non-determination which is related to the null information, is the absolute reference against which the cognition (information amount) acquired by means of the experiment may be determined. The information amount (the information's existential attribute) obtained as a result of an experiment, through which an initial domain of possible values ΔV_i is reduced at a smaller final domain ΔV_f, it is given by the following relation:

$$Q_I = \log_2(\Delta V_i / \Delta V_f) \tag{9.6.1}$$

and the measuring unit of this attribute is the information amount which is obtained as a result of the determination (also, through an experiment) on the realization of an event from two equiprobables (restrain of the values domain at half from the initial value). For such case, the relation 9.6.1 provides:

$$Q_I = \log_2(2/1) = 1 \text{ [bit]} \tag{9.6.2}$$

Comment 9.6.2: Most of the bio-systems which own a visual perception system have two exemplars belonging to this system type (the eyes) which are symmetrically placed against a vertical plane which runs through the antero-posterior axis (one of the elements of the internal reference system), plane which divides the whole visible space in two semi infinite spaces (left and right). If the bio-system is able to perceive an object, its first location is established in one of these semi infinite spaces, fact which provides to the bio-system's IPS one information bit and then, the location into up-down and front-back semi infinite spaces, which adds two more bits. The rest of the determination process of the object's position (rest of the information bits) is now provided by the animal eye which is able of a more accurate separation of the object's position, which this time is against the eye's internal reference system. This internal reference system of the visual organ is also based on a splitting of the sensitive elements area in two domains (left-right and up-down but against the eye's internal reference system), splitting which allows the differential control of the muscles of the eye, head and even of the animal torso for watching the movements of the monitored objects. Other additional information concerning the position of an external object is provided by the other sense organs of the animal IPS (the proprioceptive, auditory, olfactory system etc.).

As we have previously mentioned, the information amount is the existential attribute of the abstract object - *information.* The information is an abstract object with a high abstraction level, and according to the classic philosophical terminology, it belongs to the class of *categories* (although it has a higher abstraction level as compared to any of them). This extremely high abstraction level makes that the information definition by means of the classic method (proximate kind + specific difference) to not be used, the information lacking a proximate kind (the proximate kind is an abstract object with an abstraction level higher or lower than the defined object).

However, the objectual philosophy makes some specifications on this notion:

1) If each *material system* is an existence form of the *matter*, all these forms (material objects) having the same generic model (fluxes triad model), we may state that each *abstract system* is a form of the *information* existence, which is also related to a generic

model (the generic object model which reflects the total amount of properties associated to an ISS by an IPS).

2) If the total amount of MS and processes in which they are involved makes-up the *real world* (reality, material world), the total amount of abstract systems forms the *abstract world* (valid only for the IPS class, with sizes which depend on their performance level).

3) If the real world has an existence which is independent from the IPS existence, and it is unique, the abstract world is strictly connected to a specific IPS and through the internal ISS, each IPS has its own representation of the real world which is able to perceive it (image of the accessible known reality). An IPS is able to perceive few from the attributes of an external object (external for IPS). The total amount of these properties, each of them with a non-zero existential attribute which are perceived in parallel (therefore, simultaneously) on a single temporal DP, makes-up the ***information*** *associated* (by IPS) to that particular *object*, at that temporal DP. Thus, the abstract object named *state* of an object is nothing else but this information associated by IPS to a perceivable object. The information amount which is contained in each perceivable attribute is as high as its value has a less non-determination degree (as long as this value is more invariant, more accurate).

4) Non-determination of an amount from a specific interval also means that that value is <u>variable</u> inside the interval, either by means of known or unknown variation laws, but if there are invariant attributes distributed on that interval, these attributes represent an information which is associated to the variation (to the process)[83]. The information is provided to IPS at the moment when an experiment which allows the evaluation of the attribute's value, with a non-determination less than the one prior to the experiment unfolding. We are noticing that the probability and the probabilities calculus do not provide to IPS a larger information amount than the one which is used as a base for the probabilities calculus, because this calculus does not restrain the non-determination. The increase of the information amount stored into IPS memory is mostly achieved as a result of an experiment (the realization of the probable event).

Comment 9.6.3: There is another way for the growth of the information amount contained into the memory of an IPS, that is the determination of some invariant relations between the experimental data (so-called invariant laws between the values of the attributes which belong to the real objects). We have seen that these invariant relations (the classic continuous functions) include (if they are true as well) a quasi-infinite amount of information, being devoted on the substitution of a very large number of individual assignment relations. However, these laws can be reached only as a result of a previous existence (and processing) of a large amount of experimental data (concrete values of the attributes which will form the support of the future law).

5) The existence of some restrictions (limitations, constraints) on the value of an amount is equivalent with the existence of some attributes determinism (cognition, invariance, domain limitation) – of having the values within a specific range. By contrast, the permission, freedom correspond to the non-determination which means zero information in case it is total.

Comment 9.6.4: In case of S-type distributed MS which enforce restrictions to their elements both as regards the translation and rotation, the invariant mean values of the elements position represent an internal information, whereas the vibration of elements (both of the translation and rotation ones) represents the non-determination domain of these positions.

9.7 Conclusions

1) The total amount of the qualitative and quantitative, semantic and syntactic information, associated to a material information support system (ISS) represents an *abstract object*.

[83] As we have pointed out many times within the paper herein, if the spatial position of a body is variable, an information about this attribute cannot exist (because it is not invariant), but if the variation rate is invariant (even temporal distribution on the temporal support attribute), then, this rate (as a density of the temporal distribution) represents an information.

2) The abstract objects are therefore, information existence forms, that is a notion with which only a special type of MS is able to operate - information processing system (IPS) - whose general model has been depicted in chapter 8.

3) A source MS of specific material fluxes which carries a finite number of the MS's properties, fluxes existent at the *present* moment of an IPS, and which are partly captured by it, represents a *real object* for that IPS.

4) The total amount of the real objects and processes at which these objects are subjected to at the same time, which have a simultaneous existence at the *present* moment of a certain IPS, makes-up the *individual direct reality* of that IPS.

5) If there are more IPS which perceive simultaneously the same material objects and processes, the group of real objects and processes with a simultaneous existence for IPS set represents the *collective reality* of IPS set.

6) The total information amount about the real objects and processes which have a simultaneous existence within a temporal interval which includes the present moment, information stored into the internal or external memory of an IPS set, makes-up the *known reality* for that IPS set.

7) The entire information amount about the real objects and associated processes, which is assumed to exist simultaneously into the infinite space, makes-up the *absolute reality*. The absolute reality is a *virtual abstract object* (because it contains an infinite information amount), but which represents the basis of a dichotomous classification into other two abstract objects: *known reality and unknown reality* for a specific IPS set.

8) The information associated to an internal ISS of an IPS, as a result of the perception of a real object (ISS stored into IPS memory at the present moment), represents a *concrete* abstract object (synonym - *sensorial*), and that ISS is considered as the *internal representation* of the external object.

9) The information contained in a concrete abstract object consists of two components:

– The information which is *common* to other concrete abstract objects found into IPS memory;

– The information which is specific to that particular abstract object, information which allows the object to be differentiated as compared to the rest of abstract objects from the memory.

10) The total information amount which is common to a set M of abstract objects represents the model of another abstract object - *class of abstract objects* M - object which does not represent any longer any external real object, being only a finite amount of semantic information associated to an internal ISS. The set M represents the *support* of that particular class. As a result of the association of a specific attribute to the class model, that abstract object becomes an *instance* (a particular object) of that class.

11) The information processing operation characterized by the extraction of the common component out of many information blocks is named *abstraction.* The first abstraction level, the unit fundamental level, is represented by the concrete abstract objects. These abstract objects represent (into IPS memory) a single real perceived object. The second abstraction level (notion) extracts the common component of a set of concrete abstract objects. The upper abstraction levels represent the common component of a set of notions.

12) As it was mentioned in chapter 8, a distribution of the semantic values on the set of syntactic values of an ISS class is named *language.* If that ISS class is external to an IPS, we are dealing with an *external language*. In case of this language, the semantic information which is associated to the syntactic values of the external ISS consists in huge amounts of semantic information associated by some internal ISS of a specific IPS, and which can be found inside its memory. The external ISS whose syntactic values represent outside IPS the

information contained in its memory, are considered as *external representations* of the internal information.

13) In case of the natural human language, the external ISS are sequences of elementary sounds (phonemes) or graphical symbols (characters), sequences which are called words. The structural information of these ISS represents the *syntactic value* of the words, and the information from the IPS memory associated to these syntactic values represents the *semantic value* of those words. The external syntactic value (the word) which is associated within the natural language to a specific internal semantic value is the *name*.

14) If there are external ISS fluxes between two or more IPS, and those IPS know the same language type, we may say that a communication process takes place. The information flux transmitted within the communication process through the natural language is made-up from three classes of abstract objects: *object_name* (the nouns and their substitutes, with all their flectional forms), *process_name* (the verbs with all their flectional forms) and the *determinants* (adjectives, numerals, articles, conjunctions, prepositions etc. also with their flectional forms). The total amount of the rules which regulates the flectional forms of the words depending on the associated semantic information makes-up the language syntax.

15) Due to the fact that the semantic information existent inside the memory of some communicating IPS is not the same, the communication process is able to effectively transmit only the common component of the information domains which exist into the communicator memory.

16) One of the abstract objects with a high level of abstraction is the *system*, notion which represents a complex (compound) abstract object with invariant interdependence relations of their properties, both between its elements and between each element and the internal reference of the complex object.

17) If every *material system* is a form of *matter* existence, with all these forms (material objects) having a similar generic model (the triad of fluxes model), we may assert that each *abstract system* is a form of the *information* existence. If the entire amount of MS and processes in which they are involved makes-up the *real world*, which is unique and independent from any IPS, the entire amount of abstract systems makes-up the *abstract world,* which is valid only for the IPS class, and which has sizes depending on their performance level. According to the criterion of the contained information amount, the abstract world is divided into the world of abstract *achievable* (realizable) objects (with associated finite information which can be included into an ISS with finite sizes) and the world of *virtual* abstract objects (with a related infinite information amount which requires an ISS with an infinite dimension).

Annex X.1 - ORDER OF MAGNITUDE

The scientific notation of the numerical values has the following configuration:

$$N = m \cdot b^x \qquad \text{(X.1.1)}$$

where b is the basis of the numerical system, x is the exponent of this basis (an integer) and m mantissa, that is a numerical value ranging within the interval $[b^x, b^{x+1})$. Some of the most notorious bases are 2 and 10 from which the binary respectively decimal numbers are deriving from. Mantissa is a numerical value with a syntax known by programmers as a “fixed point”, which means that the position of the decimal separator is always placed after the first digit. For example, in case of basis 10, mantissa is a digital value under a fixed point, ranging within the interval $[1.(0), 9.(9)]$ (for mentioning the interval limits we have used the syntax of the relative accurate values (RAV) described in the annex X.3, the digits placed within the round brackets being endlessly repeated).

Under these conditions, b^x represents the ***order of magnitude*** of the numerical value N from the relation X.1.1. One may notice that this order of magnitude covers an interval of values (of the mantissa) and this coverage degree is as even more greater as the value of the numerical basis is also great; within a decimal numerical basis, an order of magnitude means an interval ranging from one to ten, whereas in a binary basis, an order of magnitude is only ranging from simple to double. Due to this reason, when we will need a high coverage degree, we may use the decimal order of magnitude, and when we will need a better resolution (for the order of magnitude), we may use the binary one.

Annex X.2 - EXAMPLES OF SYSTEMIC DISTRIBUTIONS

X.2.1 Distributions with integers support

Some of the most used distributions are the ones whose support is made-up from ordered and continuous intervals of the integers set $\{Z\}$, or natural numbers set $\{N\}$. For example, we shall consider a function-type distribution, such as:

$$y_k = x_k^3 \tag{X.2.1.1}$$

for having non-null and non-even second-rank derived distributions. We are now reminding to the reader that according to the specific notation used in this paper for the calculus with finite differences (where the notation with the reversed rank sign is being used for preventing it to be mistakenly considered as an exponent), the *posterior* finite difference (which may be also named *on the right*) between the posterior element y_{k+1} and the local reference element from series y_k is:

$$\Delta^{1+} y_k = y_{k+1} - y_k \tag{X.2.1.2}$$

and the *anterior* finite difference (or *on the left* against the same reference element y_k) is:

$$\Delta^{1-} y_k = y_k - y_{k-1} \tag{X.2.1.3}$$

the same for $\Delta^{1+} x_k$ or $\Delta^{1-} x_k$, and:

$$\Delta^{2+} y_k = \Delta^{1+} y_{k+1} - \Delta^{1+} y_k = y_{k+2} - 2y_{k+1} + y_k \tag{X.2.1.4}$$

respectively:

$$\Delta^{2-} y_k = \Delta^{1-} y_k - \Delta^{1-} y_{k-1} = y_{k-2} - 2y_{k-1} + y_k \tag{X.2.1.5}$$

so on.

By looking at the *Table 1*, one may observe that in the first four columns we are dealing with a primary distribution $y_k = f(x_k)$, where $f(x) = x^3$, in the columns 5,6,7 and 8, we may find a first rank derived distribution of the primary distribution, and in the following columns, the derived distributions of upper rank (II and III). If in case of this type of discontinuous distributions, a derivative under an algebraic meaning cannot be conceived, we may use instead, with no restrictions, the more general term (introduced by the objectual philosophy) known as *density* of distributions, which is a term applicable also in the algebraic case (but only by some compulsory conditions, see annex X.3). The table also shows that the two series of support objects (series of the singular values for the primary distribution and series of the elementary variations for the derived distributions) do not have the same number of elements (index values k, m_1, m_2, m_3), but both types of series are using the same value x_k as a local reference for the determination of posterior or anterior finite difference (the equivalent of the variations towards the right or left in case of the differential calculus).

It may be also noticed that the elementary support intervals Δx have all the same size and there is no finite difference (of any rank) between these intervals and consequently, all the elements of the derived distributions, regardless their rank, shall have the same support, that is Δx. As for the first rank derived distribution, the posterior density (the only one which is computed in *Table 1*) against the same reference element x_k which was above mentioned, shall be:

$$\rho_k^{(1+)} = \frac{\Delta^{1+} y_k}{\Delta x} \tag{X.2.1.6}$$

where, because Δx is the same, regardless the value of k, Δx_k was no longer written.

In the actual case of the primary distribution given by the relation X.2.1.1, and by replacing the values given by X.2.1.2 and X.2.1.6 we shall get:

$$\rho_k^{(1+)} = \frac{3x_k^2\Delta x + 3x_k\Delta x^2 + \Delta x^3}{\Delta x} = 3x_k^2 + 3x_k\Delta x + \Delta x^2 \qquad \text{(X.2.1.7)}$$

relation which complies perfectly with the values written in the table below.

Table 1

1	2	3	4	5	6	7	8	9	10	11	12	13	14
k	x_k	y_k	ρ_k	m_1	$\Delta^{1+}x_k$	$\Delta^{1+}y_k$	$\rho_k^{(1+)}$	m_2	$\Delta^{2+}y_k$	$\rho_k^{(2+)}$	m_3	$\Delta^{3+}y_k$	$\rho_k^{(3+)}$
1	0	0											
				1	1	1	1						
2	1	1	1					1	6	6			
				2	1	7	7				1	6	6
3	2	8	4					2	12	12			
				3	1	19	19				2	6	6
4	3	27	9					3	18	18			
				4	1	37	37				3	6	6
5	4	64	16					4	24	24			
				5	1	61	61				4	6	6
6	5	125	25					5	30	30			
				6	1	91	91				5	6	6
7	6	216	36					6	36	36			
				7	1	127	127						
8	7	343	49										

The values y_k are (as we have mentioned in chapter 4) objects which belong to the processual class S_0, and the values $\rho_k^{(1+)}$ are objects which belong to the processual class S_1. If the difference between two successive states S_0 distributed (assigned) on an elementary support interval Δx is an element of the first rank derived distribution, the difference between two successive states S_1 distributed on the same interval Δx shall be the element of the second rank derived distribution, whose density is:

$$\rho_k^{(2+)} = \frac{\Delta^{1+}\rho_k^{(1+)}}{\Delta x} = \frac{\rho_{k+1}^{(1+)} - \rho_k^{(1+)}}{\Delta x} = \frac{y_{k+2} - 2y_{k+1} + y_k}{\Delta x^2} \qquad \text{(X.2.1.8)}$$

By also making replacements in this case, the actual values given by the relations X.2.1.1, X.2.1.2 and X.2.1.6 within X.2.1.8, we shall finally get:

$$\rho_k^{(2+)} = 6x_k + 6\Delta x \qquad \text{(X.2.1.9)}$$

which once again, complies perfectly with the values from *Table 1*.

This example of a concrete distribution with a support made-up from integers aimed to clearly emphasize the accuracy of the general relations X.2.1.6 and X.2.1.8, as well as the concrete relations X.2.1.7 and X.2.1.9, accurate and valid relations for any kind of amount *Δx* of the elementary support interval. Those who would neglect in some circumstances the terms which contain *Δx* (according to the classic differential calculus) have this right, but they will reach to an approximate result, with the error in proportion to the amount *Δx*. The amounts $\rho_k^{(1+)}$ and $\rho_k^{(2+)}$ are the equivalent of the first and second rank local derivatives (right) from the classic differential calculus.

X.2.2 The distribution of states on the Earth surface

As the distribution name already suggests, we are dealing with a spatial distribution with 3D support[84] (the area of the Earth's land, neglecting the territorial water section due to simplicity reasons) of the attribute named *state sovereignty*, attribute which consists of many other components (such as the state name, national anthem, flag, official language, government form, defense system, economic system, population, international recognition, total area etc). This attribute may be represented within the abstract objects syntax as follows:

$$\{e_k\ S_k\} = \{\{\text{name}\}\cdot\{\text{national anthem}\}\cdot\{\text{flag}\}\cdot\{\text{political system}\}\cdot\ldots\} \qquad \text{(X.2.2.1)}$$

where S_k is the qualitative attribute *state sovereignty* of the state *k*, and e_k is its existential attribute (quantitative). As a result of international conventions, the same juridical unit (value which according to the international law regulations is equivalent to the states equality from the political point of view) was assigned for e_k, but the qualitative attributes S_k shall never be identical (their role is even to separate, differentiate the *states* objects one from another). The attribute S_k is evenly distributed on an area which is referred to as *state territory* (internal spatial domain of the state object), limited by a separation line from the territory of the neighbor states: common border (boundary). Each state has a capital (internal reference of the state's domain), with known coordinates (spatial position on the Earth), against which the positions of the internal objects of that state[85] are being assessed. Each state has also a political leadership (a government), that is the internal reference of the social community which populates that state.

This distribution (of the states sovereignty) taken as a whole is obviously non-even, the super political powers being much "more sovereign" than the weaker states.

Comment X.2.2.1: Although the states are *de jure* considered equal as regards their sovereignty, this equality is *de facto* just as real as the equality of people is; after all, the sovereignty of a state is a global attribute, a result of the accumulation of all the resources which are owned by that state, mostly of the political, economic and military resources (these are the real support of sovereignty).

Also, the size of these states varies very much, ranging from couple of km^2 to about 10^7 km^2, depending on the resources and greed of their leaders over the history. What is relevant for the goal of this annex is that all of these are *elements* of the distribution which is mentioned in the annex title, regardless of their area and power. The element status shows that from the point of view of the even distributed attribute - that is the state sovereignty recognized by the other states - and only from this point of view, the decomposability limit was reached.

Comment X.2.2.2: Most of the states have another internal distribution of the territories with their own government (a sort of much more limited sovereignty), with an individual reference (the regional centre), but without direct access to the political and military foreign affairs of the state as a whole. There is also an internal spatial distribution for the other internal objects (localities, agricultural, touristic or industrial areas, military bases etc.). Otherwise speaking, from the point of view of other criteria, the state system is still decomposable, but not as far as the state sovereignty concerns.

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[84] If we are talking about the Earth's political map which is a plane representation of that distribution, we shall have a spatial distribution with a 2D support.

[85] For instance, the distance covered within the road system of that state is calculated against a point which is called "zero kilometer point" (ground zero), that is a point located by convention inside the capital of that state.

Annex X.3 - SPECIFIC APPROACHES OF SOME MATHEMATIC OBJECTS WITHIN THE OBJECTUAL PHILOSOPHY

X.3.1 The set of the real numbers

The establishment of the historical motivation which was the basis for assigning the epithet "real" to the numbers which belong to that particular set is not the topic of the present paper, but it is possible that this denomination would have occurred from the need to differentiate the class of the common numbers which are currently used, from another class of numbers which has appeared among time on the mathematics "scene", that is the class of so-called "imaginary numbers". As regards the class model, the numbers which are considered "real" are different from the "imaginary" ones only by the rule which sets the sign of the result R of the product between two terms Ta and Tb, depending on their signs (both terms belonging to the same class of numbers). The two rules are:

a) *direct rule*, which was applied to the "real" numbers, according to which:

$$(+Ta)\cdot(+Tb)=+R$$
$$(-Ta)\cdot(+Tb)=-R$$
$$(+Ta)\cdot(-Tb)=-R$$
$$(-Ta)\cdot(-Tb)=+R$$

b) *reverse rule*, which was applied to the "imaginary" numbers, according to which:

$$(+Ta)\cdot(+Tb)=-R$$
$$(-Ta)\cdot(+Tb)=+R$$
$$(+Ta)\cdot(-Tb)=+R$$
$$(-Ta)\cdot(-Tb)=-R$$

If we let aside the sign of the numbers and the above-mentioned rules, both numbers classes comply with the condition imposed <u>by definition</u> to both sets, which requires them to be sets containing exclusively numbers <u>with an infinity of figures (digits)</u>. According to the objectual philosophy, in which the meaning of the word ***real*** is a totally different one, being strictly related to the concept of realizability (achievability) of an object or process, the result is that both sets of numbers from mathematics, exclusively contain virtual objects which can be symbolically rather than effectively achieved.

X.3.1.1 The informational analysis of the set {R}

According to a convention, the existential (quantitative) information amount achieved as a result of an experiment by means of which the uncertainty of an attribute value shall be reduced from the initial value ΔM_i to the final value ΔM_f (in which, obviously $\Delta M_i > \Delta M_f$) is given by the following relation:

$$Q_f = \log_2 \frac{\Delta M_i}{\Delta M_f} \qquad \text{(X.3.1.1.1)}$$

According to a convention as well, the measuring unit of the existential information amount is *the bit,* this being related to the decrease by half of the final non determination as compared to the initial one (for that reason we have the logarithmation under basis two). By looking at the relation X.3.1.1.1, we shall observe that in order to maintain the finite information amount by starting from a finite and known initial range ΔM_i, it is required that the non determination range (uncertainty) ΔM_f to be as low as it can be, but not zero.

By considering these aspects, but also the ones about the information processing systems which were mentioned in chapter 8, let us make a brief review on the axis (set) of the real numbers $\{R\}$ within the mathematics field. One of the basic properties of such a *continuous* set of numbers (which can be represented through an infinite axis named the *axis of the real numbers*), is that any finite interval, regardless how small it is, $\Delta x = x_2 - x_1$ which belongs to this axis, contains an infinity of *singular values* (numbers which are associated with dimensionless points placed on this axis). By taking into account this axis as a distribution, if the finite range Δx is considered as a support interval, and the number of possible singular values ΔN within this range corresponds with the distributed amount, one may observe that the distribution *density* of the number of real singular values arranged on the axis with the same name:

$$\rho_N = \frac{\Delta N}{\Delta x} \tag{X.3.1.1.2}$$

it is infinite (because ΔN is infinite, whereas Δx is finite).

The fact that an interval of finite values Δx contains an infinity of singular values, this also means that the non determination interval:

$$\varepsilon = \frac{\Delta x}{\Delta N} = \frac{1}{\rho_N} \tag{X.3.1.1.3}$$

of a singular value placed on this axis is null, otherwise speaking, the information amount contained by such a number is an infinite one[86]. Due to this reason, this kind of numerical values are named *absolute accurate values* (AAV) according to the objectual philosophy. The major problem of these values which contain an infinite information amount is that they can be only symbolically[87] displayed (such as, for instance, the symbol $[\infty]$, or any other literal symbol for the values along the real axis), but they cannot be displayed as class instances (actual numerical values) because the representation of an absolute accurate numerical value would require an infinite-sized ISS (a number with an infinity of digits).

According to the aspects mentioned so far, it results that the AAV which compose the so-called *axis of real numbers* are not even *abstract realizable* (therefore, they are *virtual*), because the abstract realizability requires that the abstract object to be contained within a finite ISS, and that it must be compatible in terms of size with the maximum accepted size of ISS which IPS can operate with.

The denomination of "real numbers" was assigned to these AAV when an analysis of the information amount contained into these numbers was not possible. Since the values of the real objects attributes which were experimentally determined could be assigned with any value, a set which was able to include all the possible values had to be found. However, a significant remark must be added: the real numbers coming from measurements or calculations were not absolute accurate values, but they were approximations (truncations) of such values, with a no determination range $\varepsilon \neq 0$, and this interval was due either to the determination (measure) error, or to the limitation of the number of ISS digits to acceptable values (which were processed much easier by the human brain or by the computers).

[86] According to the paper entitled "*Mică Enciclopedie Matematică – Editura Tehnică, Bucureşti*, 1980", at p. 80 we find the following assertion: "The set of real numbers is made-up from the set of positive and negative decimal fractions with an infinity of digits"

[87] In Annex X.3.6, there will also be presented a version of "realizable" AAV as the relative accurate values (RAV), but in this case we are dealing with a symbolic representation, the brackets which frame the decimal period being only a symbol (a substitute) for an infinity of digits.

These numbers (the approximate ones), named *normal numerical values* in this paper, which can be indeed real, (because they are either *abstract realizable* or *materially realizable* as values of the attributes belonging to some real, material objects), do not comply with the definition of the numbers along the axis {R}, because a finite interval Δx does not contain an infinite number of values any longer, but a finite number:

$$\Delta N = \frac{\Delta x}{\varepsilon} \tag{X.3.1.1.4}$$

Comment X.3.1.1.1: For most of the industrial mechanical works, it is enough to maintain an accuracy in the determination of 1 μm for dimension sizes, this fact implying that the numbers which represent these dimensions must have no more than three decimals after the decimal separator (in the industry based on the metric system, its size is usually expressed in millimeters). In this case, a real interval of length values Δx = *1* mm shall include only one thousand possible distinct values (not an infinity). Even the most high-tech AIPS (computers) which may be found nowadays are not able to currently operate with numbers higher than tens of digits, and in case of a single value (such as, for instance, the computed value of π), numbers with tens of thousand digits may result, but an absolute accurate value cannot be reached.

X.3.1.2 The objectual analysis of the set {R}

Most of the definitions assigned to the "set" notion from mathematics are using the term "object", but without defining it, counting on the definitions found in dictionaries. The object is even the basic element of a set, and its rigorous definition cannot be made without taking into account the basic "mechanisms" of the information processing within the biotic IPS, whose role is (among others) even to separate (distinguish) the objects with a simultaneous existence one from another. Therefore, a generic definition of the object may be provided only by understanding the operation of the biotic IPS (that is the central nervous system, in case of the humans) because it (the biotic IPS) is "guilty" for the wide-scale utilization of the objects, in total disagreement with the natural abiotic material systems, for which the external world is made-up from a single object, placed along the direction of the unique resultant of the same type fields (as it was mentioned in chapter 8).

The detailed definition and classification of the objects is made since back to chapter 3, but we are momentarily interested in one of the basic properties of this notion - *distinguishability* - which is the property of an object to be differentiated from the other objects with a simultaneous existence. This property is based on the existence of a perceptible *difference* found by an IPS between the properties of the aimed object (comparison reference) and the other surrounding objects, the difference which in this paper is also named *contrast*, which allows the separation (discrimination) of the reference object against the rest of the objects from the set.

In case of a *set of numbers*, each object (obviously, abstract) from this information structure (a complex object), with the internal domain symbolically limited by a pair of brackets *{}*, is characterized by two properties: a *qualitative* one (the element's position into the set) and a *quantitative* one (numerical value). For reaching the distinguishable status, any of the set objects must have an unique qualitative attribute. In case of the ordered sets, there is an interrelation between the qualitative (position) and the quantitative attribute (numerical value), otherwise speaking, a qualitative and a quantitative difference shall also exist between two adjacent (successive) objects of the set. This situation is altered in case of the ordered but continuous sets of numbers; in such circumstances, by means of an excessive abstraction (we might even call it abusive), a logical contradiction (absurdity) is reached, because at the limit point, in case of an infinity of objects whose numerical values are ranging within a finite interval, the adjacent objects become undistinguishable one from another (the difference between the numerical values of two objects tends to zero). Due to this reason, the present paper limits the abstraction degree to acceptable values by introducing the *realizable* set

$\{R\}_\varepsilon$ as an ordered set of the *abstract realizable* numbers, in which each element may be distinguished from the adjacent ones by means of the minimum quantitative contrast ε, however much less it is, but always different from zero. Thus, the set of real numbers, as it is defined by the mathematics rules, shall be kept for the ones which would intend to operate with it, although, according to the objectual philosophy, this set is considered as a virtual object. This fact has few important consequences:

1) The amount of digits of a number belonging to the realizable set $\{R\}_\varepsilon$ shall be always a finite one, and the associated singular numerical value is a *normal value*;

2) A finite interval from the realizable set $\{R\}_\varepsilon$ shall contain a finite number of distinct normal numerical values;

3) The realizable set $\{R\}_\varepsilon$ is a discrete rather than a continuous set;

4) The geometric equivalent of a singular value on the realizable axis $\{R\}_\varepsilon$ is not a dimensionless point anymore but a point with a dimension ε, which in this paper is named *dimensional point* (DP).

5) By means of idealization (by reducing the non determination range to zero), starting from this realizable set of numbers, the virtual set from mathematics can be reached.

X.3.1.3 Conclusions

1) The abstract objects which belong to a certain class have all the same model; since the integers, as well as the rational and irrational numbers belong to the class of the real numbers, this means that all these categories (subsets of {R} are also made-up from AAV, an infinity of digits is therefore required for the representation of an actual value. In this respect, the proof is that both the irrational and the transcendental numbers have an infinite number (officially acknowledged) of decimals, the continuity of the real numbers axis requiring that the other members (singular values) to also own the same infinite number of decimals for their representation. An accurate representation of the integers such as AAV would mean (for instance, according to the decimal syntax), an integer followed by an infinity of zero digits after the decimal separator. The mutual convention of letting aside the series of zero digits into the current representations of the integers does not also mean the renunciation at the principle that any number belonging to{R}is identical in terms of model features with any other number belonging to this set, all of them being AAV.

2) The necessity of an infinity of digits for a complete representation of an AAV makes that such numbers to not be realizable neither under a material nor an abstract form (because it would require an ISS with infinite sizes), these numbers are therefore *virtual*, unable to exist as concrete values (class instances). Thus, it is worth mentioning that despite of its denomination as set of the real numbers, this set is exclusively made-up from virtual numbers.

3) The realizability of a numerical value is strictly related to the necessity that this value to contain a finite quantitative information amount; consequently, any value which is materially or abstract realizable must have a non determination interval. Obviously, this interval is gradually decreased, as the technological and scientific progress is increasing, but it will never be null.

4) The virtual object named “the set of the real numbers”, from the official mathematics, represents an asymptotic model, a limit impossible to be reached for the realizable objects, but towards which all the numerical values tend to, as the progress in the scientific field keeps rise-up. It is an example of extreme idealization of a notion: the numerical value (existential attribute, scalar).

5) The objectual philosophy is structured on objects, with a permanent control on the types of objects used for modelling the human knowledge. It is natural that their associated objects and processes, meant to model the material systems, to belong to the class of materially realizable objects. The concrete abstract objects with which the real IPS are able to operate within the abstract processes, must belong to the class of abstract realizable objects, whose quantitative values must be finite, regardless of the IPS's performance degree. On the other hand, as we have seen in chapter 9, the *absolute reality* has attributes with infinite quantitative values, values which belong to the virtual (mathematic) set{R}. In other words, the continuous set {R}, just as the absolute reality, are virtual, asymptotic objects, towards which any kind of knowledge tends to, but at the same time, we must be aware that they are intangible in relation to any realizable knowledge.

X.3.2 Distributions

According to mathematics, the distributions are defined as functionals (a sort of generalizations of the function concept), and consequently, their differentiation and integration continues to be allowed even in case of the discontinuous dependences, despite of the strict rules imposed for differential and integral computations, which mandatorily require a continuity of the support and of the dependence relation. Otherwise speaking, the mathematic distributions suddenly introduce the bizarre concept of *discontinuity' continuity*, in the attempt to save the methods of the differential and integral calculus (which we must admit, are very good and elegant, but they cannot be applied in any circumstances without certain restrictions).

X.3.2.1 The objectual definition of distributions

While the *continuum* model was the obsession for the mathematicians and for the idealist philosophers for centuries, the objectual philosophy sets a more pragmatic approach, the discrete one, based on the concept of *object* as a finite information entity, with which a realizable IPS is able to operate with. This approach, which due to this reason is also denominated as *objectual*, is based on the fundamental properties of the objects class: *invariance* (as model), *(de)composability* and mostly, their *distinguishability*. These properties are also self-understood (but without being defined) in the mathematics field, in case of some objects, such as the sets, whose elements are referred to as "objects" of the set. On the other hand, the classic (continuous) mathematic approach may be understood due to two reasons:

- Continuity of some basic amounts (such as the spatial position of a material object), closely related to the infinite divisibility of space and of the abiotic material systems, it is upheld by the present paper as well, but with the note that this aspect (of continuity) belongs to the *absolute reality* (referred to as *objective reality* according to other papers, that is a virtual abstract object) which is inaccessible to realizable IPS, because it contains an infinite information amount. Due to the finite information processing ability, the realizable IPS must focus oneself to only on a part of the absolute reality, therefore on a discontinuous approach of the continuous amounts.
- The objectual approach on the knowledge may be made only as a result of the understanding which has been occurring over the last century, regarding the information processing processes, which can be applied only on the discrete objects (deliberate pleonasm).

According to the objectual philosophy, the distributions are considered as ordered sets of distinct *assignment relations*, between the elements of other two sets: the ordered set of the independent variable's values (set which represents the distribution *support*) and the set of the dependent variable's values (which in this paper is also named the *distributed attribute*). The three sets which are made-up from distinct abstract objects (belonging to the relations, support values and distributed values) are obviously equipotent. This way of defining the distributions determines in its turn some changes in the definition of the terms derived from the differential calculus:

– Another definition of the term *continuity* (required for defining the continuous *functions*), namely that the continuity is regarded as an invariance (a continuous unchanged maintenance) of the symbolical assignment relation on the support domain (continuity domain). In the most general distribution case (such as the lists, tables, matrix etc.), the concrete assignment relations do not have a general symbolic representation any longer (an invariant function), but they are specific to each support element, and in this case, the distributions, unlike the algebraic functions, can be used.

– Organization of the distributions as complex objects, decomposable up to the level of the elementary object, determine the occurrence of many distribution *types* depending on the structure of this elementary object:

a) Primary *distributions,* where the fundamental element is made-up from a singular value of the dependent variable, assigned by means of a concrete (local) relation to a support singular value. If the set of the concrete assignment relations of a primary distribution has a symbolic representation which does not depend on the concrete support value, then, this distribution replaces the classic continuous functions even if there is a discrete support.

b) *Derived* distributions of a primary distribution, where the fundamental element is a finite variation (difference) of a specific rank (of the same dependent variable from the primary distribution), assigned through a relation to a variation belonging to the support variable. Just as it was above mentioned, if there is an unique symbolic relation for the set of actual assignment relations of the elements belonging to the derived distribution, that distribution replaces the derivative functions (of any rank) of the primary distribution (they are also valid for discrete supports).

– The introduction of the *density* term for the ratio between the finite variation of distributed amount and the support variation, density which is equivalent to the local derivative of a function, but not in a single point (a singular value) as it is defined in the classic differential calculus, but on a support interval with the internal reference at a specific singular value.

X.3.2.2 Classic derivative of a continuous function

One of the most concise presentations of the derivative concept according to the classic differential calculus may be found into The Engineer's Textbook[88].

Derivative's definition. Considering $y=f(x)$ as a continuous function within an interval (a, b) and a point x_0 inside it. By definition, it is named the function's derivative into x_0 the limit towards which the ratio between the function growth and variable growth tends to, when the latter tends to zero.

$$\lim_{\Delta x \to 0} \frac{\Delta y}{\Delta x} = \lim_{\Delta x \to 0} \frac{f(x_0 + \Delta x) - f(x_0)}{\Delta x} = f^{'}(x_0) = \left(\frac{dy}{dx}\right)_{x_0} \qquad \text{(X.3.2.2.1)}$$

If this limit really exists, we may say that the function $f(x)$ is derivable in x_0. If we are making the graphical plotting of the function $f(x)$, the derivative represents in a specific point an angular coefficient of the tangent to the curve. It is possible that the limit of this ratio to have two values in a single point, just as Δx tends to zero by means of positive or negative

[88] *** - Manualul Inginerului - Editura Tehnică, Bucureşti, 1965.

values; we may say that we are dealing with a derivative oriented either to the left or to the right.

Differentials. We shall consider *y=f(x)* as a derivable function into an interval *(a,b)* by considering *x* a variable ranging within this interval. The growth of variable *dx* shall be called the variable's differential. By definition, we shall assign the following value to the function's differential:

$$dy = f^{'}(x)dx \qquad \text{(X.3.2.2.2)}$$

In order to comment the above-mentioned definitions, the following elements are being displayed in the figure X.3.2.2.1:

- the curve *f(x)* on which there is a current point $P(x_0, y_0)$;
- there are other two points on the curve $M(x_0 - \Delta x, y_1)$ and $N(x_0 + \Delta x, y_2)$, where $y_1 = f(x_0 - \Delta x)$ and $y_2 = f(x_0 + \Delta x)$;
- tangent at the curve *f(x)* in the point P, where the points $Q(x_0 + \Delta x, y_3)$ and $S(x_0 - \Delta x, y_4)$ may be found on;

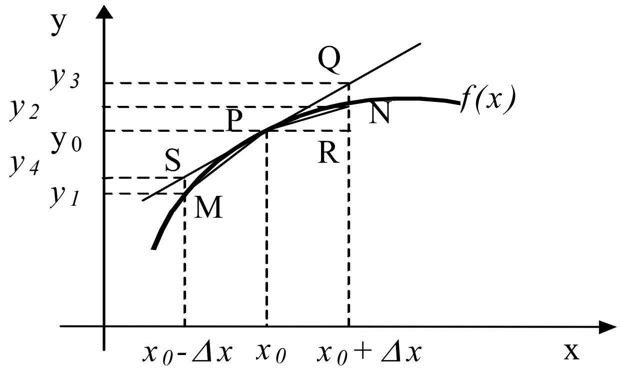

Fig. X.3.2.2.1

One may observe that the points *M, P* and *N* belong to the curve *f(x)*, whereas the points Q and S do not, but when making the differentials calculation on the left or right side of the point *P* even the values from Q and S are intervening, although they do not belong to the function (for example, the differential on the right side of *P* is represented by the segment *RQ*, according to the definition, whereas the real variation is RN). In case that the values of the function from *M, P* and *N* are obtained by means of sampling, the values from *Q* and *S* are clearly out of question since they are pure abstract values (generated by means of calculus). In the plot from the figure X.3.2.2.1, the line which connects two points from the curve, for instance *PM*, is considered as the *secant* of the curve *f(x)*. This secant shows an angular direction α_L against the reference axis *X* (axis of the values belonging to the independent variable), evaluated on the left of the reference $P(x_0, y_0)$, given by the following relation:

$$tg\,\alpha_L = \frac{y_0 - y_1}{\Delta x} = \frac{f(x_0) - f(x_0 - \Delta x)}{\Delta x} \qquad \text{(X.3.2.2.3)}$$

and secant *PN* has an angular direction α_R against the same reference axis *X*, evaluated on the right of the reference $P(x_0, y_0)$, given by the following relation:

$$tg\,\alpha_R = \frac{y_2 - y_0}{\Delta x} = \frac{f(x_0 + \Delta x) - f(x_0)}{\Delta x} \qquad \text{(X.3.2.2.4)}$$

Both relations are valid for any <u>finite and non-zero interval</u> Δx, but according to the relation X.3.2.2.1, when defining the classic derivative, this interval becomes null at a certain point (in the point *P*), where the classic differential calculus defines the <u>derivative in the point *P*</u>.

X.3.2.2.1 Families of abstract objects and their asymptotes

In the analytical geometry field, the "curves family" term is well-known, representing a set of continuous functions on a common interval, which are different one from another as a symbolic dependence relation only through the value of a parameter. For example, the family of the straight-lines which cross through the origin have a generic relation $y = mx$, where m (angular coefficient) is the parameter; in particular, in case of the straight-lines which have an angular direction ranging within the interval $\pm\pi/4$ against the axis **X,** m may take any value between -1 and +1. In this case, the family of curves does not have asymptotes, the parameter m being also able to take the extreme value (the interval's boundaries). The situation is different when there is a certain numerical value which allows the parameter to get close to it as much as possible, but if this value would be reached, it would qualitatively alter the object model (distribution type), this new object not being included into the family any longer. For making an illustration of this situation, we shall take into consideration the figure X.3.2.2.1 with the hyperbola family from the first quadrant $xy=C$, where C is a positive numerical constant (parameter), with a value specified for a certain hyperbola from the family (a certain member of the family).

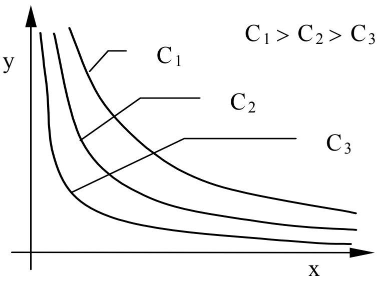

Fig. X.3.2.2.1.1

It is obvious that the axes of reference are the asymptotes of the hyperbola family for the parameter C tending to zero, but if we would accept that the hyperbola and their asymptotes belong to the same family (therefore, they have the same model, the same symbolic distribution relation), we would reach to the absurd conclusion that even the axes of reference are a hyperbola (but a edited one, isn't it? (#)). The same situation is in case of the relations X.3.2.2.3 and X.3.2.2.4, which define a group of ratios of some symmetrical finite differences (left/right) of a function against a reference value, a group whose parameter is Δx. The <u>directional asymptote</u> of this family is the direction of the tangent in the point P, object towards which the two variations tend to, but it cannot substitute them because they are qualitatively different objects.

Now, let us interpret the above-mentioned data by using the terminology specific to this paper, which is introduced in chapters 2…9. Thus, in case of the "families", it is clear that we are dealing with classes of abstract objects, a *class* being an abstract object which has the *common component* of the models from a set of objects (members, class instances). In case of the straight-lines which cross through the origin or as regards the aforementioned hyperbolas, the common component of all the class members is the general symbolic relation ($y=mx$ for the straight-lines and $xy=C$ for the hyperbolas), each instance of those particular classes being differentiated only by means of the parameter's numerical value, that is a value which represents, in terms of the objectual philosophy, the *differential* (specific) *component* of a member belonging to the class of curves (against the other members). While in case of the straight-line classes which cross through the origin, the definition relation of the class do not change regardless of the parameter value, as for the hyperbolas, an interesting aspect occurs when the parameter tends to zero, namely, as long as this parameter *(C)* is different from zero, this means that the hyperbolic dependence relation between *y* and *x* still exists; when the parameter vanishes, the dependence relation vanishes as well, and the two amounts become independent (axes of reference), as we have pointed out in chapter 2 about the independence concept regarding the variables. It is very clear that in this case, the limit objects of the class (asymptotes) and the normal objects within one class are qualitatively different as a class model, while the class members are different one from another only by means of the specific component values.

X.3.2.3 The derivative according to an objectual meaning

The essence of the objectual (systemic) approach consists in the organization of the processing information into *objects* and *processes* by using the notion of *distribution.* The identification of the objects' model attributes according to the generic object model presented in chapter 3 is also taken into consideration, and if the processes exist, the identification of the processual objects shall be also undertaken. As for the set of objects which deploy external relations (the case of the complex objects), we also know that these relations are deployed between the internal references of the objects, their internal references being considered as objects' substitutes within these relations, because quantitative relations can exist only between the singular values.

According to the facts described in chapter 2, the relation *y=f(x)* which was mentioned at the beginning of section X.3.2.2. represents the *distribution* of the attribute *y* on the support attribute *x*, when the assignment relation is invariant (a function) on the entire support range (the function's continuity range). In chapter 2, we have also noticed that in case of a singular value considered to be invariant x_k, the value of the distributed attribute y_k is also invariant, so that the values y_k distributed on the values x_k are easily recognized as abstract objects belonging to the class S_0. A couple (x_k, y_k) which is associated with the point P_k from the plot from the figure X.3.2.3.1, with the position vector $\boldsymbol{r}_k$, is an element from the set of assignment relations which make-up the distribution (that is an element of the primary distribution).

If there are two symmetrical variations of the support attribute ranging from the value $x_{k-1} = x_k - \Delta x$ up to $x_{k+1} = x_k + \Delta x$ against the singular value x_k (at values which shall be assigned to the points P_{k-1}, respectively P_{k+1}), which are small enough so that the deployed distributions to be considered as linear, then, they will be related to the attribute variations:

$$\Delta^{1-} y_k = y_k - y_{k-1} = f(x_k) - f(x_k - \Delta x) \qquad \text{(X.3.2.3.1)}$$

and:

$$\Delta^{1+} y_k = y_{k+1} - y_k = f(x_k + \Delta x) - f(x_k) \qquad \text{(X.3.2.3.2)}$$

According to the aspects which were set in chapters 2, 3 and 4, the relation:

$$\rho^{(1-)} = \frac{y_k - y_{k-1}}{x_k - x_{k-1}} = \frac{\Delta^{1-} y_k}{\Delta^{1-} x_k} = \frac{f(x_k) - f(x_k - \Delta x)}{\Delta x} \qquad \text{(X.3.2.3.3)}$$

identical with the relation X.3.2.2.3, means the even *density* of a linear distribution of the attribute variation $\Delta^{1-} y_k$ on a support interval $\Delta^{1-} x_k$ (that is the density of a P_1-type SEP) determined on the left side of the reference x_k. In chapter 4, we have seen that if the density of a SEP is invariant on its support range representing an object, in this above-mentioned case, it is an object belonging to the class S_1. This SEP has the interval $\Delta^{1-} x_k = x_k - x_{k-1}$ as its support with an amount Δx, with the internal reference at x_k (right side reference, which means that the support interval is on the left of this value. However, the same value x_k may be also an internal reference for the support interval having the same amount, but which is placed on the right side of the reference x_k, $\Delta^{1+}x_k = x_{k+1} - x_k$, that is a support interval of another PES with the following density:

$$\rho^{(1+)} = \frac{y_{k+1} - y_k}{x_{k+1} - x_k} = \frac{\Delta^{1+}y_k}{\Delta^{1+}x_k} = \frac{f(x_k + \Delta x) - f(x_k)}{\Delta x} \qquad \text{(X.3.2.3.4)}$$

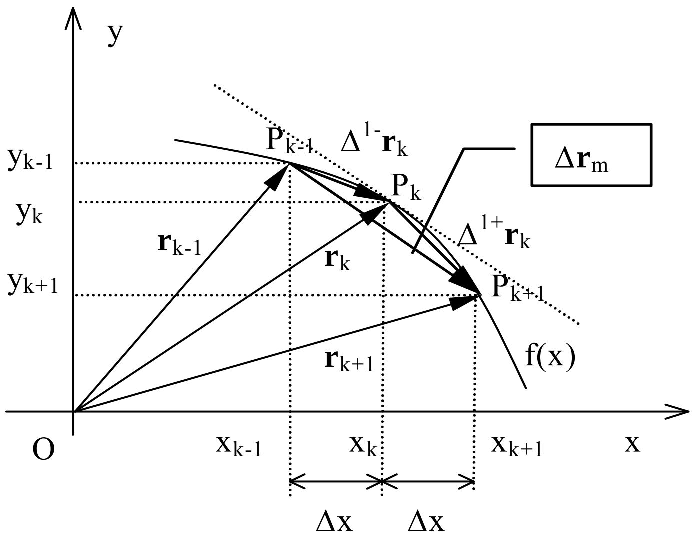

Fig. X.3.2.3.1

One may note that according to the objectual approach by means of distributions, the value x_k (the same as the one from the above-mentioned classic approach) becomes an internal reference for two interval-type objects (left and right), but they are intervals which represent the support of two even variations with amount $\Delta^{1-}y_k$ and $\Delta^{1+}y_k$, therefore, x_k will be an internal reference both for these processes and for their density values (evenly distributed on the two support intervals with the reference x_k).

Comment X.3.2.3.1: The fact that two abstract objects have the same internal reference does not always mean that the two objects are one and the same. The abstract state object S_0 with the reference x_k is distributed on the nondetermination interval of that DP, whereas the abstract object S_1 with the reference at x_k is distributed on a finite interval which consists of more known singular values (so that a non-zero process to be able to exist). In both cases, x_k is identical, but the amount of the internal domains which are referred to is different. If you read chapters 3 and 4, where the constitutive elements of an object and of a process are mentioned, it is clearly revealed that the objects belonging to classes S_0 and S_1 cannot be mixed-up even if they have the same internal reference. There was a clear specification in chapter 4 that the objects S_0 are states of some objects (with null processes) and the objects S_1 are states related to specific even processes P_1).

The total variation density (which is also considered as even) on the support interval $2\Delta x$ (by subtracting and adding $f(x_k)$ to the numerator), results to be:

$$\rho_m = \frac{y_{k+1} - y_{k-1}}{2\Delta x} = \frac{1}{2}\left(\frac{f(x_k + \Delta x) - f(x_k - \Delta x) \mp f(x_k)}{\Delta x}\right) = \frac{1}{2}(\rho^{(1+)} + \rho^{(1-)}) \qquad \text{(X.3.2.3.5)}$$

hence, it may be observed that this density is equal to the mean value of the two left-right densities with the reference point in x_k. In relation to this mean density (which is equal to the tangent density in P_k), considered as a *common component* of the two density values (internal class reference), we shall have the two specific components of the densities (given by the function D(), mentioned in chapter 3):

$$\rho_L^{(1-)} = D(\rho_m, \rho^{(1-)}) = \rho^{(1-)} - \rho_m = \frac{\rho^{(1-)} - \rho^{(1+)}}{2} \qquad \text{(X.3.2.3.6)}$$

the specific component of the density on the left side of the reference x_k and:

$$\rho_R^{(1+)} = D(\rho_m, \rho^{(1+)}) = \rho^{(1+)} - \rho_m = \frac{\rho^{(1+)} - \rho^{(1-)}}{2} \qquad \text{(X.3.2.3.7)}$$

the specific component of the density on the right side of the same reference. When we discussed in chapter 4 about the two concatenated SEP (such as the variations in question), we noticed that in case of a non-linear dependence relation such as *f(x)*, the two specific components of SEP must exist (to be different from zero), otherwise, the relation *f(x)* is a straight-line (tangent case).

As a result of this objectual analysis on the objects and processes involved in the definition of the first-rank derivative, the following aspects may be underlined:

1) The abstract object that is "*the singular value of a dependent variable y_k assigned by means of a relation f to a single independent invariant x_k*" represents an object from the processual class S_0 (class which is specific to the objects unfolding null processes).

2) The abstract object "*first rank finite variation Δy_k of the attribute y evenly distributed on a support finite variation of the same rank Δx_k*" (where x_k is the internal reference of the support interval), represents a SEP belonging to class P_1 (a finite difference between two states S_0); the even density of this SEP is a process state belonging to class S_1.

3) Two variations Δy_k, with support intervals equal in terms of the amount Δx, symmetrically arranged against a common reference x_k, shall represent two concatenated SEP where the final state of the first one is an initial state of the second one, this common state (*S_0* type) being the point $P_k(x_k, y_k)$ as it is shown in the example given in the figure X.3.2.3.1. Each of these SEP can have however small support domains, but provided that the support to comprise more than one known singular value (in order to exist a linear variation Δy_k), so that they can never converge to a point, even it is a dimensional point.

By considering this latter amendment, we may keep the notation used for the infinitesimal ranges from the differential calculus, the variations Δy and Δx becoming *dy* and *dx*, which could have as an internal reference a singular value, but they could never be replaced by a singular value (a single point). In such conditions, the relations X.3.2.2.3 and X.3.2.2.4 remain valid in case of the distributions-based mathematics, but the first rank derivative is no longer the limit (asymptote) towards which the variations ratio tends to, but it is the *density* of a first rank SEP. Another relevant specification, that is the domain *dx* in case of the realizable processes (of the numerical calculations) cannot be less than ε, the error interval used for representing the concrete numerical values on the effector IPS. As for the concatenated SEP where the support interval Δx cannot be neglected (neglection imposed by the current formula of obtaining the functions derivatives, which are valid for $\Delta x \to 0$), thus, only the calculus with finite differences can be used for computing the distributions' density values.

X.3.2.4 Conclusions

1) While according to the mathematical analysis there is a function *f(x)* on a continuous domain of a variable *x,* according to the objectual philosophy, it is a *primary distribution f(x)* (considered as continuous under the specific meaning of this paper) on a realizable support domain (discrete) *{x}*. The primary distribution has a singular value of the dependent attribute as its local element, assigned to a singular support value by means of a local relation. This local element is the equivalent of a function value in a point, according to the classic mathematics.

2) The primary distribution *f(x)* can have (if it is uneven) some derived distributions of different ranks. The local elements of these distributions are made-up from a finite and

linear variation (of a certain rank) of the dependent attribute, assigned to a variation Δx by means of a local relation, Δx which is the same in terms of the amount, regardless of the distribution rank. These local elements are the equivalent of the relations X.3.2.2.3 and X.3.2.2.4, provided that Δx to be however less but not under 2ε. The invariant density of the linear distribution on an element of derived distribution is under these circumstances the equivalent of the local derivative from the classic differential calculus. Attention! This density is assigned to an interval Δx (which can be referred to as an object through its internal reference x_k from the primary distribution *f(x)).* Therefore, according to the objectual philosophy, the derivative of a function cannot exist only on a singular value (the derivative equivalent in a point from the classic differential calculus. If you have carefully read chapter 4 where the processual classes of objects have been presented, you could also find out in this way that a primary distribution element (the equivalent of the function value in one point) is an object belonging to the processual class S_0, whereas the density of a derived distribution element (the equivalent of the local derivative) is an object from the processual class S_n (where n is the rank of the derived distribution).

X.3.3 Flux

As it may be seen within the annex X.8, when dealing with mathematics concepts, more exactly according to the theory of vector fields, the notion of *flux* is used with the following meaning: Is named the *flux* of the vector $\bar{V}$, crossing through a certain surface Σ, the value:

$$\Psi = \int_{\Sigma} \bar{V}\,\bar{n}\,d\sigma \qquad \text{(X.3.3.1)}$$

where $\bar{n}$ is the normal line on the surface, and $d\sigma$ is a surface element "which surrounds" the application point of the normal line. The amount Ψ is a scalar and it represents (in some situations) the quantity of the amount $\bar{V}$ transported through that surface. According to the objectual philosophy, the flux has a totally different meaning, because it is a vectorial field (not a scalar), as it is also pointed-out in chapter 5 which is entirely focused on the definition and classification of this type of processual object. In exchange, the relation X.3.3.1 is also valid in the present paper, but it defines the global intensity of the flux carried by the amount $\bar{V}$ through the surface Σ.

Another major difference between the interpretation of the flux notion from mathematics and the concept set by the objectual philosophy is that within the mathematics field, the flux of the velocity vector crossing through a surface Σ may be easily approached, and in this case, the vector $\bar{V}$ from the relation X.3.3.1 is the local velocity of a certain velocity field. Within the objectual philosophy, this kind of approach is not possible because here, the local vector of a flux is always a carrier vector, either the *flux density vector* (FDV applicable for the virtual flux model), or the *flux quantum vector* (FQV applicable for the objectual model) which were both defined in chapter 5, which associates to a transfer rate $\bar{v}$ a density ρ of an amount which is carried by the flux.

X.3.4 The position of a curve, surface or volume element

The objectual approach makes that the mathematic terminology used in this paper to be different in most of the cases as compared to the classic mathematics. As it may be found in the current scientific papers, the wording "which surrounds" for the surface or volume element in a point with an established position, occurs frequently because the regular mathematics does not provide any support for a more accurate expression. For the objectual philosophy, the curve, surface or volume element is an object, and as any other object, it has an *internal reference system*. As for the surface element from the section X.3.3. and in case that a central reference point is selected, the application point of the normal line is even a component of this internal reference system (if you already read chapter 3, you could find that this point is the reference T of the surface element, that is a reference which corresponds to a natural reference too).

X.3.5 Vectors

As it was mentioned in chapter 4, the mathematical representation of the *specific elementary processes* (SEP) shall be made by means of vectors. As for the concepts of *object* and *process*, which are basic notions in the present paper, the *vector* definition is a little bit different as compared to the one postulated by the classic mathematics, and even comparatively to the one taught in the higher education system. In this paper, the vectors are defined as even directional quantitative variations of a single qualitative attribute, deployed between two states: the *initial state* (which corresponds with the application point) and the *final state* (which corresponds with the vector's apex). At the same time, the vectors are processual objects which represent the total amount of the invariant attributes (on their support domain) of specific SEP (application point, direction, modulus etc.).

A special case when the vector's definition mentioned in this paper is different from the currently-issued works is the case of carrier vectors, which are components of the mathematic model for fluxes. According to the existing works, a carrier (or slidable) vector is that vector with a mobile application point. Under the meaning of the objectual philosophy, this description is also completed by the transported attribute because a carrier vector must "carry" (to be attached) an amount which shall be moving once with the vector, just as the flux density vector (FDV) is associated with the scalar density ρ of the transporting amount.

Given the fact that in case of SEP with spatial support, the vectors are the only representative means for the *direction* attribute, there is a class of vectors specialized in this field - the unit vectors - whose modulus is always unitary and which are used as <u>direction references</u> (parts of the reference R systems), either for the external RS or for the internal RS, or for the local RS (such as the normal, tangent and bi-normal line into a point of a spatial curve).

Due to the specific way of defining the vectors in this paper, some computing "artifices" used in the geometric representation of the vectors from the classic vector calculus must be regarded with discernment. For example, fig. X.3.5.1 shows a classic operation of adding two vectors $\mathbf{V_1}$ and $\mathbf{V_2}$ which have a common application point $S_{1,2}$.

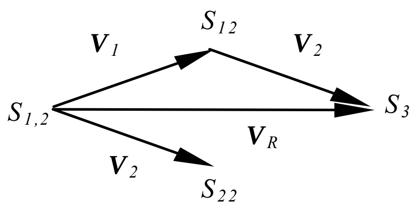

Fig. X.3.5.1

According to the classic vector calculus (where the vectors are considered free), the sum of the two vectors is the diagonal of the parallelogram which have its sides in those vectors; in this case, it is no difference in the result if the two vectors have the origin in the same point ($S_{1,2}$), or the vector $\mathbf{V}_2$ is moved in parallel with the origin into $S_{12,}$ that is the apex of the vector $\mathbf{V}_1$. Processually speaking, if the two vectors are SEP distributed on a temporal support (such as the real processes), the fact that the vectors $\mathbf{V}_1$ and $\mathbf{V}_2$ have an initial common state ($S_{1,2}$) means that the two represented SEP are <u>simultaneous</u>, and if $\mathbf{V}_2$ has the initial state equal with the final state of $\mathbf{V}_1$ (S_{12}), then, the two SEP are successive. In both situations, the resulting vector $\mathbf{V}_R$ has a different temporal support (the amplitude, modulus of the vector is the same in both situations but the temporal density of the resulting SEP has another value).

X.3.6 Dimensional points

The *point* notion is a basic concept in mathematics, mostly in geometry, representing a graphical substitute (a representation) for the *singular numerical value* from an 1D domain, further extended to the domains 2D, 3D so on, by means of a proper association of singular values (obtaining new objects as a result of internal model composition, as we have noticed in chapter 3). These singular numerical values from mathematics mostly belong to the well-known set of real numbers {R}. The major problem related to the singular values which belong to this set is that these singular values are not realizable. As it was mentioned in chapter 2 and in the annex X.3.1, the singular values from {R} are *absolute accurate values* (AAV), which means that they contain an infinite information amount, therefore, they are not realizable under an abstract form and neither the less[89] under a material form, the points which correspond with these values being considered as *virtual points* (theoretic, imaginary, mathematic, dimensionless). For overcoming this problem, people always did what it had to be done, namely, the AAV truncation up to a value with an information finite contents which could be represented through a reasonable number of digits. But, this operation is informationally similar with the association of a known non determination interval with an AAV, that is an interval which includes the rest of the digits up to infinity. This interval which is currently known as an error, tolerance, uncertainty interval etc., with a known amount, makes that the information contained into AAV to which it is related to be finite. But an interval known as an amount, even it has non-determinated values represents a dimension, therefore, the point which corresponds to a truncated (approximated) value is not dimensionless any longer. Therefore, we may find that even since the ancient times people have operated with dimensional points thinking that they are dimensionless.

Another aspect is also worth noticing: in case we are dealing with values of some concrete objects (which can be numerically expressed), either they are material or abstract, truncated (therefore, the ones with dimensions) values are used for the calculation, and when these values are mentally projected by decreasing to zero the error interval, virtual objects (as asymptotic limits) are obtained - dimensionless points. Thus, it seems to be very clear the difference between the objects called *dimensional* and *dimensionless points* - the contained information amount. This clear distinction between the two point types which is revealed to the reader by means of the objectual philosophy is only one of the numerous examples which will underline the dichotomy in the world of abstract objects, dichotomy which clearly divides this abstract world in two complementary parts: world of the abstract *realizable* objects (objects with finite information content) out of which, some of them may belong to the *known reality,* and the world of *virtual* (objects with an infinite information content), abstract objects which derive from the first category as a result of an extreme generalization, and which may belong (but not always) to the *absolute reality* (the two reality types are described in chapter 9).

[89] The material realizability requires much more strict conditions than the abstract one; we may design on a computer an invar bar with a length of 0.543218964387 m, but we would never be able to realize it because the accuracy required by that number (abstract realizable) is under the threshold of the atomic dimensions.

X.3.6.1 Dimensional point model

We have seen in chapter 3 that an object means a distribution of at least one property on a support domain, an invariant distribution, evaluated against an internal reference system. For making a differentiation between two or more objects with a simultaneous existence, those objects must be distinguished through at least one differential attribute (see the conditions 3.1.a…d from the section 3.1). We have also noticed that a realizable point means a truncated numerical value (which in this paper is named a *normal value*), and a virtual point is considered as an AAV. Since it is perceived like an elementary object (a distribution element), the realizable point has a finite interval (non determination, uncertainty, error interval) as its support domain, on which its existential attribute is evenly distributed, and the virtual point has a single AAV from the set {R} with its existential attribute, namely a Dirac-type virtual distribution, with a null no determination interval.

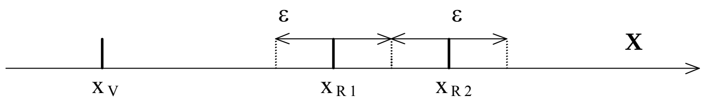

Fig. X.3.6.1.1

The figure X.3.6.1.1 shows a graphical plotting of the two cases, the axis **X** being the representation for the axis of the real numbers {R}. According to this representation, x_V corresponds to a singular virtual value (a Dirac-type distribution with an internal reference in AAV x_V), while x_{R1} and x_{R2}, each with a non determination interval ε, corresponding to two realizable values. We are reminding you that the amount of ε is given by the following relation:

$$\varepsilon = \frac{\Delta x}{\Delta N} = \frac{1}{\rho_N} \tag{X.3.6.1.1}$$

that is identical with X.3.1.1.2, where Δx is the amount of a finite interval belonging to the axis **X** and ΔN is the number of singular distinct values from this interval. The amount ρ_N, which is equivalent to a density (as we saw in section X.3.1.1.) represents the number of the singular values on the axis unit interval, number which is always finite in case of the realizable set $\{R\}_\varepsilon$.

If we are returning to the values x_{R1} and x_{R2} from the figure X.3.6.1.1, they represent, as we already said it, two normal values, even distributions of the existential attribute on the support range ε, with internal references which are also AAV, but this time, they are realizable by means of a special truncation convention. Because any interval must be defined as an amount, due to its two known boundaries, in case of the singular realizable values, the no determination interval is given either by the difference between two such successive normal values, in this case $\varepsilon = x_{R2} - x_{R1}$, or by a value imposed for the number ρ_N. According to the above-mentioned issues, x_V correspond to a virtual point, and $x_{Rk} \pm \varepsilon/2$ to a realizable point with a central internal reference.

Comment X.3.6.1.1: Now, it is time for us to give an explanation to an evident contradiction occurred as a result of introducing the term of *realizable AAV*. This means that throughout this paper, we shall put the accent on the dichotomy between the abstract realizable and virtual objects and now, we are talking about realizable virtual objects. Well, there is no contradiction, but only a special truncation convention, which allows that the representation to be done only for certain numerical values, of an endless series of digits, by using several special syntax rules. In mathematics, it is well-known the notation rule applied for the decimal numbers with groups of digits which are identically repeated from a certain position after the decimal separator (the so-called decimal periods). For example, 1/3=0,(3), where the group of digits (which in this case is made-up from a single digit) from the brackets is the period. This notation means that the group placed in brackets is endlessly repeated. Other examples: 1/6=0,1(6); 1/11=0,(09); 1/13=0,(076923) and many others. This notation agreement shows a special case: when the decimal period is exclusively made-up from zeros, there are no notations any longer (for instance, 1,(0)=1; 1/4=0,25(0)=0,25 etc.). The numerical values obtained as a result of this latter representation convention shall be named *relative accurate values* (RAV) because they depend on a truncation convention (of the zeros series). Therefore, if we have an AAV which consists of a finite number of digits followed by an infinite series of zero digits, the renunciation to that infinite zero series makes the representation to be realizable. But, it is only a representation convention, which has to be taken into account - the value from {R} which corresponds to that truncated value contains an infinity of digits (of zeros). For example, this is how the things work in case of the integers; if we would display them accurately as regards the information, as fragments of the set {R} at unit intervals, after their each numerical representation, the decimal separator should follow and it must be followed by an infinite series of zeros. The mutual agreement of representing only the digits which are different from zero placed in front of the decimal separator remains however a truncation form.

Let us return to the point model from the figure X.3.6.1.1 according to the version of the realizable point. In this case, we are also dealing with a known singular value - the internal reference x_{Rk} – which is associated to the non determination interval ε, but this time, the value x_{Rk} is a RAV (as we have aforementioned, a special type of AAV which can be represented through the renunciation to an infinite series of zero digits).

The internal reference value of the realizable point may take various positions in the internal domain ε , but three of them are the most notorious ones: the extreme left, the extreme right and the central positions. The figure X.3.6.1.1 shows the version with the central reference, and in this case, the domain ε is divided in two sub-domains which are equal on both sides of the reference. The lower boundary of the domain shall be placed at $x_R - \varepsilon/2$, the upper one at $x_R + \varepsilon/2$, and by using the notation for the open intervals from the mathematics, this domain may be written as $(x_R - \varepsilon/2, x_R + \varepsilon/2)$. In case of the left or right references, we shall use the notation for semi closed intervals which is very convenient in case of the concatenation of the realizable points. By considering the version of the extreme left reference, the support interval may be written as $[x_R, x_R + \varepsilon)$, and the extreme right version may be written as $(x_R - \varepsilon, x_R]$.

In case of the *realizable point* object, as we have already mentioned in chapter 2, the objectual philosophy states a special name, that is the *dimensional point* (DP). In case of an one-dimensional domain (1D) of a qualitative attribute X, the model of this abstract object may be defined as:

1) *Internal domain*, truncation interval (no determination, uncertainty) ε associated to an AAV x_R from the set {R}, that is an interval where no other intermediate value can be found and where the existential attribute of DP is evenly distributed;

2) *The internal reference* of the DP object is that AAV, as a result of the truncation process, which has become a RAV with a finite number of digits;

3) *The object's boundaries* are the two values: x_u (the upper boundary) and x_l (the lower boundary) with values obtained by means of specific relations which depend on the agreement settled upon the internal reference position, which were aforementioned.

By using the literal mathematic syntax for the semi closed intervals of numerical values, the object DP 1D may be displayed according to the version of the extreme left reference, as follows:

$$PD = [x_l, x_u) = [x_R, x_R + \varepsilon) \qquad \text{(X.3.6.1.2)}$$

X.3.6.2 Conclusions

1) If a continuous domain of values ε_x of the variable x is considered to be, informationally speaking, as non-decomposable, this means that inside it, there are no known singular values except the internal reference value. The non-existence of these internal values

is equivalent with the lack of information or with the existence of a non determination. Therefore, the DP 1D elementary object is equivalent with a single AAV (internal reference), where a non determination interval ε is being added. The fact that DP contains only a single known value (just like the virtual point, only that the virtual point is not related to the non determination interval any longer) was the reason for choosing the name of *dimensional point.* The association process to an AAV of a non determination interval is similar with the approximation (truncation) of that AAV (which otherwise would require an infinity of digits for its display), to a realizable value, with a finite number of digits, the difference between them being even that non determination interval. It is clear that this operation was (tacitly) made by people even since the numbers were discovered, but without respecting the definition of the real numbers from the mathematics, and by nonchalantly ignoring the clear difference between these virtual and common numbers.

2) Any interval of a domain which is major than DP may be synthesized through the adjacent concatenation (joining) of a finite number of DP, according to the following relation:

$$\Delta x_{0,n} = [x_0, x_1) + [x_1, x_2) + \ldots + [x_{n-1}, x_n) \tag{X.3.6.4.1}$$

where the object one-dimensional interval $\Delta x_{0,n}$ is represented according to the mathematical syntax as an union of elementary object intervals DP_i (demi-closed) in which:

$$x_1 = x_0 + \varepsilon ; x_2 = x_0 + 2\varepsilon \ldots x_n = x_0 + n\varepsilon \tag{X.3.6.4.2}$$

It may come out that $\Delta x_{0,n}$ is also an object, with the boundaries x_0 and x_n, the internal reference x_0 and the size of internal domain $n\varepsilon$. If you have already read chapter 3, you will recognize in the object from the relation X.3.6.4.1 the external composition of the 1D DP-type objects.

3) An informed reader could say that, so far, there is nothing new in this approach; the relation X.3.6.4.1 is nothing else but a simple integration ranging from x_0 to x_n, in case that the point interval ε is replaced by the well-known infinitesimal interval dx from the integral calculus. Indeed so, but the objectual approach on the mathematics which was initiated in this work eliminates the logical contradictions which existed so far and which were not included within the textbooks. Such a contradiction is given by the assertion "*A curve is made-up from an ordered set (a series) of concatenated points".* However, according to the classic mathematics, the point's size is zero and no matter how many zero-dimensional elements would be concatenated, a zero-dimensional result would be obtained anyway. On the other hand, the integral calculus solves the problem correctly, in order to conceive a curve, a series of curve elements being concatenated, but this time, the curve's elements have a certain dimension. However, one little formality is still required: the recognition of the existence of dimensioned points as *realizable* objects, and of the *virtual* points (dimensionless points) as *non-realizable* objects (virtual, asymptotic models of the realizable points).

4) In case of 2D and 3D domains, with two or three dimensions, DP will also be either two- or three-dimensional. The model of this kind of objects is a synthetic object (complex one, but this time, by means of internal composition within the model) which consists of two or three one-dimensional objects which were above mentioned, associated with a common reference system - a virtual point which represents the two or three RAV with a simultaneous existence, each of them with its own non determination interval, the internal references of each associated one-dimensional interval.

5) DP model has been also adopted due to other reasons, namely because the continuity and consistency of the systemic organization of the geometrical objects is therefore achieved, which means that any finite realizable curve (or straight line) segment may be decomposed into a finite number of adjacent DP, any finite surface is decomposable into a finite number of adjacent curves (which are also decomposable), any finite volume is decomposable in adjacent areas etc. This systemic continuity is also required by the existing

mathematic system (integral calculus, calculus with finite differences) which operates only with dimensioned elements (infinitesimal elements have the number of dimensions specific to the integration domain).

X.3.7 Elementariness

According to the objectual philosophy, a modification occurs in the definition of the *elementariness* concept (of an object or process), which means that the elementariness as an attribute and abstract object must have the two components, respectively, the *qualitative* and *quantitative* component. *Qualitatively* speaking, the elementariness of an abstract object is provided by means of the existence of a single qualitative property (the set of the distributed attributes contains a single element). *Quantitatively*, the same elementariness is provided by the existence of an indivisible quantity (non-decomposable) from the elementary qualitative attribute. From the point of view of the distributions, the quantitative elementariness of an assigned attribute is related to the *distribution element.*

As for the *primary* distributions, the distribution element is a singular value (virtual or normal) of the distributed attribute, assigned to a singular value (a virtual or normal too) of the support attribute, by means of a local relation. Depending on the distribution class (virtual or realizable), the two values have a non determination interval (null for the virtual distributions and DP-type for the realizable ones.

In case of the *derived* distributions, the distribution element is made-up as a result of an elementary variation (of a certain rank) of the distributed attribute, assigned to an elementary variation of the support attribute, through a local relation. Here, the *processual quantitative* elementariness intervenes, which means that a non-decomposable variation is imposed (as magnitude) for the two variations (mostly for the support one) which makes-up the element of the derived distribution, but which also allows the existence of a non-null process. The definition manner of this elementary variation is different for the two distribution types, one currently used by mathematicians, and the other used by the objectual philosophy. As for the classic derived distributions (the ones used in mathematics), the elementary variation is defined as a limit of a process which implies the amount decrease towards zero, whereas in case of the systemic derived distributions, the quantitative elementariness is provided only with the condition that the previous distribution (in terms of rank) of the dependent attribute on the elementary support interval to be considered as linear, so that its density to be evenly distributed.

Due to such a definition of the elementariness, mostly in case of the processes (whose model abstract objects are the derived distributions), it is possible the unified approach of all the vector classes (SEP), including of the position vectors, which according to a classic quantitative approach, do not belong to the class of the elementary processes (their variation being unlimited in terms of magnitude), but which are elementary in terms of *quality,* due to the fact they have the spatial density (direction) evenly distributed on the support domain.

X.3.8 Elements and quanta

In accordance with the specific approach of this paper, the singular numerical values cannot contain an infinite information amount (such is the case of the values belonging to the set of the real numbers {R}), but a finite information amount, contained in *normal numerical values*, abstract realizable, values which are associated to a non determination interval $\varepsilon \neq 0$. Consequently, a finite interval Δx placed on the axis of numbers, shall contain a finite number of singular numerical values:

$$N_x = \frac{\Delta x}{\varepsilon} \tag{X.3.8.1}$$

For making a clear picture on the value of ε, let us take a computing example by using an AIPS (a computer). Each AIPS has a maximum limit of ISS required for the storage of a numerical value, which is given by the word size in bits and by the number of words used for a singular numerical value. Regardless of how great this total number of bits will be for a singular value, it is finite, integer and equal with N_b. In such conditions, there will be a no determination interval between two singular adjacent values which are abstract realizable on AIPS:

$$\varepsilon = \frac{1}{2^{N_b}} = 2^{-N_b} \tag{X.3.8.2}$$

Any interval of values Δx of a variable x which is about to be used on this AIPS, shall be made-up from no more than N_x (given by the relation X.3.8.1) possible numerical values. In most of the cases, this is a very great number (though finite) and due to reasons related to the shortening of the computing time by decreasing the iterations number, there will not be used all these values, but only:

$$N_{xi} = \frac{\Delta x}{dx} \tag{X.3.8.3}$$

where dx is (for that calculus process) the elementary interval. This is an elementary interval because it is the iteration step of the variable x and there will not be other numerical values. Therefore, there are two types of elementary intervals of a variable in the abstract realizable world and these are dx and ε. The first is the elementary interval whose dimension is imposed by the number of iterations which may approximate a continuous variation of an uneven distribution by means of even distributions. The second one is the non determination interval ε which is introduced in order to display a numerical value with a finite number of digits (N_b binary digits). For a certain type of AIPS, as well as for the human mind, there is no other numerical value within this interval, except the internal reference of the singular value, that is a RAV (see section X.3.2.2.1). As a conclusion, according to the realizable mathematics used within the objectual philosophy, when we are dealing with an elementary domain of a variable x, instead of the notation $\lim\limits_{\Delta x \to 0}$, we may use $\lim\limits_{\Delta x \to \varepsilon}$ because ε is the compulsory (minimum) "quantum" which separates two numerical realizable values.

If we are dealing with an area element dS with the dimensions dx, dy, and by considering that ε is the same for both dimensions, each interval shall contain N_x and N_y singular values. We saw that the normal numerical value is also referred to as domain point (DP), and according to the one-dimensional case, it will be 1D DP. Therefore, an one-dimensional interval dx contains N_x 1D DP, and N_y for dy. In such conditions, the area element dS shall contain:

$$N_s = N_x N_y = \frac{dxdy}{\varepsilon^2} \tag{X.3.8.4}$$

2D DP. Let us presume that an amount dM of the attribute M is evenly[90] distributed on this area element. In this case, the density of the even surface distribution is:

$$\rho_s = \frac{dM}{dS} = \frac{dM}{dxdy} = \frac{dM}{N_s \varepsilon^2} \tag{X.3.8.5}$$

According to the relation X.3.8.5, we may see that in case of the realizable surface distributions which always contain an integer number of elements, each distribution element contains a number N_S of 2D DP and each 2D DP is related (in case of the cumulative

[90] The expression is intentional pleonastic (redundant), only for underlining the fact that according to the objectual philosophy, the elementariness of a support domain is not necessarily related to its size, but rather to the compulsory condition which requires that an even distribution to be deployed on it.

attributes) to the same elementary quantity $q_M = \rho_s \varepsilon^2$ of distributed attribute. Obviously, there is a similar approach for 3D spatial distributions, and in this case, a volume element *dV* shall contain:

$$N_v = N_x N_y N_z = \frac{dxdydz}{\varepsilon^3} \tag{X.3.8.6}$$

3D DP. If a quantity *dM* of attribute *M* is evenly distributed on this volume element, then, the distribution density shall be:

$$\rho_v = \frac{dM}{dV} = \frac{dM}{N_v \varepsilon^3} \tag{X.3.8.7}$$

and each 3D DP from the structure of the volume element will be related to a "quantum" $q_M = \rho_v \varepsilon^3$ of attribute *M*.

X.3.9 Sets

Unlike the generic term of *set* used in mathematics, which allows the existence of a set with a single element, or even with zero elements (void set), the objectual philosophy does not admit such virtual constructions in case of the set of objects, because in this instance, the singular object and the set of objects cannot be mistaken. For avoiding the confusions and for maintaining the relation with the existing mathematic language, the term of *systemic set* has been introduced, that is a term which is defined as a set with $n \geq 2$ elements. When we are referring to *set* across this paper, it should be always understood that we are dealing with a systemic set.

On the other hand, the sets are complex objects under the meaning of the present paper, and just like any other object, they are confined (contained) in an abstract container (see the annex X.4), which stands for (represents) the object's internal domain which is included within its boundaries. Because a set is a complex object, such reserved domains must exist for all the elements of the set (delimited by the elements boundaries) as well as the total reserved domain of the set as a whole, domain which represents the sum (union) of the elementary domains. According to the common mathematic language, a set *{X}* may be represented as follows:

$$\{X\} = \{x_1, x_2, \ldots x_n\} \tag{X.3.9.1}$$

In this example, the global domain has its boundaries represented by brackets *{}* and the boundaries of the elementary domains are represented by means of comma. As for the internal domain of an object, either it is real or abstract, the objectual philosophy issues the term of *container*, which is minutely presented in the annex X.4. The correspondent of the *set* term from mathematics is the set of the abstract containers existent within the global boundaries.

These containers may be occupied or not. If a container is empty, we shall say that it is *void*, and if all the containers from the internal domain of a set are void, we shall have a *void set*. This objectual approach is valid for any type of existing mathematic object, either it is a number, matrix, tensor, geometrical object, image point, body etc. all of these having an internal domain associated with an abstract container, and that container must be contained into a syntactic value, that is either an internal ISS, or an external one, found outside the IPS which operates with it. The ones who are familiar with a programming language know very well that for each object from the structure of a program, a storage space must be previously assigned, in which that particular object will be stored. This reserved memory space is even the container for that object, the real container of the object's syntactic component.

Annex X.4 - CONTAINERS

According to the objectual philosophy, a ***container*** is an ensemble of virtual, abstract realizable or real boundaries, which confine an internal domain reserved to an object. Based on the type of the contained object, we shall have:

– *Virtual* containers, which contain inside them virtual objects. For example, the virtual object *the set of the real numbers* from mathematics or subsets of this set. This object is “packed” (contained, confined) in a virtual container symbolized by the two brackets *{}*, which include a symbol (such as Z, N, R, etc.) which is specific for one or more common properties of the constitutive elements, infinite in terms of number. In this case (the most generic), the brackets are symbols without any other semantic value than the one of separator of an internal domain, which can be empty, such as for instance the case of the void set $\varnothing = \{\}$, where only the virtual internal domain has remained from the set object, which is reserved by the two boundaries. In case that the set has one or more properties which are common to all the contained elements, the contrast between the existence of this property within the container’s internal domain and its absence in the rest of the “universe”, becomes a property associated to that particular container. The virtual containers may contain infinite domains (such as the case of the set of numbers which were mentioned above {Z}, {N}, {R} etc.

– *Abstract realizable* containers, applicable for instance, in case of the *set* object, but this time with a finite and determined number of elements, which are all abstract realizable objects (contained by the finite ISS). For example, the set of the letters from an alphabet, the set of the numbers from a list, etc. Since we are talking about sets, the symbols for the boundaries are also the brackets with associated semantic values, as in case of the virtual containers. For certain sets of abstract objects, with finite numbers of elements which are positionally arranged based on one or more dimensions, at which the position assigned to an element into the internal domain is invariant (for instance, the matrix), there will be corresponding symbols for the boundaries of the container, others than the brackets (for example, $\| \ \|$). The category of the symbols for denoting the boundaries of the abstract realizable containers also includes the separating characters from the natural written language (break space, comma, dot, brackets etc.) which have the role to define the internal domain of a number, word, collocation, sentence, phrase etc.

– *Real* (material) containers which define the inside of a real (material) object. Based on the generic model of the material system proposed by the present paper, the result is that a real container is made-up from a real bounding surface (RBS), either it is natural or artificial. This type of container is minutely described in chapter 7, which is focused on the natural RBS.

Annex X.5 - NON-CONTRADICTION PRINCIPLE

X.5.1 Complementarity

For being able to conceive an objectual definition of a term, we shall start with an *objectual* analysis (synonym - *systemic*) of the definitions assigned to this word by dictionaries. The objectual approach implies the extraction of the common component from a set of abstract objects, this component becoming the class model for the generic abstract object of this set (notion). According to the Dictionary of General Mathematics[91] we find out that:

1) The *complement* term comes from the latin word *complementum* (completeness, replenishment);

These are few excerpts from The Encyclopedic Dictionary[92]:

2) *Complementary*: what is added to something in order to replenish it;

3) The *complement* of a number with n digits written within a numerical system with the base q is the difference between q^n and that number;

4) Two angles are *complementary* if their sum is $\pi/2$;

5) The *complementary* of a set A against another set B is the set of the elements which do not belong to A but belong to B;

6) Two colors which belong to the visible spectrum are *complementary* if when they are superposed, white color occurs;

At last, The Dictionary of Logics[93] issues the following definition:

7) *Complementary:* "operation which, by starting from a set X, makes possible the creation of another set $\overline{X}$ (*nonX* or **C** X) named *complementary set* and defined as follows: $\overline{X} = \{x / x \notin X\}$. It is assumed that X is taken from an universe U, so that $U = X + \overline{X}$ (the operator [+] stands for *exclusion* in this context). By means of **c**., we divide the universe in two classes (dichotomy). **C.** has the property of *involution* ($\overline{\overline{X}} = X$), and the intersection between $\overline{X}$ and X is void".

Comment X.5.1.1: By using specific terms for this paper, the operator [+] symbolizes the adjacent-disjoint union of the two sets, so that the existence domain of the universe U to be equal with the sum of the domains belonging to the sets X and $\overline{X}$. It is clear that the disjunction relation implies the exclusion as well.

Taking into account the seven definitions which were previously presented, now, we shall extract the common components with which we shall design the generic model of the abstract object *complementarity*. First, we must notice that this complementarity involves many *relations* between <u>three</u> abstract objects (an object which is considered *as whole* and the two sections in which it is divided), which are relations underlined at the points 3, 4, 5, 6 and mostly 7. These relations determine the bipartition (splitting in two parts, the dichotomy) of a whole object named ***base***, namely, other two objects which claim the internal domain of this base.

Comment X.5.1.2: The *base* term for the existence range of the complementarity relation must not be mistaken with the *base* term of the *numbering system* which may be found at the definition from the point 3. In this case (from the point 3), the complementarity base is represented by the term q^n, whereas

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[91] *Dicţionar de Matematici Generale* - Editura Enciclopedică - 1974

[92] *Dicţionar Enciclopedic* - Editura Enciclopedică - 1993…1999

[93] *Dicţionar de Logică* - Editura Ştiinţifică şi Enciclopedică - 1985

the base of the numbering system is *q*. In case of the definition from the point 7, the base of complementarity corresponds with the universe *U*.

Each of the two objects which were generated by means of the base splitting is the complement of the other against the common base, the union of their individual domains being obviously equal by definition with the internal domain of the base.

Therefore, the *complementarity* is a *complex relation* (decomposable) deployed between two abstract objects whose internal domains represent a bipartition of another object (base), and the following elementary relations with simultaneous existence belong to this relation:

1) Bipartition relation - union (sum) of the internal domains of the two complementary objects is equal with the domain of the base object;
2) Disjunction relation - intersection (conjunction) of the two domains is void;
3) The adjacency relation - there is a common boundary between the two domains.

The disjunction relation between the internal domains of the two complementary objects involves the exclusion of the attribution of a singular property value to both objects. On the other hand, one may observe that an object with a specific qualitative property (number, angle, wave length, set of objects belonging to the same class etc.) distributed on its unitary support domain (base) is divided in two abstract objects which own the same property, objects which are assigned with different qualitative attributes (for instance, positive and negative), although the single difference between them is only the support domain on which this unique property is distributed (complementary domains generated as a result of the base bipartition).

Comment X.5.1.3: There is a special case of complementarity which apparently does not comply with the definitions stated by the objectual philosophy, that is the complementarity with a null base. As it was mentioned in chapters 1…9 of the present paper, an abstract object with a null existential attribute means that it does not exist. In case of a null base, it seems that no complementariness is able to exist either. However, if there are two qualitative properties with non-zero existential attribute, belonging to two different objects which are able to form a complex object but which properties are no longer existent in case of the complex object (as if they were mutually cancelled), those properties are also considered as complementary. For instance, in case of EP with opposite charges (a proton and an electron), the complex object from the two EPs (e.g.: the hydrogen atom) does not have charge attributes in the outside. In this case, the complementariness base is represented by the complex object which has null properties in terms of the electric charge.

X.5.2 Dichotomy

According to The Encyclopedic Dictionary, the element *dicho* comes from the Greek word *dicha* - separation, in two parts (the two meanings belong to two different words which contain the same component *dicho*, namely the *dichotermy* and *dichotomy*). The component *tomia* comes also from the Greek language, more precisely from *tome,* which means section, cutting. Semantically speaking, the dictionaries show three values for the term dichotomy:

1) (LOG) Division with two members;
2) (BOT) Ramification method of the stems in two equal branches which are also divided in two other equal branches, so on.
3) Determination key of the types and species of plants and animals.

A very useful specification is given by The Dictionary of Logics in case of the term known as *dichotomic classification* - "Classification in two classes of the objects belonging to a set. For example, the natural numbers are divided in *even* and *uneven.* Usually, **d.c.** is made according to a property and it generates a positive and a negative class (complementary). It may be said that any property is able to generate a **d.c.** $\left(K,\overline{K}\right)$ in relation with the class to which it is applied to."

The same dictionary shows us the existence of another classification, the *positive politomic classification*, which is "a classification of a set of objects into *n* classes (n>2), so that all the classes are positive (there are no classes which are made-up from a simple complementarity). The categorization system used in the biology field is an example of **p.p.c**".

Based on the above mentioned issues, it is clear that the dichotomy is also a relation (an abstract process) of separating <u>two</u> parts of an abstract object, parts which will be assigned with different qualitative attributes although they are coming from the same initial object. Therefore, the dichotomy applied to an abstract object (base) will separate it in other two objects which will become complementary, and reciprocally, two abstract objects which are considered as complementary have a common origin - its base divided by means of dichotomy.

X.5.3 The non-contradiction principle

The Dictionary of Logics provides many wordings of this principle:

1) Onthologic wordings: "*at the same time and under the same circumstances, it is impossible that the same thing to exist or not to exist*" or "*at the same time and under the same circumstances, it is impossible that a thing to have or to not have a property*";

2) Semantic wordings: "*at the same time and under the same circumstances, it is impossible that a sentence to have or to have not a logical value W, "a sentence is impossible to be true and not true at the same time", it is impossible that a sentence to be true together with its negation"*;

3) Aristotle's wordings: "*it is impossible that contradictory assertions to be both true*" and "*it is impossible that something to belong and to not belong to a thing in the same sense"*.

A similar definition but with an additional specification is included in the **law of the excluded tertium** from the same dictionary: *"at the same time and under the same circumstances, a thing either exists or does not exist, the third possibility being excluded"*.

One may observe that these definitions have a common component made-up from two elements: the *dichotomy* and *simultaneity* concepts. As we have previously find-out, the dichotomy is able to create a dichotomic classification into a set of objects based on the criterion of a property existence, that is a splitting of the set (base) into objects which have and do not have that particular property. The evaluation of the existence or non-existence of the property is made by an IPS by following a clear rule: if the existential attribute of the property has the value <u>under the perception threshold of IPS</u>, that property <u>does not exist</u>, and if the value is <u>over the threshold</u>, the property <u>exists</u> and the extent of this existence is the value of that particular existential attribute. **Attention!** This binary-type evaluation method of a property existence deals only with the fact that the property is able to exist or not. In case that it exists, its evaluation is no longer a binary one, but all the possible values of the existential attribute have a common component - they are different from zero.

Therefore, as a result of the dichotomic classification of the base's objects, we have obtained two complementary classes of objects which have or do not have <u>a specific property</u>, that is the affiliation of the existential attribute value of those objects only to one of the two adjacent-disjoint intervals which were created as a result of the bipartition of the basis domain.

These objects which make-up (by means of union) the base, must also have an essential property, which is the simultaneous existence. The simultaneous existence of the objects is also validated by the perceiving IPS, and that is because of the existence of more perception channels in that IPS, which are able to run both in a parallel and synchronic way (as we saw in the chapter 8).

After all the aspects presented so far, it results that this principle is <u>exclusively</u> applied to those abstract objects which have a simultaneous existence and which are the subject of a dichotomic classification. If generally speaking, an abstract object means either abstract concrete objects or more general abstract objects (sentences, reasonings etc. at which the complementary properties may be their true values) this principle may be defined as follows:

> ***The non-contradiction principle:*** *An abstract object cannot have complementary (contradictory) properties at the same time.*

Thus, all the definitions mentioned at the beginning of this section can be covered and the two principles can be even unified, unification which depends on an essential aspect - the existence of a dichotomic classification. The non-existence of this classification directly determines an incorrect application of the law of the excluded tertium, which is no longer valid in case of a politomic classification (for example, see the polyvalent logics), as well as of the non-contradiction principle. But, as regards the dichotomic classifications, these two principles (unified) shall be applied with no exceptions, and the *non-contradiction principle* alongside other principles stated in this paper is considered as a basic element of the objectual philosophy structure.

X.5.4 Complementarity into the natural distributions

Unlike the abstract distributions (virtual or realizable) which are synthetic, mathematic models ("build" by an IPS), the properties of the sets of real objects have also some distributions, but these are self-settled[94] by means of repeated interactions deployed between all the objects of the set. However, a specification is required: the properties whose distributions are self-settled within a set of real objects must be *transmissible* (namely, it is required to be carried by a flux), and the interactions are even the property interchange (transactions) processes between the two objects which are interrelated one another[95].

The natural distributions are evaluated by the human IPS by means of a complex mixed process, made-up from a series of real (experiments) and abstract processes (information processing obtained by means of experiments). This way has allowed that the attribute distributions of the real objects to be known, such as the distribution of the molecular velocity into gases, the frequency of the thermal photons, of the richness or education level of the individuals belonging to a society etc.

It was found that for most of the attributes distributed on a set made-up from real objects, the Gauss-type distribution may be applied (also named *normal distribution*):

$$\rho(x) = C \cdot e^{-\frac{(x-\mu)^2}{2\cdot\sigma^2}} \qquad \text{(X.5.4.1)}$$

where $\rho(x)$ is the population of the distribution's elementary support *dx* (fraction, number of objects from the set which own the value *x* of the support property, *C* is a normalization constant, μ is the mean value (internal reference of the distribution object), σ represents the variance and *x* is the internal reference of the support element *dx*.

If we are talking about the distribution of the velocity within a gas[96], *x* is the velocity value (more exactly, its modulus), ρ is the fraction from the molecule population which

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[94] Self-settle means that the quantitative values of the attributes are not imposed by an IPS, but they are distributed on the set of the involved objects, by means of a simple interaction between the real objects, through real, natural processes.

[95] For instance, the distribution of the individual kinetic energy of the molecules on the set of the gas molecules, or the distribution of the material assets which are owned by an individual (richness) belonging to a human population.

[96] Distribution known as Maxwell distribution but which is similar with Gauss distribution.

reaches to that particular velocity, and μ is the mean velocity, that is a calculus value depending on the conditions in which the gas may be found (temperature, pressure etc.). This mean value is the reference against which the gas molecules are divided in two complementary classes: the molecules with a velocity surplus (as compared to the mean values) and the ones with a velocity deficit. In this case, the positive or negative character of the two complementary properties is given only by the symbol of the difference between the value of the molecular velocity and the mean value, therefore, by a quantitative value. However, for people, this symbol is a qualitative attribute because any school boy knows that positive numbers are different in terms of quality as compared to the negative ones, although they are different (at the same modulus) only by the symbol which is placed in front of them.

Comment X.5.4.1: If the reader has already read the chapter 2, he will probably notice a discrepancy between the denomination for some of the Gauss-type distributions presented in the current scientific papers (or of other distributions of an attribute on a set of objects, such as the Maxwell or Plank distribution) and the name of the distributions given according to the model used in the mathematics field (which is also used in the present paper). In chapter 2, we saw that a distribution has a distributed attribute (dependent variable displayed on the vertical axis) and a support attribute (independent variable displayed on the horizontal axis), with a set of assignment relations deployed between their values (relations which can be symbolically invariant - functions - such as the case of the above-mentioned distributions). The name of a distribution must specify the distributed attribute and its support. It is clear that as regards the Gauss-type distribution, the support (mathematic) attribute is the variable x, and ρ (number of the elements which own that value) is a distributed attribute (this should be put at the genitive in order to show the affiliation to all the support objects). On the other hand, the elements belonging to the set of objects are material supports (ISS) of the information regarding the existence of the property x, but they are not the distribution's support and their number is the distributed attribute. It is compulsory that a clear distinction to be made between the notion of distribution's support (as an independent variable), and the one of material support of an information (ISS). Because the denominations of the above-mentioned distributions are quite frequent in the specialized papers, we shall further tolerate them although they are inaccurate in terms of the distributions definition.

X.5.5 Conclusions

The complementarity in case of the natural distributions requires the existence of an attribute which has values unevenly distributed on a support domain, the reference value being the mean value (the support's internal reference). By considering this reference value, some values show a property "deficit" while others are characterized by a property "surplus".

The same situation is found in case of the distribution of the human attributes (qualities) on the set of the individuals belonging to a society; all the qualities of an individual are being evaluated (by himself or by other members of the society) by making a comparison of each quality with a reference value specific to a certain society, and a reference is always existent - that is the mean value of the support attribute[97]- against which the two segments of the above-mentioned set may be distinguished: with property deficit or with surplus property. Because most of the distributions deployed by these attributes take place as a result of natural processes (self-settle by means of repeated bilateral interactions or by means of the specific individual components of the human genetic code), according to the objectual philosophy, the reference in question (mean value) is referred to as *natural reference*.

For example, the complementary attributes occur at the moment of the distribution of the instantaneous velocity on the set of gas molecules (either lower speed rates or higher than the average values), the distribution of intellectual abilities (stupid-clever) on the set of the individuals belonging to a social group, esthetic appearance (ugly-beautiful), muscular strength (weak-strong), etc. In most of the cases, the people have assigned different names for the two property types, although the two complementary properties are facets of the same distributed property, but with domains of the support's quantitative values on both sides of a natural reference. By making a more increased generalization and by extending the

[97] Value which belongs to most of the individuals in a society.

dichotomic classification (against a natural reference as well) to all the types of human behavior, we finally reach to the concepts of *evil* and *good*, which are certainly determined against a natural reference - an average human behavior, obtained as a result of the mediation between more behaviors of different populations, on periods of time for which stored data are available.

The complementary properties are basic examples of the existence of quality difference of a property, exclusively based on the sign of a quantity difference (against the reference value). If we observe that the Gauss distribution of an attribute has an unique support domain which is dichotomically divided in two sub-domains by the internal reference (natural mean value), in that case we could find that the two opposite qualities are nothing else but the same property, but distributed on adjacent-disjoint support domains.

The complementarity concept which was previously analyzed allows us to operate with new abstract objects (presented in chapter 9), such as the *absolute reality* as a basis for two complementary abstract objects: the *known reality* (made-up from the total amount of MS and of the real processes with simultaneous existence for which the mankind owns specific information at a certain moment), and the *unknown reality* (the rest of MS and of their associated processes, with a simultaneous existence, yet unknown by the mankind).

The non-contradiction principle, exclusively applicable under the conditions of a dichotomic classification of a set of objects with simultaneous existence is a very old principle, accepted without hesitations by the entire scientific community, but yet unreasonably ignored in some cases. A notorious example of non-application of the non-contradiction principle may be found in the classic physics where the simultaneous existence at the same object (for example, a material point) of the position and velocity (or of the impulse) is (still) accepted. But, my dear reader, the velocity implies the variation of the position of that particular point; how can it be possible to simultaneously exist two opposite attributes - an invariant attribute (position) and a variation of the attribute (velocity)? Does it mean that an attribute may be constant and variable at the same moment t? This error of the classic physics comes from another error of a similar kind, but which this time may be found in mathematics - the existence of the derivative in a point (namely, the existence of a variation - derivative - at the same time with the existence of an invariant value - the function value in that particular point (see also the annex X.3).

Annex X.6 – PROCESSUAL OBJECT CLASSES

For an easier understanding of the notion of *processual object*, we shall analyze the existence of such objects, by taking as an example the well-known case of the motion processes. After reading this annex, the reader will be able to understand that the processual objects can exist within any other processes, regardless of the variable attribute and regardless of the distribution support which defines this process.

The translation motion of a MS is a *specific process*, a variation of an attribute - the spatial position vector $\overline{r}$ - of an internal reference T of MS, in relation to an external reference. The objectual-processual analysis of the motion processes reveals the possible existence of many types of specific elementary processes (SEP, type P_0, P_1, P_2 etc.) and of more state types of these motion SEP (S_0, S_1, S_2 etc). All the *state*-type objects which are in question, may be considered as elements of some distributions (with a temporal support, applicable in case of the motion); the states S_0 are elements belonging to a primary distribution, the states S_1, S_2, S_3 are elements of the derived distributions belonging to the first, second and third rank of the primary distribution. In chapter 5, we have seen that the primary temporal distribution of the spatial positions of a moving MS is a Lagrange distribution (a trajectory):

$$\overline{r}_k = f_k(t_k) \tag{X.6.1}$$

This kind of realizable trajectory (obtained as a result of a sampling process) is displayed in the figure X.6.1, by means of a simple case with only five elements within a 2D space:

$$\{\overline{r}_k(t_k)\} = \{\overline{r}_1(t_1), \overline{r}_2(t_2), \overline{r}_3(t_3), \overline{r}_4(t_4), \overline{r}_5(t_5)\} \tag{X.6.2}$$

which are enough in order to explain the composition of the derived distributions up to the third rank.

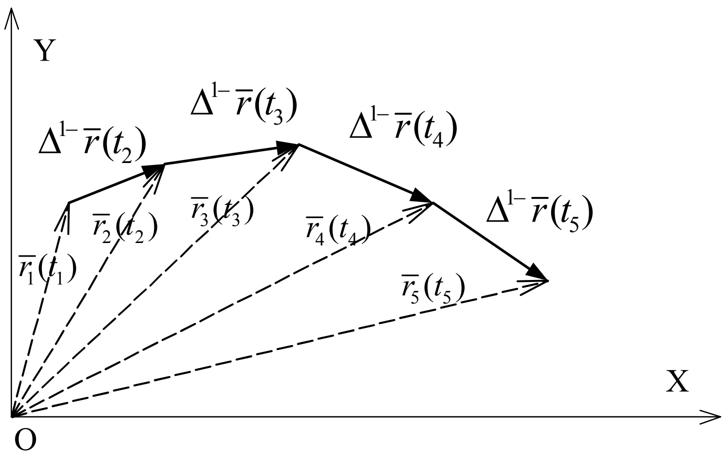

Fig. X.6.1

The elements of this kind of distribution are states belonging to the class S_0 with null specific processes (P_0), each element having (in case of a realizable distribution), a temporal DP (a normal value placed on the time axis) as its support.

Therefore, the moments t_1 ...t_5 are temporal DP which were subjected to samplings of the spatial positions of the moving MS, moments which comply with the following condition: the values t_k *(k=[1,5])* are internal references (extreme right[98]) of some specific temporal DP with amount ε, placed at equal intervals Δt (therefore, the finite temporal differences with a rank major than one are considered null).

The motion is assumed to be so uneven so that there are finite differences of the position vector up to the third rank (for allowing the processes existence up to this rank). In case of the motion existence, the state condition S_0 requires that the amount of the temporal support DP (duration of a sample) to be low enough so that the motion process to be considered insignificant (namely, a null one).

A first rank motion SEP (P_1) consists of a linear and finite variation of position $\Delta^{1-}\overline{r}(t_k)$, distributed on a support domain Δt (between two S_0-type states, see the figure X.6.1).

Comment X.6.1: We are reminding the reader that the symbol $\Delta^{1-}x_k$ or $\Delta^{1+}x_k$ represents a right (anterior) finite difference, respectively left (posterior) against the reference element x_k $(k \in [1, n])$ from an ordered set of *n* singular values of the variable *x*. In case of a first rank finite difference, we shall have:

$$\Delta^{1-}x_k = x_k - x_{k-1} \tag{X.6.3}$$

$$\Delta^{1+}x_k = x_{k+1} - x_k \tag{X.6.4}$$

The reason for using this kind of notation, with the reversed position of the sign, was chosen for avoiding the confusion between the rank of a finite difference and an exponent (a power).

The amount of the interval Δt (sampling period) is selected so that a position variation to be possible, but this variation must be considered linear (with an even density). S_1-type state (temporal density of the position's linear variation, that is the *velocity*) of the first rank SEP, which is evenly distributed on the support interval Δt is:

$$\overline{v}(t_k) = \frac{\Delta^{1-}\overline{r}(t_k)}{\Delta t} = \frac{\overline{r}_k(t_k) - \overline{r}_{k-1}(t_{k-1})}{\Delta t} \tag{X.6.5}$$

namely, the density of a first rank distribution element:

$$\overline{v}_{k-1} = f_{k-1}^{(1)}(t_k) \tag{X.6.6}$$

of the primary distribution X.6.2.

Comment X.6.2: One may notice that there is a ratio between a vector quantity (the first rank difference of two vectors) and a scalar (a temporal interval), resulting that the density of that distribution is a vector quantity. The reader is invited to accept that the distributions density values are scalars only as regards the primary distributions, where the distributed attribute is also scalar, and if the distributed attribute is a vector quantity (a process, that is the case of the derived distributions), then, the density shall be a vector as well. In case of an invariant vector density (on its support domain), this aspect implies the simultaneous invariance of the modulus and of its direction.

The figure X.6.2 shows the evolution of the information[99] regarding the position vector modulus throughout time, in order to clearly emphasize what are the support intervals of the two types of states S_0 and S_1. We have settled that within the sampling intervals with amount ε (amount of a DP), the position vector remains invariant, and within the interval which is associated to the sampling period (Δt), the position vector is linear variable. Taking into account the figure X.6.2, it may be noticed that the motion's support interval is $\Delta t - \varepsilon$ and not Δt, just as the relations X.6.5 and X.6.7 indicate, because the motion is null on the interval ε (invariant position through the definition of the state S_0). Because we did not want to make things too complicated, we stopped mentioning ε in the relations X.6.5 and X.6.7., but the reader must consider these notes in order to clearly understand that the temporal support of

[98] In case of the temporal intervals, we must choose the extreme right reference because IPS are able to receive information about the real processes only for the present moment (the reference against which the comparison is made) and the previous moments (which are already stored into memory and placed in the left side of the time axis). We are politely asking the ones who do not agree the extreme right to accept our apologies, but in case of the processes deployed in real time, there is no other alternative (#).

[99] Information which is provided to us by means of the sampling process, the only possible way to find out the evolution of a real process.

the state $\overline{r}(t_k)$ (state S_0) is different from the support of the state $\overline{v}(t_k)$ (state S_1), the two temporal intervals being adjacent but disjoint.

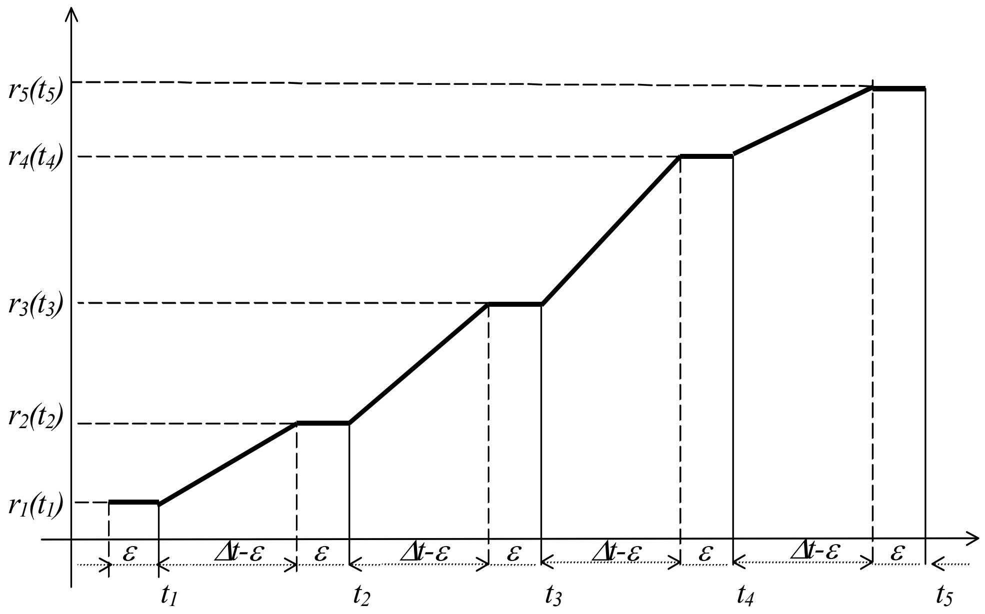

Fig. X.6.2

Although the temporal reference of both objects is the same value t_k, in case of the state S_0, it is an internal reference included in the support interval, whereas as regards the state S_1, it is an asymptotic reference (it is adjacent, but it does not belong to the support interval). Mathematically speaking, by using the notation for the closed or open intervals, the support interval of the state $\overline{r}(t_k)$ is $[t_k-\varepsilon, t_k]$, whereas the support interval of the state $\overline{v}(t_k)$ is $(t_{k-1}, t_k-\varepsilon)$. According to the figure X.6.2, it clearly results that the position and the velocity of a material object cannot have a simultaneous existence, although both abstract objects have the same reference value t_k.

As for the second rank motion SEP, the S_2-type state (temporal density of the velocity's even variation, that is the *acceleration*) which is evenly distributed on the support interval Δt is:

$$\overline{a}(t_k)=\frac{\Delta^{1-}\overline{v}(t_k)}{\Delta t}=\frac{\overline{v}_{k-1}(t_k)-\overline{v}_{k-2}(t_{k-1})}{\Delta t}=\frac{\Delta^{2-}\overline{r}(t_k)}{\Delta t^2}=\frac{\overline{r}_k(t_k)-2\overline{r}_{k-1}(t_{k-1})+\overline{r}_{k-2}(t_{k-2})}{\Delta t^2} \quad \text{(X.6.7)}$$

that is the density of a second rank derived distribution element:

$$\overline{a}_{k-2}=f_{k-2}^{(2)}(t_k) \quad \text{(X.6.8)}$$

In the actual case of the primary distribution X.6.2, the second rank derived distribution shall be:

$$\{\overline{a}_{k-2}(t_k)\}=\{\overline{a}_1(t_3),\overline{a}_2(t_4),\overline{a}_3(t_5)\} \quad \text{(X.6.9)}$$

The figure X.6.3 shows the distribution X.6.7 (only the velocity modules), which displays both the velocity modules and the modules of the velocity variations $\Delta^{1-}\overline{v}(t_k)$. This graphical plotting (as well as the ones from the figure X.6.1 or X.6.2) must be understood with all its shades. The temporal distribution of the information on the velocity which is provided to us as a result of the sampling process is displayed through a thickened line, not the real velocity of the motion process which is under study, but this fragmentary information is the only one we are able to get and the only one with which we can operate to during the information processing process.

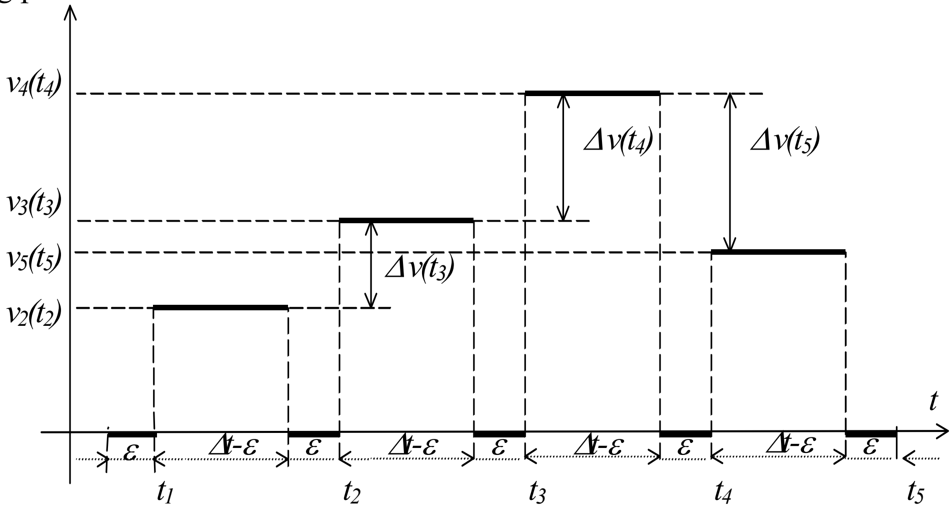

Fig. X.6.3

Comment X.6.3: The reader must understand and make a distinction between a real motion process and an information about that process. As regards an object or process which are located outside our body, we can have only partial informations provided by our sensory organs and by other auxiliary means, but not the total information about that object or process, information which is infinite in terms of quantity. Both the position and the velocity or acceleration of a moving object are the only data which are categorized by us in order to be able to differentiate (distinguish) them one from another, and these informations are our only link between our brain and the outside world. When we are saying that the position and velocity cannot have a simultaneous existence, we are referring mostly to the information about position and to the information about velocity. But even as a result of the idealization of the partial information (by decreasing the support intervals ε and Δt to zero), we cannot let aside the principle of non-contradiction (see the annex X.5) which forbids that the same attribute to be constant and non-constant (variable) in the same time interval.

According to the figure X.6.3, we may notice that the information about the velocity variation occurs with a delay of a sampling period, but this variation may be found (is distributed) along the same period of velocity existence, that is also on an interval $\Delta t - \varepsilon$.

As for the third rank motion SEP, the S$_3$-type state (temporal density of the even acceleration variation) distributed on a support interval Δt is:

$$\overline{b}(t_k) = \frac{\Delta^{1-}\,\overline{a}(t_k)}{\Delta t} = \frac{\overline{a}_{k-2}(t_k) - \overline{a}_{k-3}(t_{k-1})}{\Delta t} = \frac{\Delta^{3-}\,\overline{r}(t_k)}{\Delta t^3} \tag{X.6.10}$$

that is the density of an element of third rank derived distribution:

$$\overline{b}_{k-3} = f^{(3)}_{k-3}(t_k) \tag{X.6.11}$$

of the primary distribution X.6.1.

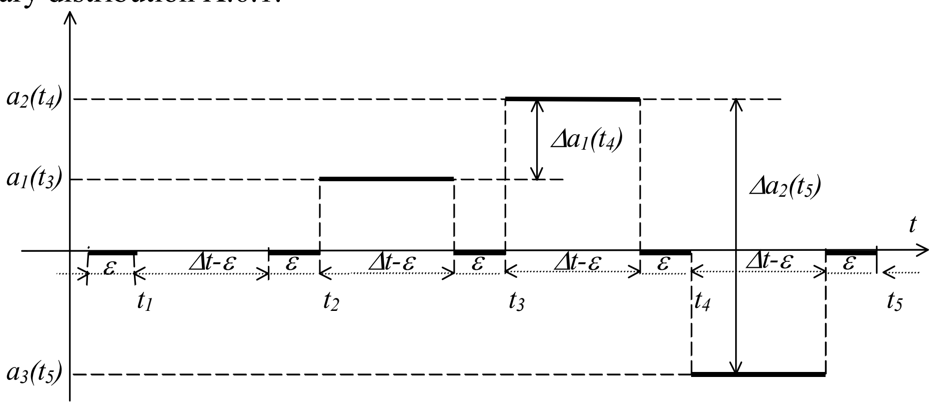

Fig. X.6.4

According to the figure X.6.4 in which the distribution of the acceleration modulus is being displayed (modules of the distribution X.6.11), we may notice that the information about the acceleration variation occurs with a delay of two sampling periods.

Comment X.6.4: The processual states S_1, S_2 and S_3 about which we have discussed so far, reaching to the conclusion that they are objects (obviously, abstract ones), because these are invariant distributions on their support domains and besides they are objects, they are also complex objects. According to their definition relations X.6.5, X.6.7 and X.6.10, it may be noticed that a state S_1 is based (in its composition) on a relation between two states S_0, a state S_2 consists of two states S_1 or three states S_0, so on. All these components of a state are abstract objects, which at the moment of assessment are considered as operands of an abstract process (computing, information processing), performed by an IPS; but, as we saw in the chapter 8, the operands of a specific abstract process must all have a simultaneous existence, whereas the states which they stand for, are no longer available at that specific moment (but they were existent at the previous moments). Due to this reason, all the information regarding the previous states which are perceived by IPS must be stored, and the storage takes place into a basic component of an IPS - its memory. In chapter 8, we have also read (the memory's axiom) that only objects can be stored into a memory (invariant and finite information amounts). This is the reason why the systemic philosophy has chosen an objectual approach on the cognition, approach which in some cases is far more different from the currently existing approach, but which is based on the fact that the cognition cannot be separated from the abstract processes deployed into the human mind or into AIPS, and these processes cannot be understood without an accurate and general model of IPS, model which explains us what the information processing actually means.

In order to allow the reader to make a clear picture on the essence of the motion's objectual approach, let us imagine that the process which we have analyzed it is an extremely simple motion picture made-up only from five shots, in which a point from the screen (the internal reference T of the moving object) performs the motion from the position $\overline{r}_1(t_1)$ to $\overline{r}_5(t_5)$. Each shot is associated to a state S_0 of the point object (in any movie, a shot is a state of all the objects which are caught on camera, all of them are motionless because they were recorded (stored), the shot being related to temporal interval *ε* as its support (which during the recording session corresponds to the exposure time and during playing, is related to the lighting time of that shot). There is a finite interval (several temporal DP) between two shots, which is high enough so that at a certain speed of the motion process, it will allow the occurrence of different detectable positions of objects.

This interval Δt is the temporal support of the even process P_1 and its density (invariant on this interval) is the constant motion speed (which is assumed to be constant only in this interval), that is a state S_1. In case of a movie, this interval is used when the motion picture moves forward with one frame (that is a motion process which substitutes the motion of the filmed object). Because the human brain works similarly (by means of sampling and storage too), it is very easy for it to "synthesize", to reconstitute the motion from the frames (samples) which were played, just as if this motion would be continuous. Finally, the usual remarks:

1) The objects S_0 with null specific processes (P_0) exist (for an IPS) during their support interval, that is a temporal DP (in case of the motion processes, but if the object does not move, the state S_0 can last endlessly). The processes P_1 are also deployed on the duration of their temporal support, that is a set of concatenated DP which make-up a first rank finite interval, with such an amount so that the process could be considered as uneven. The two temporal domains (a DP for the object S_0 and a DP set for the object S_1) are different, therefore, the objects S_0 and S_1 <u>do not have a simultaneous existence</u>. The same attribute - spatial position - cannot be invariant (P_0) and variable (P_1) at the same time. The two abstract objects - one which is a state of an object (S_0) and the other, a state of a process (S_1) - have different support domains, therefore, they cannot exist at the same determined moment, position and speed.

2) The objectual approach which is specific to this paper, based on distributions, reveals in this way a fundamental error of the classic physics - that is the acceptance of the simultaneous existence of the position and impulse (velocity) of a MS. This error comes from another error which this time may be found in the mathematics field - the derivative

existence in one singular point - same type of error which may be also noticed if we shall review the notion of derivative, by taking into account the concepts which are specific to the objectual philosophy (see the annex X.3).

3) The definition of the specific elementary processes (SEP) as distributions with even density of some variations (first rank finite differences between two states S_x) allows on the one hand an analysis of the processes, regardless their complexity, by decomposing them into various ranks SEP, and on the other hand, a better understanding of the operations with the abstract objects which are a substitute for SEP - *vectors*.

4) The classes of processual objects include abstract processes which are defined by means of elementary processes (namely, only through even processes). In case of the real objects, which are subjected to the real processes, these classes of processual objects (available only in the memory of an IPS) are always associated with a temporal interval as its model attribute, which may be considered as a “history” of that object. The exclusive utilization of the even processes as elementary processes is due to their property which does not allow them to contain internal differential information (the variation density is even into the support temporal interval, therefore, there are no internal contrast elements of the density).

Annex X.7 – ABSOLUTE AND RELATIVE FLUXES

Let us take a material system MS_1, with the spatial position $\bar{r}_1$, which is momentarily considered as invariant against an external RS_e. In such conditions, any flux defined against RS_e and which intersects RBS of a MS_1 is considered (for this MS) as an active flux, because it is able to generate an action on the system. The intensity of these fluxes is equal with the attribute amount which is carried in a time unit through a motionless imaginary surface, normal on the flux line. In case of our material system, the agent fluxes are decomposed on RBS into trafluxes and refluxes, and the traflux enters into the system by modifying its internal state first, and then, its external one. The traflux intensity is the integral on RBS of its normal and tangential component, determined into the time unit as well; the normal component shall provide the normal traflux (component T of the traflux) and the tangential one, shall provide the tangential traflux (component R of the traflux). The fluxes distribution is also similar in relation with the internal RS (which shall be referred to as RS_i) of MS_1, with just an origin displacement.

All goes well as long as MS_1 stands still. But, what it happens if $\bar{r}_1$ becomes variable, which means that MS_1 shall be moving with the velocity $\bar{v}$ (determined against the same external RS_e)? It is natural to presume that all the distributions of the fluxes which are incident on RBS of MS_1 would be changed because their transfer rates by means of RBS shall be vectorially composed on RBS of MS_1, with velocity $\bar{v}$, and even more, all the <u>motionless</u> material systems (against the same external RS_e) which are placed on the motion direction of MS_1 shall become fluxes (for MS_1), but this time, they are defined against the internal RS_i of MS_1, and they are fluxes which shall move with the velocity $-\bar{v}$ against RS_i. If the fluxes which were determined against an external RS_e (considered as an absolute RS) may be called ***absolute fluxes***, the fluxes whose transfer rate is determined against an internal RS_i of a MS shall be called ***relative fluxes*** <u>against that particular internal RS_i</u>.

But, my dear reader, we have seen that any material flux which is incident on a RBS of a MS and which has a component sent inward (traflux), regardless of its name, is an agent flux, which generates an action on that MS; similarly, a *relative* (at the internal RS of a MS) *flux* can be an agent flux for that MS, the action produced by it on a driven MS has a special name even since the Newton's time – that is ***reaction***.

Otherwise speaking, the reaction is a response of a driven MS, to the action of an external flux, response which consists in the state modification produced on the agent flux by the *reaction flux*[100] generated by the driven object, that is a flux which occurs as a result of a relative motion.

Let us assume that we have two material systems MS_1 and MS_2 which deploy an even motion (with constant velocity against an external RS_e), with velocity $\bar{v}_1$, respectively $\bar{v}_2$. The two velocity rates are given by the following relations:

$$\bar{v}_1 = \frac{d\bar{r}_1}{dt} \tag{X.7.1.a}$$

and:

$$\bar{v}_2 = \frac{d\bar{r}_2}{dt} \tag{X.7.1.b}$$

[100] The reaction flux is another denomination given to the relative flux of a driven MS. The name *relative fluxes* is more general, being also applicable in case of the fluxes which do not interact, but they are only determined against an internal RS of a MS.

where $\bar{r}_1$ and $\bar{r}_2$ are the position vectors of the two MS, and $d\bar{r}_1$, $d\bar{r}_2$ and dt are elementary variations under the meaning given by the objectual philosophy (not in the sense of the classic differential calculus, see the chapters 2, 3, 4 and the annex X.3). The internal references T of the two MS have a relative position one against the other:

$$\Delta\bar{r}_{12} = \bar{r}_1 - \bar{r}_2 \tag{X.7.2.a}$$

and:

$$\Delta\bar{r}_{21} = \bar{r}_2 - \bar{r}_1 \tag{X.7.2.b}$$

If the relative distance (position) vectors $\Delta\bar{r}_{12} = -\Delta\bar{r}_{21}$ are coplanar with the vectors $\bar{v}_1$ and $\bar{v}_2$ (which means that the mixed product of the three vectors is null), then, the fluxes T generated through the translation motion of the two bodies can be intersected one another[101], which means that the two MS shall interact (by means of collision) in a future moment. In this case, the relative transfer rates[102] of the two fluxes shall be:

$$\bar{v}_{12} = \frac{d\bar{r}_{12}}{dt} = -\bar{v}_{21} = \frac{d\bar{r}_{21}}{dt} \tag{X.7.3}$$

namely, in case of the relative fluxes between the elements of a MS couple, their relative transfer rates shall be always equal and shall have an opposite sign[103], regardless of the absolute values of the two velocity rates and regardless of their evaluation moment.

[101] The intersection conditions of the fluxes are more numerous, but for avoiding to make the presentation too complicated, we shall focus only on the coplanarity.

[102] Attention ! We are talking only about the transfer rates, not about the intensity of the two fluxes.

[103] As for a straight line segment (distance between the two MSs) which is either elongated or shortened, it is not the motion of the two ends which matters, but only the modulus variation.

Annex X.8 - LOCAL AND GLOBAL VECTORIAL QUANTITIES

This annex shows as a remember the most frequent relations from the theory of vector fields which are used throughout the entire paper, with the specification that the notion's denominations are the ones from the mathematics field, some of them being redefined in the present paper.

1) **The gradient** of a scalar field *ρ(x,y,z)* is a vector $\overline{V} = grad\,\rho(x, y, z)$ given by the following relation:

$$\overline{V} = \frac{\partial \rho}{\partial x}\bar{i} + \frac{\partial \rho}{\partial y}\bar{j} + \frac{\partial \rho}{\partial z}\bar{k} \tag{X.8.1}$$

where $\bar{i}, \bar{j}, \bar{k}$ are the versors of the axes **X,Y,Z**.

2) **The elementary flux** of the vector $\overline{V}$ is named the product $\overline{V}d\overline{\sigma}$, where $d\overline{\sigma}$ is the oriented area element ($\overline{n}d\sigma$). If the area element surrounds a point *P(x, y, z)*, then, the elementary flux will be in point *P*.

3) **Total** (global) **flux** of the vector $\overline{V}$ through any surface Σ is:

$$\Psi = \int_{\Sigma} \overline{V}d\overline{\sigma} \tag{X.8.2}$$

4) The total flux Ψ through a confined surface Σ which is the boundary of a volume Ω is also named the **productivity** of the volume Ω. The ratio Ψ/Ω is the **average productivity** of the volume unit and the limit of this ratio when all the points of the surface Ω tend to an internal point *P,* it is named the **divergence** of the vector field ***V*** in the point *P*.

$$div\overline{V} = \lim_{\Omega \to 0} \frac{\oiint_{\Sigma} \overline{V}d\overline{\sigma}}{\Omega} \tag{X.8.3}$$

Under the assumption that the partial derivatives of $\overline{V}$ are continuous in P, there is a limit which can be expressed by means of:

$$div\overline{V} = \frac{\partial \overline{V}}{\partial x}\bar{i} + \frac{\partial \overline{V}}{\partial y}\bar{j} + \frac{\partial \overline{V}}{\partial z}\bar{k} = \frac{\partial V_x}{\partial x} + \frac{\partial V_y}{\partial y} + \frac{\partial V_z}{\partial z} \tag{X.8.4}$$

5) **The curl** of a vector field $\overline{V}$, $curl\overline{V}$, is defined by using the circulation $\Gamma = \oint_C \overline{V}d\overline{s}$ on a confined curve C. A plane runs through the point P, having the versor of the normal line in $\overline{n}$. A confined curve *C* which surrounds the point P, placed in this plane delimit an area Σ. It is known that the limit of the ratio Γ/Σ when all the points of the curve C tend to P is the projection of a vector on the direction $\overline{n}$, that is a vector which is known as the *curl* of the field $\overline{V}$ in the point *P*. Therefore,

$$\lim_{\Sigma \to 0} \frac{\oint_C \overline{V}d\overline{s}}{\Sigma} = \overline{n}(curl\overline{V})_P \tag{X.8.5}$$

where

$$curl\overline{V} = \bar{i} \times \frac{\partial \overline{V}}{\partial x} + \bar{j} \times \frac{\partial \overline{V}}{\partial y} + \bar{k} \times \frac{\partial \overline{V}}{\partial z} \tag{X.8.6}$$

Circulation on the curve *C* goes directly against $\overline{n}$ (rule of the right screw). The curl may be also written as a symbolic determinant:

$$curl\overline{V} = \begin{vmatrix} \overline{i} & \overline{j} & \overline{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ V_x & V_y & V_z \end{vmatrix} = \left(\frac{\partial V_z}{\partial y} - \frac{\partial V_y}{\partial z} \right)\overline{i} + \left(\frac{\partial V_x}{\partial z} - \frac{\partial V_z}{\partial x} \right)\overline{j} + \left(\frac{\partial V_y}{\partial x} - \frac{\partial V_x}{\partial y} \right)\overline{k} \tag{X.8.7}$$

6) **The divergence's integral formula** (Gauss-Ostrogradski):

$$\oiint_{\Sigma} \overline{V} d\overline{\sigma} = \int_{\Omega} div\overline{V} d\omega \tag{X.8.8}$$

where Σ is the confined area of the volume Ω. The sense of the normal line on the oriented surface is considered to be positive <u>to the outside</u>. Other two relations are coming from the relation X.8.8, that is the **curl's integral formula**:

$$\oiint_{\Sigma} d\overline{\sigma} \times \overline{V} = \int_{\Omega} rot\overline{V}\, d\omega \tag{X.8.9}$$

which may be also written as:

$$rot\overline{V} = \lim_{\Omega \to 0} \frac{\oiint_{\Sigma} d\overline{\sigma} \times \overline{V}}{\Omega} \tag{X.8.10}$$

and **the gradient's integral formula**:

$$\oiint_{\Sigma} \varphi d\sigma = \int_{\Omega} grad\varphi\, d\omega \tag{X.8.11}$$

7) **Stokes's formula**:

$$\oint_C \overline{V} d\overline{s} = \int_{\Sigma} rot\overline{V} d\overline{\sigma} \tag{X.8.12}$$

where Σ is any surface limited by the confined curve *C*.

Annex X.9 – SCALARIZATION OF THE VECTORIAL QUANTITIES

By considering a set of material objects which exists at the same time (with simultaneous existence), the motion processes of these objects shall be simultaneous as well. The state of these processes decomposed into SEP shall be represented by an Euler-type vector distribution (defined in chapter 5), which exists at a moment *t* (moment which, according to the objectual philosophy, represents the internal temporal reference of a temporal interval and not a moment under the meaning of the classic physics). The vector objects of the Euler distribution belong to the carrier vectors class and they shall have their application points in the internal T reference of the moving objects, the modulus equal to the intensity of the motion process deployed by that object, and its direction depends on the concurrent previous processes (if there is no concurrent SEP, which means that there is no interaction occurred between objects, then, the direction of the individual SEP remains invariant, rectilinear).

Let us presume that the Euler distribution of the moving SEP of the objects is a stochastic (chaotic) one, which means that SEP modulus is included into a known and finite value interval, and SEP directions are uniformly distributed in the intervals $\alpha \in [0, 2\pi)$, $\beta \in [0, 2\pi)$ and $\gamma \in [0, 2\pi)$, evaluated against the axes of reference. It is clear that at the level of an individual process and during a period short enough in order to allow that the objects' motion velocity to be invariant, the character of this process is undoubtedly vectorial. However, the situation may be changed if the temporal observation interval is longer, so that the velocity of the motion process of an object to have numerous changes on the direction and modulus. In chapters 4 and 5, we saw that this type of individual process may be approximated by means of a series (a set) of concatenated SEP, that the temporal distribution of these concatenated SEP is a Lagrange distribution, and the invariant attributes (states) of these abstract objects can have a common component (one of them is the external reference) and against it - the specific components of each SEP.

If we shall take a more simple example, such as the case of the motions of a single object included into a plane, the different directions of SEP which make-up the series of concatenated processes can be evenly distributed within their existence interval $[0, 2\pi)$, in other words, any successive direction is equally possible within the temporal observation interval. In this case, the common component of these directions is null, and according to the objectual philosophy, this means that there is no direction. However, the common component of the modules is different from zero within the same temporal interval. Therefore, we are dealing with a positive amount different from zero (the modules' mean value), which has a null direction, otherwise speaking, <u>a scalar</u>. In this way, an apparently paradoxical situation occurs, in which a process (a finite series of concatenated processes is still a process, but a complex one) which actually existed on the entire temporal observation interval is represented by a scalar quantity.

In the above-mentioned example, we have taken into consideration a Lagrange distribution (a trajectory) of a single object, and in this case, the common component from a series of <u>successive</u> processes of a similar object should be determined. The situation is however similar if we are taking into consideration the common component of some <u>simultaneous</u> SEP (the aforementioned Euler distribution), but in this case, we are interested only in the spatial distribution of the SEP with simultaneous existence, rather than in the temporal distribution. Here, the situation in which this common component of SEP must be null is also likely to occur, which means that the coherent component of the Euler-type vector field should not exist, but in exchange, to be a common component of the simultaneous SEP modules, that is also a scalar. In chapter 5, we saw that this case is typical for the stochastic fluxes, fluxes which are strictly vectorial at the elementary level (of SEP), but on the global scale, they have only a scalar attribute as a result of the vanishing of the common direction. This is the notorious case of a gas from a confined and motionless container, in which SEP are the impulses of the individual molecules, with a clear vectorial character, but whose common component is a scalar which is the source of a series of scalar attributes as well, such as the pressure, the mean energy per molecule, so on.

Based on the data presented so far in this annex, the following conclusions may be drawn:

1) There are processes distributed either temporally or spatially, whose global representative is a scalar (the common component of the distribution elements has a null direction). In this case, we may say that a ***scalarization*** of the distributed process takes place.

2) The necessary and sufficient condition required so that the scalarization to occur is that the distribution of the constitutive SEP directions to be even (all the possible directions must exist in the temporal or spatial computation interval, so that their common component to be null, or otherwise speaking, the components' directions must be equiprobable).

3) It is possible that other scalar attributes of MS (besides the above-mentioned ones, such was, for example, the pressure) to be the result of the scalarization of some strictly vectorial processes (the internally stored fluxes), only due to an even distribution of the constitutive SEP directions. This is applicable for the electric charge, energy etc. One may notice that an even distribution of the directions of some SEP may be found in case of the stochastic motions, as well as at the coherent cyclic motions deployed on a confined trajectory (circular or elliptical rotations, vibrations etc., whose common component is null for the integers multiples observation intervals of the cycle).

4) *Scalarization* of some processes with even distribution of the directions is an abstract operation (performed into an IPS which monitors the phenomenon); the real individual or collective processes are always vectorial.

Annex X.10 – TRANSMISSIBLE ATTRIBUTES AND TRANSACTIONS

The attributes of the real objects can be divided in two categories:

1) *Transmissible* attributes, which can be transmitted (transferred through a flux) from one object to another, during a process which is named *transaction*;

2) *Non-transmissible* attributes, which remain specific to that particular object (stored inside it) until the expiry of its lifespan.

For becoming transmissible, an attribute must be carried by an *open flux*, that is a transfer process from one location (position) to another, and obviously, the flux must exist between the real objects which undergo an attribute exchange. Among the transmissible attributes, the *energy* and *information* are the most important ones for the objectual philosophy.

When we described the SM model, we saw that a real agent flux which covers the system's RBS generates a change on the internal state first, and then, on the external state, change which is called *action*. If the state changes occur in two MS as a result of the mutual actions of the fluxes released by the two MS and mutually received, we are dealing with an *interaction* process.

As it was noticed at the description of the generic IPS model, each distinct flux type released by a MS and which can be perceived (noticed, detected) by that IPS, it means a distinct *qualitative attribute* of that emitting MS. These material fluxes released by a MS and partly received by IPS, represent the support of the information associated by IPS to the perceived material system, and the certification (undertaken also by IPS) on the *existence* of this MS shall take place as a result of receiving this information.

Taking into account the above-mentioned issues, this means that the *transmissible* attributes are related to *active* (open) *fluxes* as their material support, and the *non-transmissible* ones have *closed fluxes* as their support, or objects placed inside the object to which they belong to. As for the interactive systems, the flux exchange processes (of transmissible attributes) which take place during the interaction are also named *transactions* because they are similar with the processes of assets exchange developed in the economic-financial field.

For beginning the study of the transaction process, a classification of their phases (stages, states) would be required:

1) *Initial state S_i* when there was no exchange between the two objects, and the transmissible attribute (which may be transacted) of each object is stored inside the object, this attribute stockpile representing the result of the previous transactions. Under this state, the two objects may be considered completely isolated (in terms of the transmissible attribute);

2) *Transaction process* (interaction) during which the transmissible attribute fluxes are transferred from one object to another;

3) *Final state S_f*, occurred after the completion of the transfer process, in which the two objects have another distribution of the transmissible attribute as compared to the initial state (a modification of the internal stockpile), and where once again, the two objects are isolated (until the next transaction).

An important observation: the two states which limit (as any other SEP) the transaction process both belong to the same processual class (in case of the "physical" interaction processes, they can be two positions, two velocities etc.).

Let us assume that there are two objects Ob_A and Ob_B which own the same transmissible qualitative attribute E, which is assigned (distributed) to the two carrier objects in the initial quantities e_{1A} and e_{1B}. In such circumstances, the abstract object:

$$S_i = \{e_{1A}E, e_{1B}E\} \quad \text{(X.10.1)}$$

which represents a distribution with only two elements of the distributed attribute E on the support made-up from the set of the two objects Ob_A and Ob_B, is considered as an initial state which is prior to the transaction process. After the process completion, we shall have the following state:

$$S_f = \{e_{2A}E, e_{2B}E\} \quad \text{(X.10.2)}$$

The transaction process between the two objects is a complex process, made-up from two simultaneous processes (therefore, according to the classification from chapter 4, there is a collective and specific process), and since we have information only about the two states, initial and final, the two simultaneous processes shall be considered as linear (with even density), namely, two SEP with a common temporal support Δt.

By using the transition operator from one state to another [$\Rightarrow$], we shall therefore have:

$$PES_A = \{e_{1A}E \Rightarrow e_{2A}E\} \quad \text{(X.10.3)}$$

that is the variation process of the attribute E which belongs to Ob_A, and:

$$PES_B = \{e_{1B}E \Rightarrow e_{2B}E\} \quad \text{(X.10.4)}$$

similarly for Ob_B. The states of the two processes (their density) are:

$$\rho_A = \frac{\Delta e_A}{\Delta t} = \frac{e_{2A} - e_{1A}}{\Delta t} \quad \text{(X.10.5)}$$

and:

$$\rho_B = \frac{\Delta e_B}{\Delta t} = \frac{e_{2B} - e_{1B}}{\Delta t} \quad \text{(X.10.6)}$$

According to the relations X.10.5 and X.10.6, we may notice that depending on the actual initial and final values, the two variations Δe_A and Δe_B may be positive, negative or null, each case being associated with a special denomination in accordance to the current terminology. Thus, if Δe_A is negative, the transaction in case of the object Ob_A is considered as *unfavourable*, and it is *favourable* if Δe_A is positive and *equitable* in case of a null variation.

Comment X.10.1: Now, it is the moment to draw the reader's attention on a major approach difference regarding the transaction notion (property exchange as a result of a flux), against the classic approach presented in text-books and in other papers. The notion of *null transaction* cannot exist in the objectual philosophy field, because any property (either objectual or processual) which owns the null quantitative attribute means that it does not exist. The fact that a transaction is made-up from two simultaneous non-zero processes (fluxes) means that these processes exist even if the state variation is null (equitable transaction). In case of this latter transaction, because $S_i = S_f$, the classic approach states that there was no occurrence of property exchange. On the contrary, the objectual philosophy upholds that there was a transfer (transaction) process but, in equal quantities and opposite senses. This approach is used for instance in case of the energy exchange (by means of the energy fluxes) between two MS which are under equilibrium, which deploy static, equal and counter direction forces.

So far, we have discussed only about a transaction deployed between a single couple of objects. In the real world, where there are lots of objects with a simultaneous existence (a DS in which only the proximity elements are in interaction, or a CS in which, besides the interactions with the proximity elements, each element must be also subjected to the permanent interaction with the central system), the transactions can be collective, multiple, simultaneous or successive.

The case of the successive interactions (temporally concatenated) is worth mentioning because the effects generated by this succession are very interesting. Let us assume that we are dealing with the same couple of objects Ob_A and Ob_B which were above mentioned, only that, instead of a single transaction, we shall have a series of successive transactions. In this case, we shall take into account the temporal distribution of the attribute transactions of one of the two objects, that is a distribution which represents (as we have seen in chapter 4) a series of concatenated SEP. In case of such a distribution (which is a first rank derived distribution), the primary distribution is represented by the temporal series of the transmissible attribute stock of the researched object, between two transactions. Let us assume that this series for Ob_A is $e_A(t_1)$, $e_A(t_2)$, ... $e_A(t_n)$, where $\Delta t = t_k - t_{k-1}$, $k \in [1, n]$ is the support interval for the aforementioned SEP. There are only two values of the series which are relevant for this topic: initial $e_A(t_1)$ and final $e_A(t_n)$. The difference between the two states of the transmissible attribute after a series of transactions shows us what kind of transaction (out of the three above-mentioned types) was *prevalent* for a particular object. Naturally, if the two states are equal, the object had mostly even transactions, if the difference is negative, the unfavourable transactions have prevailed and if it is positive, the favourable ones were predominant. This predominance of a transaction type for a series of successive transactions which have affected a specific object is the cause of the unevenness of the natural distributions based on Gauss distribution.

As we have mentioned in the annex X.5.4, there is an internal reference in case of these natural distributions, against which the distribution elements can have a property surplus (in relation to the mean value) and elements with a property deficit. The elements with a property surplus took benefits (as a result of the repeated interactions) from a series of prevalently favourable transactions, and the ones with deficit, were affected by a series of predominantly unfavourable transactions. While in case of the natural distributions (such as for instance, the distribution of the molecular velocity rates in a gas), the objects with a property surplus or deficit are not always the same, fact which certifies the process “naturalness” (namely, the lack of an artificial interference on these processes), as regards the distribution of the valuable resources on the humans’ society, the situation is much more different….

Annex X.11 - BIOSYSTEMS

X.11.1 The model of the bio-system object

In the beginning, it must be clearly settled that the bio-systems also belong to the class of the material systems, the abiotic material systems making-up the abiotic support of all the bio-systems, regardless of their complexity. Consequently, the model attributes of the abiotic MS shall be present (inherited) at bio-systems as well, but there will also be extra attributes which are specific only to the bio-systems class. Similarly with the abiotic MS, there will also be a reference medium (RM), the medium with an existence previous to any bio-system and whose elements were the basis for the formation of the first and the most simple biosystems. This medium must own some compulsory qualities:

1) RM's elements must be the generating set for any system which will be comprised in the composition of all the bio-systems. Since the internal organization of the elements of known bio-systems starts from the atomic and molecular level, the media which are made-up from these elements are the natural media (NM, whose elements are those about 90 types of stable atoms which can be found in the peripheral media of the Earth[66]);

2) RM must allow the quasi-free rotation of the atoms and molecules, that is a basic condition for the stereo-chemical synthesis. This condition excludes the S-type RM (solids) which does not allow the elements rotation;

3) RM must allow the existence of the internal mobile bounding surfaces (cavities). This condition can be accomplished by a single type of NM - $\boldsymbol{L_A}$ media (liquids);

4) RM must contain in a relative small volume (in a sufficient concentration) all the chemical elements and their abiotic compounds which are necessary to the bio-system synthesis (to be, among others, a good solvent for the compounds of these elements);

5) RM must be polar, which means to allow the appearance, the existence and motion of ions;

6) As compared to RM, the chemical compounds which may be found in this medium must be divided in two classes, the medio-*philes* ones with attraction forces to the medium, and medio-*phobics* with repulsion forces against the medium. This last condition is absolutely necessary for the synthesis of the bi-layer plasmatic membrane which makes-up the RBS of the living cells, and the cell is, as we are going to see later on, the basic biotic system, the existence of all the bio-systems depending on this condition.

Based on the above-mentioned conditions, an almost unique medium is going to result, which can be found in large quantities on Earth - that is **water** - as a support medium in which (as solutions, emulsions, suspensions etc.) all the abiotic elements which are necessary for the bio-system's structure are spread. This medium was also preserved as an internal medium in an amount of over 70% at the advanced biosystems which currently exist, even if most of them were diffused from the primordial medium into other media (atmosphere, soil and the interstitions from the earth crust). The water is absolutely needed for all the biosystems, mostly in the areas where the chemical synthesis is deployed - the cell cytoplasm - or as a carrier medium for the internal fluxes.

[66] But the atoms with instable nuclides must not be neglected either (the radioactive isotopes of the stable atoms), especially if they have a span life comparable or longer than the bio-systems' one.

As compared to this reference medium from which the bio-system collects the elements of its structural abiotic support[67], the bio-system must be supplied with energy in order to support its internal fluxes - vital fluxes. Just as in case of the abiotic MS, this energy must be obtained from the outside by means of the *supply fluxes*, which are immergent fluxes running through the biosystem's RBS (most of them are coming through the RBS's specialized gates). The supply fluxes must bring inside the biosystem both the energy required for the maintenance of the internally stored fluxes (vital fluxes) and the support biotic or abiotic material, which is required either for maintaining the proper integrity, or for the future biosystem which shall be synthesized within the *reproduction process*. In other words, the biosystem's input fluxes must contain both the structural and the energetic component.

The internal chemical reactions which are the basis for the formation and existence of the bio-system, generate both useful and non-useful compounds, or even noxious ones, compounds which must be eliminated to the outside. These compounds, together with their carrier media (water or air), shall make-up most of the structural fluxes emerging from the bio-system, besides the unavoidable energy loss fluxes by means of the emergent fluxes consisting of thermal photons.

The flux triad model - immergent, stored, emergent - which was observed for the first time at bio-systems, but which is considered as an universal model for MS in the paper herein, is obviously valid for the bio-systems as well, but on another organization level against the support abiotic systems.

Due to its importance, we let at last the specification that, besides the above-mentioned fluxes, there are also information fluxes included in the fluxes which make-up that particular triad. The significance of these fluxes is also underlined by the fact that the triad of the information fluxes makes-up a special material system: information processing system (IPS). This MS-type is specific to the biosystems and only in the last century, its imitation has become possible by means of the artificial IPS.

Therefore, the biosystems are a MS class with the following specific attributes (besides those of the abiotic MS):

1. The existence of the *fluxes triad* (3**F**) against the abiotic reference medium: the supply (immergent) fluxes, the vital (stored) fluxes and the output (emergent) fluxes;
2. The necessity of this kind of fluxes determines the need for an additional energy supply (against the abiotic level);
3. The existence of the *self-reproduction process*;
4. The existence of a specialized MS - *information processing system* (IPS) - which operates with another class of specialized MS which are the information support systems (ISS), that is a system which controls all the internal processes of the biosystem, from the RBS permeability to fluxes, up to the self-reproduction and external behaviour processes. This system is also organized on hierarchical levels, depending on the biosystem's complexity.

X.11.2 The cell - elementary bio-system

As we were saying in the previous section, the bio-systems are a MS class which must comply with the existence criteria of such a system (besides those of the abiotic MS):

Criterion 1: The existence of the *fluxes triad* (3**F**) against the medium of existence (abiotic or biotic medium from which the biosystem's elements are originating from): the

[67] We are talking about bio-systems placed at the lowest trophic level, which are those inferior organisms whose input fluxes are exclusively abiotic. The structural input fluxes of the superior organisms have components already produced in other bio-systems, by using them as food.

supply fluxes (import fluxes, immergent through RBS), vital fluxes (stored into RBS) and output fluxes (export fluxes, emergent through RBS).

Criterion 2: The existence of the information acquisition and processing processes into a specialized MS (IPS), also organized according to 3**F** model, system which is able to operate with another class of special MS - the information support systems (ISS). Based on the existence of an internal IPS and on the decisions taken by it, this will allow the existence of the control on the *selective permeability* against the fluxes through RBS and of the internal and emergent fluxes of the bio-system.

Criterion 3: The existence of the *self-reproduction process*, required for the preservation of the species and of its specific genetic information.

Criterion 4: The need for fluxes triad also draws another need: the necessity for the *supply with a second level energy* (the first level is required for maintaining the abiotic support MS fluxes).

In case of the bio-systems living on Earth, the generating medium (reference medium, L_A-type, peripheral medium) is the planetary hydrosphere (with all its existence forms: oceans, seas, lakes, rivers, subterranean water), in which all the elements necessary for a biosystem structure are spread (as solutions, emulsions, suspensions etc.). For the time being, it is impossible to mention what were the primordial elementary bio-systems, but at the current stage of the bio-systems evolution on Earth, the most simple bio-systems which comply with the four above-mentioned criteria are the *prokaryotic cells*. If the set of the abiotic MS from the hydrosphere is a generating set for the set of the living cells from the planet, the set of the prokaryotic cells is also a generating set for all the other cellular or pluricellular bio-system types.

The fulfillment of the bio-system criteria no 1, 3 and 4 is clear and well-known, the feeding, excretion, reproduction processes of the living cells being well-known. As for the existence of the criterion 2, the chemical synthesis processes based on the information contained into some ISS with an universal syntax for the bio-systems on the Earth are certainly known and these are the DNA or RNA molecules. Therefore, the intracellular chemical syntheses are *information processing operations* of structural synthesis. The processing of the information related to the external medium of a cell are not known enough yet, but there is no doubt that they exist because, without these processes, the other processes such as feeding, reaction to the unfavorable environmental conditions etc. could not be achieved (we are talking about free living cells, which have to manage by themselves, not about the cells belonging to a pluricellular organism).

The bio-systems must be able to distinguish (to deploy an objectual separation) the "good" systems (useful, which can be, for instance, ingested) from the outside medium, from the "bad" ones (which may be considered as a danger for the bio-system's integrity). These performances cannot be achieved without the existence of an internal IPS. We must also take into account that the most advanced IPS which can be currently found on the planet is the human brain, containing a cell which is specialized in the information processing, that is the neuron. But, this huge information processing capacity, associated to a specialized cell was not able to occur without the existence of some elementary information processing operations, processes which are specific to any living cell and which have the same ISS as an information basis - the DNA and RNA molecules.

Based on the existence of an internal IPS, the bio-systems are endowed with a characteristic which did not exist at the abiotic systems: the selective permeability to the fluxes. In this way, the access through RBS both for the immergent fluxes and for the emergent ones is strictly controlled; the access to the inside is allowed to MS which are recognized as "good" ($p_k=1$) and the access is restricted for the others ($p_k=0$).

According to the above-mentioned issues, we may certainly state that from the point of view of the bio-system's existence criteria, the living prokaryotic cell is a *basic element* (fundamental object).

Comment X.11.2.1: In the eukaryotic cells, some of their organelles are themselves specialized prokaryotic cells (such as for instance, mitochondria or chloroplasta). This means that an eukaryotic cell is a system which is already made-up from more cellular-type biosystems, which are systems associated according to the laws of formation of the natural material systems, with the reciprocal advantages which are generated by this association.

There are fragments (subsystems) from the composition of a cell which may exist in the external environment, as a result of the destruction of the cellular membrane (RBS), but these fragments alone cannot fulfill all the main criteria for a bio-system, therefore, they are not bio-systems any longer, but only some compounds with a biotic origin. For example, a class of commonly systems which is considered as belonging to the bio-systems category, the *viruses*, are proved (according to the objectual philosophy) to not be bio-systems. These MS made-up from a DNA or RNA fragment covered by a protein shell are not self-reproducing, but they are simple abiotic ISS, but with a biotic origin which baffle the access control system through the plasma membrane of some cells and in this way they get inside. Here, any genetic information (contained in a DNA or RNA fragment) goes into "the replication machinery" embedded in any living cell, and thus, the virus' genetic information determines its deviant reproduction until the destruction of the penetrated cell.

Comment X.11.2.2: The situation is similar with the manufacturing schemes of a high-tech product. By assuming that they are into a container, it is clear that they will remain there without being able to self-reproduce until the moment they will casually reach a proper environment (a technologically developed society able to understand the plan and to manufacture the product). If the product will prove to be harmful, it is likely that the society would be destroyed (the same as the penetrated cell in case of the virus).

Similarly with the abiotic material systems, the bio-systems also make-up a structural chain of MS, that is an hierarchical set of organization forms of these system types, but which this time are spaced on a finite number of complexity levels.

X.11.3 The bio-systems' structural chain

Once with the specification of the basic element (the first element of the chain) and by also knowing the maximum limit of the generating set (the planet's peripheral media), we may conceive a structure of the organization levels of the bio-systems which exist on this planet. We shall use the same method that was used in the chapter 1 for displaying the organization levels of NAMS, in which the organization levels are colligated by means of the operator [$\rightarrow$] (structural implication operator):

$$PBS \rightarrow OM \rightarrow OG \rightarrow FA \rightarrow OR \rightarrow CM \rightarrow EC \rightarrow PC \qquad \text{(X.11.3.1)}$$

The relation X.11.3.1 represents the structural chain of the biosystems organization on Earth, in which the used acronyms have the following meaning:

PC - prokaryotic cells;

EC - eukaryotic cells;

CM - cellular media (cellular populations, G-type media for the spread bacteria media, S-type media for the compact tissue or bacteria compact media);

OR - organs (tissue media systems with specific functions such as the intestines, liver, pancreas, kidney, brain etc.);

FA - functional apparatus (systems made-up from organs, with specific functions such as the digestive, breathing, excretory, reproduction system etc.);

OG - organisms (an autonomous system consisting of functional devices);

OM - organismal media (populations of organisms, mostly G-type media);

PBS - planetary biosphere, global system made-up from the total amount of the organismal and cellular populations with a simultaneous existence in the peripheral media of a planet.

If we are taking into account that the organization levels OR and FA cannot have an independent existence, they are just parts (subsystems) of an OG system, the relation X.11.3.1 can be simplified and becomes:

$$PBS \rightarrow OM \rightarrow OG \rightarrow CM \rightarrow EC \rightarrow PC \qquad \text{(X.11.3.2)}$$

that is a relation which represents the structural chain of the organization of the autonomous bio-systems on Earth (the ones which meet all the criteria of the bio-system model).

Comment X.11.3.1: The reader has certainly noticed that unlike the relation 1.2.3 from chapter 1, the relation X.11.3.2 lacks of the question marks which trace the possible limits of the organization levels applicable for NAMS. It is natural because BMS have a lower limit of the decomposition level (there are elementary systems regardless of the cognition level), as it revealed by the issues presented in this annex. On the planet, there is also a maximum limit in terms of composability, which is dictated by the sizes of the peripheral media of the resident planet, media in which PBS is distributed. While as regards the lower limit of the BMS' organization, the objectual philosophy clearly postulates that in case of the BMS with atomic abiotic support, PC biosystems are elementary systems, as regards the upper limit, it is likely to exist some systems made-up from different PBS, placed in the same PS (what the scientists are doing now by trying to colonize the Moon and Mars), or in different PS, under the assumption of a technological lap which would be sufficient for ensuring the biosystems fluxes on astronomical distances. The previous underlining has a specific purpose, that is to represent that a lower limit of the organization levels can be noticed in case of a certain environment of existence, made-up from NAMS with a specific organization level (in case of the notorious bio-systems, this is a L_A medium - the water - as it was previously mentioned). As for another media generation, such as PFM, and similar with the way how NAMS were created, the possibility of occurring another biosystem generation which owns the PFM elements as its abiotic support shall not be let aside as well.

We may notice further on that the PC, EC and OG systems are all centralized (CS, all the cellular functions are controlled by a cellular or neuronal IPS which exists inside the nucleus), and CM, OGM and PBS systems are distributed systems (DS, in which there is no interactions except the ones deployed between the proximity elements. Thus, an interesting alternation of the system types occurs into the structural chain:

$$DS \rightarrow CS \rightarrow DS \rightarrow CS \qquad \text{(X.11.3.3)}$$

The reader must understand that this structural chain has no connection with the taxonomic classifications which are stated in the biology field, classifications which are focused more on the reigns, orders, species etc. It is clear that these categorizations are useful because they emphasize the common and different elements of the various biosystem classes, but these do not concern the organization levels.

Annex X.12 – INTERNAL, EXTERNAL, LOCAL AND GLOBAL STATES

In chapter 4, we have seen what are the definitions of an object's state or of an even process, as well as the types of the processual states which are coming from this kind of definition. Based on these definitions, and on the fact that the assessment of each state type is made against a reference system, and on the fact that the object whose state is assessed may be a complex object, there are also other state classes which can be defined.

When we have discussed about objects, we saw that their properties are determined first of all against an internal reference system and in this case, we are dealing with some *internal properties*. All the properties of an object are also determined against a reference which is outside the object and that is why they are called *external properties*. Let us remember the definition 3.1.3 which was given to the notion of object: The object is a finite and invariant set of qualitative attributes (properties), with simultaneous, finite and invariant distributions, on the same finite and invariant support domain, which are determined against a common internal reference system. If the set of the attributes of an object is made-up from *m* properties, each element x_k of the common support will be associated with *m* values of the distributed attributes which are related to that particular element by means of *m* assignment relations.

According to the definition 4.2.1, all the existing (distributed) invariant attributes on an element x_k of the common support, makes-up the abstract *state* object at the value x_k of that particular support. In chapter 2, we saw that the support element may be a singular value, that is a case when we are dealing with a primary distribution, or an elementary interval of values (with an internal reference x_k), and in this case we are dealing with a derived distribution (of a primary distribution). In chapter 4, we saw that the state applicable to a singular value of the support is a state S_0 (state of a primary distribution element), and the one which is related to a support finite interval is a state S_n, where *n* is the rank of the finite difference distributed on the elementary interval Δx_k (state of an element of derived distribution of rank *n*).

Because any of the above-mentioned states, either S_0 or S_n represents a set of properties belonging to a certain element of the support attribute, all of these will be considered as ***local states*** (specific either to the support element x_k, or to the elementary interval with an internal reference at x_k) of the object with the above mentioned *m* properties.

The evaluation of the value of the local states attributes can be done, as we have previously pointed out, against a reference system inside the object, when we shall be dealing with ***internal*** (local) ***states***, or against an external reference system, when we shall be dealing with ***external states*** (local as well).

We were previously saying that the local states are states *specific* to a certain distribution element, either primary or derived distribution which belong to an object. The *m* distributions which belong to an object *Ob* with *m* qualitative properties in set, have a finite number of elements (for the realizable distributions): the number of normal singular values corresponding to the primary distributions, or the number of elementary intervals in which the support is divided, concerning the derived distributions. In chapter 3, we saw that the elements of a distribution are elementary objects at the same time, therefore, the object *Ob* is an object composed from a set of elementary objects, each with its own *m* properties which are provided by means of the assignment relations. Since all the properties of an elementary object are specific (local) properties, they all have a common component, aspect which was presented in chapter 3, the reference value against which these properties are evaluated, that is a value which belongs to the internal reference system of the object *Ob*. We have also noticed in chapter 3 that this reference value valid for an isolated object has a null value *(absolute reference*), and for an object which deploys relations with other external objects, its value shall be established against an external reference, common to all the objects which develop mutual relations, and it becomes a *relative reference*. In this case, the set of objects which deploy external relations makes-up a complex object, the composition relations being created between the internal reference systems of each constitutive object, and as a result of the existence of such relations, each internal reference shall be assigned with a non-zero value. But, this means that there is a set of dependence relations deployed between the values of the internal references of the constitutive objects and the external reference, set which will make-up a new distribution, which represents the complex object.

The total amount of properties assigned to the internal RS of a complex object against the external reference makes-up an external state of this RS, and because that state is common to all the internal elements of the complex object, it will be a ***global state*** of this object.

As a conclusion, an amount which is placed inside an invariant confined surface may be characterized from two points of view - *local* and *global.* The local characterization is given by the elements of the spatial distribution of that amount inside the surface (mostly by their density), and the global one is given by the integral of this distribution (the total attribute amount distributed into the inner volume, that is the attribute *stockpile*), or by the internal RS of the distribution. As for the distributed processes, the local characterization is made by SEP (the element of Euler distribution), and the global one is given by the resultant of the vectors' distribution (which is also the result of an integration).

Annex X.13 – ABSTRACT SUPPORT AND MATERIAL SUPPORT

The chapter 2 which is focused on distributions also defines the *support* of a distribution as the domain of values of the independent variable. This domain consists of a set of singular values, which are either quantitative (numerical, scalar) or literal (words, characters), or other type (for instance, graphical symbols), otherwise speaking, we are dealing with an abstract object. All the singular values contained by this object - distribution's support - are evaluated by an IPS, if those values exist in its internal or external memory. Even the distributions are only some mathematic models of real objects, the distribution's support being only a part of this model. According to the objectual philosophy, the word *support* was continually used for the values domain of an independent variable belonging to a distribution only due to reasons related to a gradual transition from the usual terms from mathematics to the terms specific to this paper. It is clear that in this case, we are dealing with an ***abstract support***.

In chapter 8, where the general IPS model was presented, we have seen that each information perceived by an IPS has a ***material support*** - a MS belonging to the class of information support systems (ISS). When we are talking about ISS, this means that each type of transmissible qualitative information perceived by an IPS is associated to a material flux with specific properties, flux which is coming from (efferent) a source material object. Besides the natural qualitative properties (given by specialized sensory organs of each type of evolved organism), the people are able to perceive properties of the transmitted objects also through fluxes placed outside the natural perception range, by means of flux converters which turn the fluxes which cannot be directly perceived (IR (infrared), UV (ultraviolet), X, γ photons, electrons, neutrons fluxes etc.) into directly perceivable fluxes (IR or UV visors, electronic microscopes, IR, UV, X, γ photons, telescopes etc.). Taking into account these findings, it is worth noticing the fact that absolutely all these properties which are perceived either directly or indirectly have as their *material support* both the aimed object and the material fluxes which are generated by it (either the emergent fluxes or the reflected ones). Since one of the most important properties of the objects perceived by an IPS is the *spatial position* (determined against an internal spatial RS, which can be found at any organization level of the biosystems), the objectual philosophy claims that:

> **AXIOM VIII (space axiom):** *The* **spatial position** *property of a MS, with its domain of values - infinite space - cannot exist without a material support. Since this property is considered to be continuous and infinite divisible, this means that for each infinitesimal space domain, a support MS must exist.*

The axiom VIII together with SOP (systemic organization principle) which was presented in chapter 1, both postulate the direct interrelation between the infinity of the organization domain of the abiotic MS and the space infinity. The space exists just because of the fact it is the support domain of the material systems existence; any MS needs an internal spatial domain (delimited by RBS) and an external spatial domain delimited by the contests with the proximity neighbors (in which the external energy of a MS is contained). Due to this reason, it is impossible to exist any spatial domain, no matter how little it is, without being fully charged with MS with different organization levels. The systems with superior organization are nothing else but finite and limited parts (partitions) belonging to this overcrowded MS set which have an uneven energy distribution per element, sections which can move/propagate through that set. The assumption of the infinite size of the space therefore draws both the assumption of the infinite divisibility of MS and the assumption of their infinite composition ability. Moreover, if the space is the abstract support domain of the material systems, the material systems are the space's real support.

Annex X.14 – OBJECTS' PERCEPTION BY IPS

In chapter 3, we have seen that an object is a distribution set of the values of some attributes, on a common support with a finite domain named the object's internal domain, distributions which do not exist or are different outside this domain. A MS able to detect an object must be also able to perform few types of fundamental processes:

A. *Qualitative* evaluation of the distributed attribute, which consists in the distinction (separation, discrimination) from the set of external influx types, of a single one, that is an influx which is received by one of the specialized input units of the perceiving IPS;

B. *Quantitative* evaluation of the attribute distributed on each element of the primary distributions belonging to the object's set;

C. The evaluation of the difference between the values distributed on two adjacent elements of primary distribution, otherwise speaking, on each element of the derived distribution coming from the primary one;

D. Overall quantitative evaluation of the distribution's support domain (the object's internal domain), in order to evaluate the object's dimensions.

The process **A** is based on the fact that all the properties which are found into the model set of an external object must be transmissible properties, which means that these properties may be transferred (carried) by some fluxes. A certain type of flux, for instance, a photon flux is able to carry properties such as: photon frequency (which is preserved into a homogeneous medium and for non-astronomic distances), the direction of the photon flux (which is preserved into a homogeneous medium with evenly distributed parameters), flux intensity (that is the number of photons received per time unit) etc. After their conversion into IPS, these properties become associated to the agent object: colour, spatial position (against the internal spatial RS of IPS), brightness (shining) etc.

The process **B** is a process with point like localization (at the limit); the shortest the domain of this localization is, the better is the domain resolution (within the distribution's support domain) of the detecting system. Because into the point domain (PD) of the process **B**, there is no possibility of distinguishing an internal distribution, the distribution on this domain shall be considered as even (even if in reality it can be however uneven).

Comment X.14.1: An example of this kind of point like process is the detection process which occurs in a cell of a human sensory organ. This kind of cell receives an external flux from the specialized qualitative cell domain (a photon flux from the visible domain for the retina cells, an acoustic flux for the cells of Corti organ, a thermal photons flux for the thermo-receiver cells etc.). As a result of receiving (transmitting) that particular flux through the cell's RBS, the flux action occurs, that is the information exit flux, with the intensity proportional with the intensity of the agent flux. Because a cell cannot perceive the distribution of the incident flux on it, but only its global intensity through the cellular RBS across the cell domain, the distribution of the external flux is considered as even, therefore, a sensory cell perceives an elementary flux. An adjacent cell shall also receive an elementary flux from an area which is adjacent with the area of the first cell, and it will provide an information output flux which is proportional with the intensity of this flux. Thus, the total amount of the sensory cells of a specific organ shall provide at the exit a spatial distribution of some information fluxes which are proportional with the spatial distribution of the external fluxes, incident on the sensory organ. Since the external fluxes are produced by some external objects (agent objects), and these fluxes carry some properties of these objects, the distribution of the information fluxes provided by a sensory organ at a specific moment is an abstract object, an *internal representation* of the state of the external objects whose fluxes have been received. Obviously, when we are talking about the state of the external objects as the total amount of the invariant properties of these objects, we are referring to those or that property which can be detected by the sensory organ. For a more accurate representation of the real state of an external object, a cumulation (qualitative composition) of the simultaneous representations of that object provided by all the sensory organs belonging to the organism and which receive fluxes from that particular object. This is the main reason of the objectual philosophy for upholding the synchronic perception, at the same internal tact impulse (that is the equivalent of a sampling impulse) of all the sensory organs belonging to a specific organism.

The process **C** is a process of comparison and qualitative evaluation of the difference between two values of the intensity deployed by the elementary information fluxes, supplied by two cells of the same sensory organ, if the cells are adjacent, the result of this operation (the contrast) is the attribute distributed on another type of support element - the domain (interval) between the internal references of the two adjacent cells. However, a finite difference between two values of an attribute, distributed on a finite difference between two values of the support attribute represents an element of derived distribution (in this case, a first rank one). Therefore, the **C**-type processes extended on the set of all the adjacent cell pairs of a sensory organ provides a derived distribution of the information fluxes efferent from that organ. Because the operands involved in the **C**-type processes must have (and so they are) a simultaneous existence (as we have mentioned in the previous comment), this means that the derived (contrast) distributions have also a simultaneous existence on the level of the entire organism.

Primarily, the process **D** must perform a qualitative identification of the support attribute type which is common to all the model distributions of the perceived object. Unlike the attributes from objects' model sets, which are quite numerous, there are only three support attributes, the so-called fundamental attributes: spatial position, frequency and time. The spatial position is a support attribute for the material objects, time for the processual objects (S_x) and the frequency goes with the periodical processes. This is applicable to the external IPS objects; the internal IPS objects which we have seen that they are exclusively internal ISS, all of them have a single type of support attribute - spatial position (location into the internal memory).

Comment X.14.2: While the comment X.14.1 was focused on the visual perception organ, now it is time to shortly present the acoustic perception organ. A sensorial distribution provided by this sensory organ at a specific moment is an image (a conform representation) of the frequency distribution of the perceived agent flux. Within this sensorial distribution, each cell of the Corti organ receives an elementary sound flux, that is the intensity of the sonic flux evenly distributed on the frequency domain which is assigned to the cell (Δf_k, where *k* is the cell index within the ordered set of cells which makes-up the Corti organ). The internal reference frequency f_k of this elementary domain is given by the spatial position of the sensory cell in the cochlea. Since the relative spatial position both of the cells from the Corti organ and of their related axons into the acoustic nerve is preserved up to the auditory cortex, a spatial representation (a primary spatial distribution) of the frequency of the received sound, more precisely of its spectrum, will be developed into the neurons placed in this cortex area. The derived distributions coming from this primary distribution shall be generated into the neurons from the auditory area as well, by means of an evaluation on the contrast between the sensorial signals of two neurons which are related to two adjacent Corti cells. As for the temporal evolution of the auditory sensations, their analysis and evaluation is made similarly with all the other fluxes, the information perceived at contiguous moments being stored in adjacent spatial locations of STM, consequently, for each perceived frequency we shall finally have a distribution with spatial support, which corresponds with a temporal support distribution (the perceived and stored process). The fact that the biosystems (which for the time being, may be considered as natural MS) use a single type of support attribute – the spatial one - is a major argument used by the objectual philosophy for upholding the assertion that the space is the single fundamental *material realizable* support attribute (see the annex X.13).

Annex X.15 – LOCAL COMPONENTS OF THE FLUXES

X.15.1 The flux density vector (FDV)

The density is an amount which is specific only to the even distributions, and it represents an abstract amount (that is the result of an abstract, computing process) which is generated by the ratio between the distributed amount and the amount of the distribution's support domain. On short, the density represents the "overcrowding" degree of the amount distributed on the support interval, or (for the cumulative attributes) the attribute amount distributed on the abstract unit amount support. Since it is an abstract amount, the density cannot exist in the absence of an ISS which would be the recipient for its value, and without an IPS which would be assigned with its calculation, but it is used on a wide scale, being among others, the single attribute which allows the determination of the process intensities.

The intensity of a distributed motion process is determined by means of a virtual (theoretical, imaginary, computing) surface with a stable spatial position against an external reference (the same reference against which the distributed motion velocity is being computed).

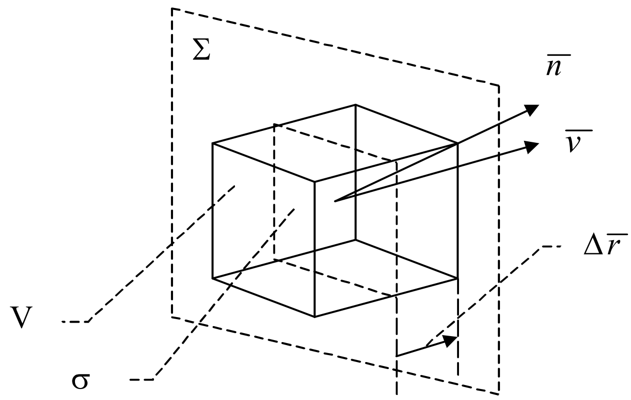

Fig. X.15.1.1

By considering the volume *V* from the figure X.15.1.1 which contains the amount M, evenly distributed, with the density:

$$\rho_M = \frac{M}{V} \qquad \text{(X.15.1.1)}$$

and a theoretical plane surface of reference Σ, with a steady position against an external reference. The internal T reference (with a central inner position) of the volume *V* has a position vector $\overline{r}$ against the same external reference (non-displayed in the figure X.15.1.1 for not making the scheme too complicated). Let us assume that, at a certain moment t_0, the volume V, together with the amount *M* which is evenly distributed in it, starts to move with the velocity:

$$\overline{v} = \frac{\Delta\overline{r}}{\Delta t} \qquad \text{(X.15.1.2)}$$

which is considered to be uniform (constant) within the interval Δt. The intersection between the moving volume *V* and the reference surface Σ is σ, that is a surface with the normal line $\overline{n}$ (the same with the normal at Σ) through which the transfer (displacement) of the amount M takes place. The following amount shall cross through the surface σ in the interval Δt:

$$\Delta M = \rho_M \Delta V = \rho_M \Delta\overline{r}\,\overline{n}\sigma \qquad \text{(X.15.1.3)}$$

If the relation X.15.1.3 is divided by Δt, we shall get:

$$I_M = \left.\frac{\Delta M}{\Delta t}\right|_{\sigma} = \rho_M \frac{\Delta\overline{r}}{\Delta t}\overline{n}\sigma = \rho_M \overline{v}\,\overline{n}\sigma = \overline{f}_M \overline{n}\sigma \qquad \text{(X.15.1.4)}$$

that is a relation identical with the relation 5.2.1.4 which defines the intensity of the vector flux $\overline{f}_M$ through the surface σ. This vector $\overline{f}_M = \rho_M \overline{v}$ has a major relevance in the present paper, being named *flux density vector* (FDV) of the amount M. One may notice that FDV is always collinear with the transfer rate, and it is the carrier vector of the abstract amount ρ_M, spatial density of the transported amount. In this way, the flux of the amount *M* may be displayed as a vector distribution of FDV (a vectorial field). If the spatial distribution of the amount *M* is not even, we shall divide the volume V in volume elements *dV* with dimensions selected in the way that the distribution of the amount *M* to be even inside them. The intersection of this kind of element with the surface Σ shall be $d\sigma$ and the flux intensity through $d\sigma$ shall be:

$$i_M = \left.\frac{dM}{dt}\right|_{d\sigma} = \rho_M(\overline{r})\overline{v}\,\overline{n}d\sigma = \overline{f}_M(\overline{r})\overline{n}d\sigma \qquad \text{(X.15.1.5)}$$

namely, the intensity of an *elementary flux*. If the ratio between the flux intensity and the amount of surface σ or $d\sigma$ is being computed into the relations X.15.1.4 and X.15.1.5, the surface density of the flux intensity shall result:

$$\frac{I_M}{\sigma} = \frac{i_M}{d\sigma} = \rho_M \overline{v}\,\overline{n} = \overline{f}_M \overline{n} \qquad \text{(X.15.1.6)}$$

Thus, the meaning of FDV seems to be more clear, the modulus of the normal component of FDV through the reference surface is even the surface density of the flux intensity of the amount carried through that surface.

Comment X.15.1.1: One may notice that FDV has as component a cumulative attribute - that is the spatial density of the conveyed amount - fact which makes that FDV to become a cumulative attribute as well. Thus, the amount of the vectors FDV which are evenly distributed either on the surface or on its volume, having a common direction, it can be replaced (represented) by a single vector - the resultant - which will have a common direction and its modulus will be equal with the sum (spatial or surface integral) of FDV.

X.15.2 The local components of FDV

In case of any reference surface (not necessarily a plane one), for each point on that surface there is a normal $\overline{n}$ and a plane which is perpendicular on that normal, that is the tangent plane P_t (see the figure X.15.2.1) which crosses through the normal's application point (local T reference).

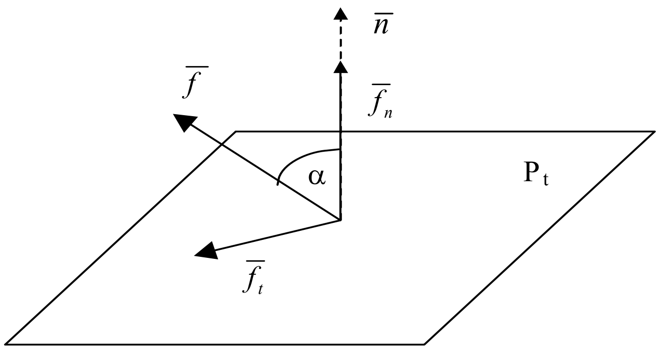

Fig. X.15. 2.1

By considering an angular direction α against the normal as a reference direction, FDV of any flux which covers this surface has two vectorial components: the common component with the normal $\overline{f}_n$ and the specific component against the normal $\overline{f}_t$, both components complying with the following relation:

$$\overline{f} = \overline{f}_n + \overline{f}_t \tag{X.15.2.1}$$

Because the two components are perpendicular one another (independent in terms of direction), namely, $\overline{f}_t$ is included into the tangent plane, all the elements of the relation X.15.2.1 are coplanar. The two local (point wise) components of FDV are given by the functions C() and D() introduced in chapter 4, functions which provide the common and specific component of a vector against a reference direction:

$$\overline{f}_n = C(\overline{n}, \overline{f}) = \overline{f}\, c\, \overline{n} = f \cos\alpha\, \overline{n} \tag{X.15.2.2}$$

$$\overline{f}_t = D(\overline{n}, \overline{f}) = \overline{f}\, s\, \overline{t} = f \sin\alpha\, \overline{t} \tag{X.15.2.3}$$

Comment X.15.2.1: Here, there are two operators *c* and *s* which were introduced for avoiding the confusion with the operators which are already used into the vector calculus, and these are the scalar (dot) and vectorial product, whose formula are similar (*c* with the scalar and *s* with the vectorial product, but the results are quite different.

So far, we have presented the simple case when a single FDV runs through a point of the reference surface. Now, let us presume that there are *N* fluxes which run through that surface, they have a simultaneous existence and belong to a similar type, but they are originating from different sources placed at different spatial positions, and consequently they have different directions and intensities. By crossing the reference surface through the same point, that is the local T reference, all FDV of those *N* fluxes which cross through the same point shall make-up a "bunch" of concurrent vectors, therefore, a common component and *N* specific components may be determined for them, all of these specific components being included into the normal plane on the common component.

Comment X.15.2.2: Based on the statement that FDV and its two local components are coplanar vectors, this means that only the collinear common component is unique, all the *N* specific components being included into the tangent plane, but with different directions $\overline{t}_k$ ($k \in [1, N]$).

Here, there are two situations, depending on the type of the reference direction we choose for the set of *N* vectors:

1. *Artificial reference*, the above mentioned case, in which the reference direction (common component's direction) is the normal's direction. Taking into account this direction, we have:

$$\overline{f}_n = C(\overline{n}, \overline{f}_1, ... \overline{f}_N) = \frac{1}{N}\sum_{k=1}^{N}(\overline{f}_k\, c\, \overline{n}) = \frac{1}{N}\sum_{k=1}^{N}(f_k \cos\alpha_k \overline{n}) \tag{X.15.2.4}$$

$$\overline{f}_{tk} = D(\overline{n}, \overline{f}_k) = \overline{f}_k\, s\, \overline{t}_k = f_k \sin\alpha_k \overline{t}_k \tag{X.15.2.5}$$

2. *Natural reference*, that is the case when usually, the reference direction does not correspond with the normal's direction, but it has an angular β direction (β is the angle between the natural and normal component in that point, which is determined into the plane who include the two vectors). The direction of the natural reference comes from its basic property, which asserts that the common component of the set of specific components is null (non-existent) against a natural reference, namely:

$$\sum_{k=1}^{N} \overline{f}_{tk} = 0 \tag{X.15.2.6}$$

where the specific natural components are included into a perpendicular plane on the natural reference direction (not into the previous tangent plane), which plane runs also through the common application point of all the vectors (T local reference).

As for the artificial reference, the relation X.15.2.6 is not compulsory, on the contrary, we may have:

$$\sum_{k=1}^{N} \overline{f}_{tk} = \overline{f}_{tr} \tag{X.15.2.7}$$

namely, the sum of the specific (tangential) component belonging to the set of the concurrent N FDV vectors has a resultant which is different from zero, a component which is common with the direction $\overline{t_r}$.

Comment X.15.2.3: If the reader has already read the chapter 7 in which the (de)composition processes of the fluxes deployed on the real bounding surfaces (RBS) of the material systems are presented, the case of a non-zero resultant for the specific components (tangential) of more fluxes may be translated through the existence of a tangential coherent component of the resultant flux, component which may have a non-zero circulation on RBS. And where a vector circulation exists, there is also a rotational distribution into the volume included into RBS (Stokes theorem).

Annex X.16 – LIFE SPAN OF THE MATERIAL SYSTEMS

As we have noticed in chapter 7, if Q_{kr} is the model stockpile of the k-type flux of a MS, and the real k-type flux stockpile of MS at a moment *t* is $Q_k(t) \neq Q_{kr}$, then, the difference:

$$\Delta Q_k(t) = Q_k(t) - Q_{kr} \tag{X.16.1}$$

is the *k*-type *flux demand (necessary amount)* of MS at the moment *t* if $\Delta Q_k(t)$ is negative, and the k-type *flux surplus* if $\Delta Q_k(t)$ is positive. Under such circumstances, if:

$$I_{ki} = \frac{dQ_k(t)}{dt} \tag{X.16.2}$$

is the temporal density (rate, intensity) of the internal consumption of the same flux type, the typical (by model) life span of the MS, relative at the *k*-type flux, in the absence of an external supply flux, shall be:

$$\mathrm{T}_k = \frac{Q_{kr}}{I_{ki}} \tag{X.16.3}$$

According to the real k-type flux stockpile, at the same intensity of the internal consumption rate I_{ki}, the real life span of MS relative at this flux type (in the absence of the *k*-type supply flux) shall be:

$$\mathrm{T}_k(t) = \frac{Q_k(t)}{I_{ki}} \tag{X.16.4}$$

resulting that the life span of a MS can be less or major than the model duration given by the relation X.16.3, depending on the state of the internal flux stockpile.

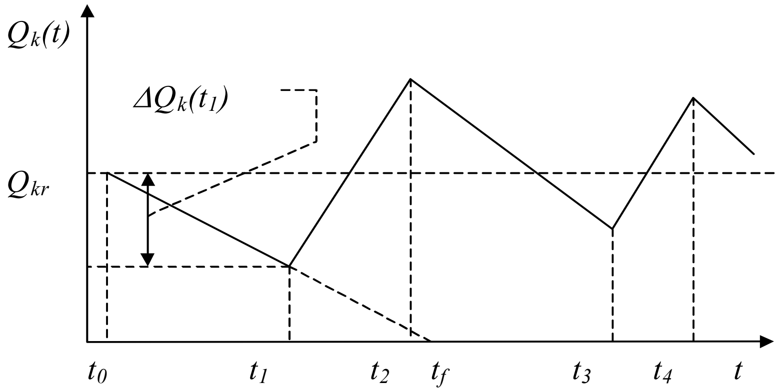

Fig. X.16.1

The figure X.16.1 shows the evolution in time of the stockpile $Q_k(t)$ of a MS, where the horizontal dotted straight line represents the model stockpile Q_{kr}. Let us presume that we are studying the stock evolution starting from the moment t_0, when the stock $Q_k(t)$ is equal with Q_{kr}. In the interval $\Delta t_{1,0} = t_1 - t_0$, in the absence of an external k-attribute influx, a decrease of the internal stockpile $\Delta Q_k(t_1)$ occurs (caused by the consumption or by the losses through emergent fluxes). If the absence of the external supply flux would carry on, and the internal consumption would be maintained at the same rate:

$$I_{ki} = \frac{\Delta Q_k(t_1)}{t_1 - t_0} \tag{X.16.5}$$

then, at the moment t_f, the internal k-type flux stockpile is vanished and the MS's life span expires.

Comment X.16.1: If MS is an individual biosystem, and the *k*-type flux is a vital internal flux (oxygen flux, water, proteins etc.) and when the internal stock expires, the system dies; if MS is a social biosystem in the same situation, all the system's elements die as well. In case of the state systems, the crisis and the economic failure occur. Under such circumstances, and for extending the life span, a drastic decrease of the consumption rate is required (the so-called "consumption rationalization" in the periods of economic crisis, under siege, embargo etc. or the hibernation state of the individual biosystems during the periods without food resources). However, the situation is identical for the abiotic MS as well, for instance the case of the free neutrons (neutrons which are expelled from their usual environment - the nuclear medium. A neutron has a certain rate of internal energy consumption, rate which is usually provided entirely from their neighbors from the nuclear medium (by means of mutual supply). Once it is outside the nucleus, at the same consumption rate and in the absence of their nuclear partners, its internal energy stockpile is enough for only about 10 minutes, after which the neutron is dismembered into its elements (a proton and an electron), elements which are able "to survive" also in the extra-nuclear medium. For ensuring a much longer life span, it is enough that the neutron to be associated with a single proton (making-up a deuterium nucleus).

Fortunately, in case of the system displayed in the figure X.16.1, a supply flux occurs which, within the interval $\Delta t_{2,1} = t_2 - t_1$, increases the internal flux stockpile over the value Q_{kr} (a temporary flux surplus occurs). In this way, by means of continuous or periodical supplies, the relative life span at the k-type flux of a MS can be endlessly extended, if other processes which may cause its destruction do not interfere.

Comment X.16.2: The same situation can be found at the unstable particles which are artificially accelerated. No matter what acceleration method would be chosen, the essence of this process consists in an energy input from the outside for the set of the particles from the accelerator. In chapter 7, we have seen that a kinetic energy input supplied to a free MS generates its acceleration. Consequently, in case of the particles, either they are stable or unstable, the acceleration means an energy input provided to the entire particles' internal structure, input which generates not only the acceleration but also the prolongation of the life time of an unstable MS. It is true that the energy input given by the accelerator is low as compared to the internal consumption demand of an unstable particle, but it is enough for explaining the extension of the particle's life time with the fraction which currently is motivated through "the time expansion".

Next, we shall briefly discuss about the life time of the material systems as complex objects. If the objects from the structure of a complex object are always the same (they have the same life span as the complex object), we may say that the complex object is also invariant throughout its entire life time. But, if these elements have a shorter life time than the life span of the complex object, and if they can be replaced, then, they will be always different ones. In this case, it cannot be said that the object is basically the same: the structure (configuration, shape, spatial distribution) is, but the elements of this structure are not. The temporal interval which is necessary for changing all the elements from the composition of a complex object with new ones shall be named *maximum regeneration interval* (duration) (recovery, renewal, recycling interval) τ_{re}.

For example, the human body has a specific τ_{re}, interval in which most of the old cells are replaced by new ones (except the neurons and the cells of the cardiac muscle, which are considered as non-renewable). The maximum regeneration duration τ_{re} of the earth crust may be estimated based on the oldest rocks which have been found (about 4.5 billion years). During this interval, any part from the Earth crust will be melted (as a result of subduction), being replaced by new rocks, occurred by solidification of the lava generated by the surface or under sea volcanoes. But, the duration τ_{re} of the Earth crust is not the same with the duration of the Earth's life time, the latter being much more longer than the life span of any crust part (according to the objectual philosophy, the age of the Earth and of the entire Universe is considered to be much older than the one which is currently estimated).

The same situation is found at the social objects (family, clans, companies, associations etc.), whose internal structure may be preserved on very long periods of time, but the abstract containers from their structure (positions) shall be occupied by other persons. There is also a

τ_{re} for this kind of objects, according to whom the entire structure population is completely different.

Annex X.17 – OBJECTUAL ANALYSIS OF THE VECTORIAL FIELDS

According to chapter 4, a *vector* is a literal or graphical representation of a *specific elementary process* (SEP), which means an elementary variation of a single attribute, distributed on an elementary variation of a support attribute, that is an element of a derived distribution of a primary distribution. The variation takes place between two S_0-type states (two elements of primary distribution)[107], *initial state* and *final state*, states which represent the asymptotic boundaries of the vector object, but at the same time, they are also its internal references.

The density and direction of the derived distribution element, which are invariant in the elementary support interval, are states S_x (where *x* is the rank of the derived distribution) of SEP. As we have seen in chapter 3, an object is characterized by a set made-up from six basic properties which form the *general object model*:

- P1 Set of the distributed properties;
- P2 Type of the support attribute;
- P3 Distribution type;
- P4 Amount of the support domain;
- P5 Internal reference system;
- P6 Simultaneous existence of all these properties, at the same time *t*.

As for the vectors, they belong to SEP-type, the set of the distributed properties consists of only a single property (variable attribute). The support attribute type is mostly the temporal attribute, but it can be other type as well, such as the spatial one (for example, in case of the gradient), frequential (applicable in case of the phonetic or musical processes) etc. As regards the vectors, the distribution type is always the same, that is the *linear distribution*. The amount of the support domain is always the same, the domain on which the distribution linearity is maintained. The internal reference system (RS) is made-up from the two above-mentioned states S_x, which are the marks between which the SEP takes place (asymptotic boundaries of the internal domain), and these states are defined against an external reference system (the reference system against which the internal reference of the primary distribution is being determined).

As for the actual case of the velocity vectors, the set of the basic properties is:

- P1 Variation of the spatial position;
- P2 Temporal attribute;
- P3 Linear distribution;
- P4 Interval Δt on which the density (velocity) is kept even;
- P5 Initial or final state (position) between which the position variation takes place;
- P6 The moment t_f of the final state, the right-side internal reference of the temporal interval Δt, which represents the SEP support (the left-side internal reference t_i can be also used for the abstract SEP).

All the abstract objects which have the same model make-up a *class* of objects. When we are dealing with a set of objects from the same class, all these objects shall have a set of common properties, that is even the set which makes-up the class model. Due to distinction reasons, the concrete objects of the same class (instances) must also contain specific

[107] This assertion is applicable for the first rank derived distributions. In general, a P_n-type SEP has two S_{n-1} -type as its boundaries.

attributes, besides the common attributes, between which there are non-zero differences (contrast).

In case of the vectors (but also of other objects), the quantitative contrast is determined by means of a difference between the values of a specific attribute; but, we saw that the relations deployed between two or more objects are relations developed between their internal reference systems, systems evaluated against an external reference system, common for all the set vectors.

The internal reference system of a vector *k* (where *k* is the running number of the vector from the arranged set of *n* vectors which make-up the vector field) is made-up from the properties P5, out of which the reference may be either the final state $S_{0k}(t_f)$, or the initial state $S_{0k}(t_i)$. In case of the velocity fields, defined against an external RS, the two states (elements of a primary spatial distribution) are the positions:

$$S_{0k}(t_i) = \overline{r}_k(t_i) \tag{X.17.1}$$

and:

$$S_{0k}(t_f) = \overline{r}_k(t_f) \tag{X.17.2}$$

The state $S_{1k}(t_f)$, the velocity, is the density of the first rank derived distribution element of the primary spatial distribution:

$$S_{1k}(t_f) = \overline{v}_k(t_f) = \frac{\Delta\overline{r}_k(t_f)}{\Delta t_f} = \frac{\overline{r}_k(t_f) - \overline{r}_k(t_i)}{t_f - t_i} \tag{X.17.3}$$

The velocity field is therefore made-up from *n* vectors, which are simultaneously found in the interval Δt_f (interval with a right-side internal reference at the moment t_f), with disjoint spatial positions, given by the sets $\{\overline{r}_k(t_i)\}$ (set of the application points) and $\{\overline{r}_k(t_f)\}$ (the set of the peak values of the velocity vectors). If we are taking into account that the spatial velocity is a property of some MS, the spatial-temporal exclusion principle of MS postulates that both the set $\{\overline{r}_k(t_i)\}$ and $\{\overline{r}_k(t_f)\}$ are strict sets, because the spatial positions of more MS at the same moment *t* cannot be identical. Otherwise speaking, the spatial positions of the vectors from the velocity field are external specific attributes for these objects. The set of the positions $\{\overline{r}_k(t_i)\}$ is a complex abstract object, for which a *natural internal reference* can be defined, that is a reference which shall be a common component (since it is a reference) for all the objects from the set.

The natural internal reference of a set made-up from *n* values $\{\overline{r}_k(t_i)\}$ is the arithmetic mean of the set values, given by the following relation:

$$\overline{r}_c(t_i) = \frac{1}{n}\sum_{k=1}^{n}\overline{r}_k(t_i) \tag{X.17.4}$$

so that each property from the set $\{\overline{r}_k(t_i)\}$ is made-up from two components:

$$\overline{r}_k(t_i) = \overline{r}_c(t_i) + \overline{r}_{dk}(t_i) \tag{X.17.5}$$

where $\overline{r}_c(t_i)$ is the common component of all the objects at the moment t_i (the internal natural reference), and $\overline{r}_{dk}(t_i)$ is the *natural specific property* of the object k (deviation, dispersion) at the same moment (against the internal natural reference).

The natural specific properties have the basic property of having a null internal natural reference (specific properties do not have a common component). Therefore, we shall have:

$$\frac{1}{n}\sum_{k=1}^{n}\overline{r}_{dk}(t_i) = 0 \tag{X.17.6}$$

The abstract object $\overline{r}_c(t_i)$, given by the relation X.17.4 represents the *global* (general) *position* of the objects set (of the vector field) at the moment t_i, against the external position reference.

Similarly, at the moment t_f, we shall have:

$$\overline{r}_c(t_f) = \frac{1}{n}\sum_{k=1}^{n}\overline{r}_k(t_f) \qquad \text{(X.17.7)}$$

If $\overline{r}_c(t_f) \neq \overline{r}_c(t_i)$, this means that there is an overall motion of the objects set with the following common (global) velocity:

$$\overline{v}_c(t_f) = \frac{\Delta\overline{r}_c(t_f)}{\Delta t} = \frac{\overline{r}_c(t_f) - \overline{r}_c(t_i)}{\Delta t} \qquad \text{(X.17.8)}$$

which is also a natural reference of the velocity field, against which a set of natural specific velocity rates shall result. All of these are coming through the derivation of the relation X.17.5 in relation with the time, resulting that:

$$\overline{v}_k(t) = \overline{v}_c(t) + \overline{v}_{dk}(t) \qquad \text{(X.17.9)}$$

The global motion can be also time variable, consequently, a global acceleration $\overline{a}_c(t)$ could be deployed, a global variation of the acceleration, so on. The most relevant fact is that all the global amounts, because they are considered as natural references, are also common properties to all the vectors from the vectorial field.

Annex X.18 – SENSORIAL DISTRIBUTIONS

X.18.1 Sensory cell distributions as objects

In chapter 8 we have discussed about the sensory organs, their types and material flux types received by these. We saw that these organs make-up the information's input units into NIPS and at the moment of their output an ISS flux is released, which depends on the external material flux which is incident on the sensory organ. Therefore, functionally speaking, a sensory input unit is a flux converter (transformer): an external flux with a specific spatial, temporal or frequential distribution and a specific intensity, all of these existing at a specific moment *t*, will generate an ISS flux with a certain structure, a certain spatial distribution and a certain intensity, all existing at the moment $t+\Delta t$, where Δt is the temporal interval required for the flux conversion (interval which is momentarily let aside because it is not relevant for the topic of this annex).

Each sensory organ is made-up from a finite and invariant number of sensory cells which are specialized in receiving a certain type of external material flux, cells which are spatially distributed in certain areas placed either on the body's RBS or inside it. The distribution of the sensory cells for a specific organ and organism are provided by the genetic code of the biosystem species to which the organism belongs to, and these distributions are invariant throughout its entire life time, and identical for all the normal specimens of that species. Each of these distributions has, objectually speaking, all the properties within the general object model presented in chapter 3:

P1 The set of distributed attributes is related to the set of sensory cells which are part from the structure of that organ, each type of cell receiving a specific qualitative property of the external flux[108];

Comment X.18.1.1: For example, there are four types of sensory cells in case of the retina - the R, G, B - types of cones and the rods. Their spatial distribution is uneven, in fovea (visual center, origin of the retina's internal RS) the cones are prevalent and the rods are more numerous at the peripherical area. The rods are reference cells as regards the intensity of the light flux and they are not sensitive at a specific color; at the same time, they have a much faster response than the cones, being suitable for detecting the motion in a peripherical visual field.

P2 The distribution support is the spatial position of the sensory cells within that particular organ, against the internal RS of that organ;

P3 The spatial distribution type is settled by means of the species' genetic code, each sensory cell being placed in a certain spatial position against the internal spatial RS of the sensory organ and of the organism;

Comment X.18.1.2: The internal spatial reference system of the animal organism is generally made-up from the anterior-posterior axis (axis of the digestive tract), which is crossed by two perpendicular planes and each of them separates two half-spaces: left-right and ventral-dorsal. At the middle of the axis, another perpendicular plane which is placed on the other two separates the anterior-posterior half-spaces. In case of humans, because of their bipedal position, the anterior-posterior axis has become vertical (local direction of the gravity field gradient), the anterior-posterior half-spaces being changed in an up-down half-spaces. This is an artificial RS, useful for defining the anatomic position of the organs or cells by the humans; the real internal spatial (natural) RS, used by the intra-cellular processing systems of the genetic code for establishing the position of each cell is yet unknown.

P4 The amount of the support spatial domain both of the organism and of the sensory organ is also established by means of the genetic code, through the size of each cell type and through their number;

[108] We are talking only about the cells with a sensory function, not about the ones with auxiliary functions which belong to the structure of a certain sensory organ.

P5 The internal reference system is also established by means of the genetic code, through the existence of either a spatial RS which is specific to the sensory organ against which the position of each sensory cell is being settled (for example, the case of the retina or of the Corti organ), or a global spatial RS of the organism (for the sensory cells placed into the epidermis);

P6 All the above-mentioned components simultaneously exist at the *present* moment of the IPS inside the organism.

An elementary sensory flux (elementary sensation) is found at the output (axon) of each sensory cell, with an intensity depending on the intensity of the elementary flux incident on the cell. On the way between the sensory cell and the central nervous system (the brain), the spatial relative positions of these nervous endings within the same sensory organ are being preserved, so that the spatial distribution of the cells from the sensory organ determines a spatial distribution which is a conformable representation of the elementary fluxes which have reached to the brain. At the same time, each sensory organ has an associated (reserved) cortical area with an invariant position against the internal RS of the brain. Finally, there will be the same number of cortical spatial distributions as the number of the body's sensory organs, each with its own spatial domain and with the distribution type of the elementary sensations generated by the distribution of the received external fluxes.

X.18.2 External and internal sensorial states

An advanced animal organism is the owner of a neural NIPS; this neural system is placed inside the host organism, but it is isolated by its own RBS. Each neuron as an independent cell has its own RBS, the connections with the other neurons being made through specialized junctions – synapses - which preserve the spatial segregation of the neurons, but they allow the existence of unidirectional neuromediators molecular fluxes. The set (union) of all these neural RBS which are mutually disjoint, makes-up the *global* RBS of the animal IPS. All these specifications allow the following finding: all the input information into the neural IPS are considered as external information (fluxes) against the global RBS of IPS, but these data are coming from two distinct spatial domains, limited by the *global* RBS (epidermis) of the host organism - *the internal* and *external domain* of the organism.

All the data which are coming at the *present* moment from the outside make-up the abstract object called *present external individual state* (of the medium outside the body), and the total information amount which is coming from the inside makes-up the abstract object called the *present internal individual state* (of the medium inside the organism).

X.18.3 Types of sensory cell distributions

For the perception of the external states, the animal organisms have the following sensory cell distributions[109]:

1. *Visual* $\{E_v\}$, made-up from $\{E_{vl}\}$ (left) and $\{E_{vr}\}$ (right), defined against the internal RS of the organism (OG), each with an internal spatial (retinal) RS which divides each distribution in four sections, up, down, left, right, sections which are required for the differential control of the opposite pairs of muscles which perform the movement of eyes, head or torso.

2. *Tactile* $\{E_p\}$, made-up from $\{E_{pl}\}$ and $\{E_{pr}\}$, defined against the internal spatial RS of the OG;

[109] We are mainly talking about the superior animals (mammals class), to which the humans also belong to, because in the first place we are interested in the human cognitive processes. The sensory cell distributions may be found at all the evolved animal species, but they can be much different than the ones applicable to mammals.

3. *Auditory* $\{E_a\}$, made-up from $\{E_{al}\}$and $\{E_{ar}\}$, defined against the internal RS of the OG;

4. *Thermal* $\{E_t\}$, made-up from $\{E_{tl}\}$ and $\{E_{tr}\}$, defined against an internal RS of the OG;

5. External *nociceptive* $\{E_n\}$ (pain), made-up from $\{E_{nl}\}$ and $\{E_{nr}\}$, defined against an internal RS of the OG;

6. *Gustatory* $\{E_g\}$;

7. *Olfactory* $\{E_o\}$, made-up from $\{E_{ol}\}$ and $\{E_{or}\}$, defined against the internal RS of the OG;

8. *Pheromonal* (*vomero-nasal*) $\{E_f\}$ similarly divided as the olfactory ones into $\{E_{fl}\}$ and $(E_{fr}\}$;

There are other sensory cell distributions for the perception of the internal states:

1. *Kinaesthetic* $\{I_k\}$, made-up from $\{I_{km}\}$ (sensors of the contraction degree of the muscular fibre and $\{I_{kt}\}$ (effort sensors of the muscular fibre), each of these distributions being divided in the two sections: left, right;

2. *Vestibular* $\{I_e\}$ made-up from three distributions$\{I_{ex}\}$, $\{I_{ey}\}$ and $\{I_{ez}\}$ arranged in three mutually perpendicular planes, which control the muscular system for keeping the equilibrium of OG against the gravity field (vertical position);

3. Internal *nociceptive* $\{I_n\}$;

4. Prurit's sensors $\{I_p\}$ (itching, the sensation which triggers the reflex act of scratching);

5. $\{I_v\}$ for the nausea sensation (which triggers the reflex act of vomiting);

6. $\{I_g\}$ generic distribution, with many structures, each of them in charge with a distinct basic mental state (fear, anger, joy, pleasure etc.).

X.18.4 Sensorial distributions

The above mentioned distributions are cellular spatial distributions, whose elements are cells specialized in the receiving of specific fluxes. Each of these set of cells which are spatially distributed generates at the present moment *t* a spatial distribution of elementary sensations, which are nothing else but spatial distributions of elementary fluxes of the internal ISS of animal IPS. This kind of spatial distribution of ISS elementary fluxes which exists at the moment *t* and is produced by a specific distribution of sensory cells is named ***sensorial distribution***. It is clear that each type of sensory cell distribution (each sensory organ) shall produce a specific type of sensorial distribution which is specific in terms of syntax (the containers structure) to each sense organ, and in terms of distribution, it is specific to the received (internal or external) state.

In the previous section, we have seen how many types of sensory cell distributions has an evolved organism. If we shall associate to each cellular distribution of a specific quality type a sensorial distribution provided by it at the output occured at the present moment *t*, we shall get the set of the sensorial distributions with a simultaneous existence at that moment, which are incident on the brain at the spatial position assigned to each cellular distribution (to the sensory organ). Thus, there are eight distributions which represent the external state of the environment $\{SE_v(t)\}$, $\{SE_p(t)\}$, $\{SE_a(t)\}$, $\{SE_t(t)\}$, $\{SE_n(t)\}$, $\{SE_g(t)\}$, $\{SE_o(t)\}$, $\{SE_f(t)\}$ and the six (at least) internal sensorial distributions $\{SI_k(t)\}$, $\{SI_e(t)\}$, $\{SI_n(t)\}$, $\{SI_p(t)\}$, $\{SI_v(t)\}$, $\{SI_g(t)\}$. Most of these distributions are divided in sub-distributions such as left/right, up/down, and they have a great number of elements (millions), all of them existing at the same moment, for example t_1. After the interval Δt which is required for the sampling of other external or internal state, another global set of the sensorial distributions existing at the moment $t_2=t_1+\Delta t$ shall be found at the brain's entrance. In case of an individual OG_k organism, defined within its own species (with the necessary specific attributes) and with a defined spatial position, which owns a NIPS with the above-mentioned sensorial distributions, a global set shall exist at the moment t inside NIPS (more exactly into its STM):

$$\{SE(t)\} = \{SE_v(t)\} \cup \{SE_p(t)\} \cup ... \cup \{SE_f(t)\} \qquad \text{(X.18.4.1)}$$

which represents an abstract object named the *present external individual state* at the moment t of the environment, for the organism OG_k. It is clear that another global set shall be related to the same organism OG_k:

$$\{SI(t)\} = \{SI_k(t)\} \cup \{SI_e(t)\} \cup ... \cup \{SI_g(t)\} \qquad \text{(X.18.4.2)}$$

which represents another abstract object for the same organism OG_k, called the *present internal individual state* at the moment t.

X.18.5 Qualitative and quantitative differentiation of the sensorial attributes

Specific rules are required for the clear differentiation (separation, distinction) of the sensorial attributes:

1) Two sensations which are coming from the same elementary information channel (the same sensory cell), at different moments, can be different only in terms of *quantity.* If the quantitative difference between the information produced at successive moments (temporally adjacent) is non-zero, we shall be dealing with a *temporally distributed quantitative process* (an evolution).

2) The elementary sensations which are simultaneously generated by different information channels (different sensory cells) are different in terms of *quality*. We saw that the set of all these sensations generated at the moment t by a specific sensory organ makes-up a *sensorial distribution* (distribution which, according to the classification from chapter 2 is a primary distribution. Because the spatial positions of the sensory cells are invariant for a certain sensory organ, they make-up a S-type system, and the sensorial distributions shall be also S-type (abstract) objects. As for the visual, tactile and thermal sensory distributions, this kind of distribution which may be found at a certain moment represents a form (structure, configuration) of the flux sources from the outside of the organism. In case of the auditory sensorial distributions, there is a frequency-based primary spatial distribution of the intensity reached by the frequency components belonging to an acoustic flux, namely a spectrum (sound).

3) If the quantitative difference between the information generated by the spatially adjacent channels of the same sensory cell distribution is non-zero, we shall be dealing with a spatially distributed quantitative process (a derived distribution with a spatial support of the contrast). The evolutions (described at point 1) are derived distributions with temporal support of the above-mentioned spatial distributions.

The instantaneous sensorial information (sensorial distribution) which can be found at the moment t_i at the output of a sensory organ x is made-up from N_x elementary sensorial data, which are different in terms of quality (N_x is the number of the same type sensory cells which compose the sensory organ x). A certain sensory cell C_{xk} ($k \in [1, N_x]$) of the organ x shall provide at the output the elementary information $S_{xk}(t_i)$ at the moment t_i, and at the moment t_{i+1}, the same cell shall provide the elementary information $S_{xk}(t_{i+1})$. Between the elementary information $S_{xk}(t_i)$ and $S_{xk}(t_{i+1})$ only quantitative differences (quantitative contrast) can exist, whereas between two different cells, the contrast is qualitative but it can be also quantitative.

We may say that there are two variable types: qualitative and quantitative. The variable x is a qualitative variable which is external to the sensory organs; it receives values against the reference system of the organism. The variable k is also a qualitative variable, but it is internal to a specific sensory organ; it receives values against the internal reference of that sensory organ, defining the cell position within that organ.

The elementary information $S_{xk}(t_i)$ is proportional with (depends on) the elementary flux intensity $d\overline{F}_{xk}(t_i)$ sent through the RBS of the cell C_{xk} at the moment t_i. We are reminding you that the discrete variable x which makes a formal differentiation of the sensory organs, it also differentiates the flux types which can be received by those organs.

Annex X.19 – OBJECTUAL AND PROCESSUAL CAUSALITY

The operation with the two basic concepts of the objectual philosophy - *objects* and *processes* - makes that the meaning of some terms which are commonly used within the current scientific papers to be a different one, depending on the association with the one or other of these notions. This is also the case of the term known as *causality*. These are few excerpts from The Dictionary of Logics[110]: "**Causality** (causal connection) - relation between phenomena (events) characterized by the fact that a phenomenon (named *cause*) generates another phenomenon (named *effect*). For example, we may consider the physical law of the materials *dilatation* by means of *heating*. The heating is the cause of dilatation, and the dilatation is the effect of heating. The causality relation shall be displayed as follows: $C(x,y)$ ("x is the cause of y"). A much debated issue in the causality theory is the ratio between the cause and effect *throughout time*. Is it the cause *simultaneous* with the effect or is there a temporal *succession* between the cause and effect? One may notice that the cause-phenomenon comes along with a series of circumstances. This set of circumstances which contains the cause shall be called *complex cause*. Let us consider $C(c)$ as the complex cause. There are numerous complexes which are related to a specific cause: $C_1(c), C_2(c), ..., C_n(c),$ ... Regardless of other reasons, it may be found that: **a**) the cause phenomenon occurs (is recorded) experimentally, before the occurrence of the effect phenomenon; **b**) the effect phenomenon occurs only after the generation of the cause phenomenon; **c**) at least some of the features belonging to the cause phenomenon may be produced apart from the effect phenomenon…" (quote ending).

If we shall interpret the terms of the above mentioned definition in terms of the objectual philosophy, the *phenomenon* notion is mainly referring to processes, more exactly to an agent process - *the cause* - which acts on an object, produces another process, an action, a state variation of the driven object - that is the *effect.* In this case, it is clear that we are dealing with a causality relation between the two processes, namely a relation of ***processual causality***. But, both the cause and the effect processes are some variation state of specific objects: *the agent* and *the driven object*. The states of the two objects, which are also objects (obviously, abstract ones) are also maintained in a causality relation, because the state of the driven object is an effect of the action, and the state of the agent object is an effect of the reaction (if the reaction exists). The states of some objects which deployed or still deploy processual causality relations between their properties become objects which are under ***objectual causality*** relationships.

If we are taking into account the axiom I (axiom of the quantitative value), which postulates that any existential attribute is the result of a generating process (and vice-versa, any vanishing of the value of an existential attribute is the result of an annihilation process) we have the possibility of showing-up the causal bonds, because the collection of the existential attributes of an object or process (collection which makes-up the state of the object or process) is the result of a set of generating processes. This collection of generating processes makes-up a *causal structure* for the state at the present moment, state which is the *effect* of the causal structure.

Comment X.19.1: The term of "causal structure" which is used in this context is the equivalent of the "complex cause" term from the above-mentioned causality definition. The word "structure" was used because, in a graphical representation (for example, the flow chart on the production of a specific object),

[110] Gheorghe Enescu – *Dicționar de Logică*, Editura Ştiinţifică şi Enciclopedică, Bucureşti 1985

there is an invariant spatial distribution of the various stages (state-type objects) of the processes with invariant bonds deployed between them, therefore an S-type system.

Both the *chains* of successive processes and the *branches* with simultaneous processes belong to this structure, all these having a specific contribution to the effect state. There is always a *causa proxima*, the process which occurs right before the effect, this cause being analyzed by many philosophers[111]. It is worth noticing that in a causal chain, the absence of any process from this chain leads to the absence of the final effect (the objects and processes are conjointly associated, that is the equivalent of the function "AND" from the mathematical logics).

The introduction within the objectual philosophy of the unusual concepts of *objectual* and *processual causality* allows a correct understanding on the occurrence of some real or abstract objects from our surroundings and their categorization into the appropriate classes. For example, the children and the parents within a family are involved in a relation of objectual causality, because the children are a result (effect) of the previous reproduction, nursing and education processes performed by their parents.

Another example which is also taken from the biosystems field is represented by the hierarchical organisation of the individuals which belong to a group forced by circumstances to act together (packs, school groups, teams of professionals etc.). Within such a group, as a result of the numerous bilateral interaction processes deployed between its members (physical or intellectual confrontations, mutual evaluation of the activity results etc.) which occur in a long enough time interval, a "scale of values" is generated, in which each individual has its place, depending on the attribute quantity under evaluation which belongs to each one of them. Every bilateral interaction process settles a winner and a loser (another two objects which are in a relation of objectual causality). The member of the group which wins all the confrontations with the other members shall become an alpha member, and the one which loses all, shall be the omega member. The others shall be placed in intermediate positions within this hierarchy. This kind of attributes evaluation, by means of bilateral interactions, leads to an internal, relative evaluation of the property difference between the members of the same group (by resulting the internal distribution of the attribute differences on each group member), without the possibility of mentioning the absolute value of the property associated to each member. If an external evaluation is required, specific interactions between groups are needed or the attribute evaluation against an external reference considered to be absolute (impartial evaluator) is also required.

All these hierarchical structures are abstract objects which are the result of a causal structure (a long series of simultaneous and/or successive processes) which produce the occurrence (generation) of a value order of the objects involved in the interactive processes from the causal structure.

Comment X.19.2: As we have previously mentioned, the objectual causality relations are mostly visible in the social media. Within these media, some attribute differences may be found between two individuals (fame, fortune, education level, look, intelligence etc.), differences which are exclusively due to some previous processes (therefore, to a processual causality). As a result of these differentiated previous processes, a "sedimentation" of the society's individuals in the so-called "layers" or social "classes" takes place, which are nothing but a set of individuals with a quasi-even distribution of a specific property, and these individuals are involved in the same type of causal relations against another set (other layer), to which the same property, also quasi-evenly distributed, is very different in terms of quantity.

The various organization levels of the material systems are also involved in objectual causality relations, because the systems with a high organization level are a result (effect) of a formation (synthesis) process of the system, from the systems with an inferior structure (subject which was also approached in chapter 1).

[111] **V.I. Perminov** - *Cauzalitatea*, Editura Ştiinţifică şi Enciclopedică, Bucureşti, 1988

Annex X.20 – NATURAL INTERNAL REFERENCES

Let us consider a 3D even, finite and invariant spatial distribution of an attribute, such as, for instance, the mass density $\rho_m(x,y,z)$. In relation to an external reference **X,Y,Z**, each DP_i of the distribution (the primary distribution element) has the position vector $\overline{r_i}(x_i,y_i,z_i)$, according to the figure X.20.1.

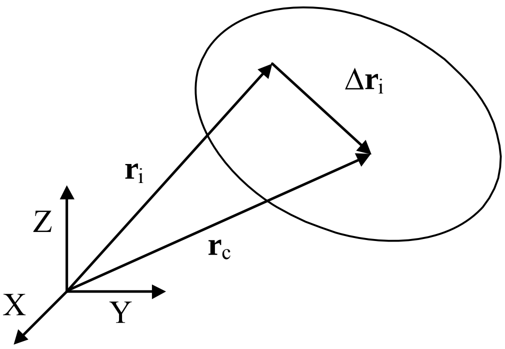

Fig. X.20.1

The common component of the set of position vectors is also a position vector which shall be written as $\overline{r_c}(x_c,y_c,z_c)$. In relation to this unique and invariant (as internal position) vector of the distribution, each position vector $\overline{r_i}(x_i,y_i,z_i)$ has a differential (specific) component $\Delta\overline{r_i}(x_i,y_i,z_i)$. If by convention, the following rule is settled for the set of the distribution elements: *the common component of the set of specific components is null* (nonexistent), then, this condition transposed in the example shown in the figure X.20.1 becomes:

$$\sum_i \Delta\overline{r_i} = \sum_i (\overline{r_i} - \overline{r_c}) = 0 \qquad \text{(X.20.1)}$$

which if it is written by components, it means:

$$\sum_i (x_i - x_c) = 0\,,\ \sum_i (y_i - y_c) = 0\,,\ \sum_i (z_i - z_c) = 0 \qquad \text{(X.20.2)}$$

If we presume that 3D distribution contains *n* elements, namely, *i=[1,n]*, the relations X.20.2 may be also written as:

$$\sum_i x_i = nx_c\ ,\ \sum_i y_i = ny_c\ ,\ \sum_i z_i = nz_c \qquad \text{(X.20.3)}$$

hence the result is:

$$x_c = \frac{1}{n}\sum_i x_i\ ,\ y_c = \frac{1}{n}\sum_i y_i\ ,\ z_c = \frac{1}{n}\sum_i z_i \qquad \text{(X.20.4)}$$

the notorious relations which define the coordinates of the mass-center (or the weight-center) of a material object with even distribution of the mass density.

This means that the center's position represents the common component of the spatial positions of the distribution elements set, that is an abstract object which represents at the same time an *internal natural reference* T of that distribution (against which the specific components of each element are being estimated). The relations X.20.4 are applicable for any discrete distribution, such as, for instance, the finite sets of numerical values; in this case, the common component (the natural internal reference) of these sets is the *mean arithmetical value*. Also, the relations X.20.4 justify the relation X.20.1 (which was used before its justification), fact which shows that the value of the common component is null, only if the sum of its individual (specific) values is null (assertion applicable for the quantitative attributes).

Comment X.20.1: It must be emphasized that both the common component of a set of objects and the other reference values, either natural or artificial, are abstract objects without any correspondence to the objects of the set used for their determination (they are external references to these objects). If we are talking about the set of vectors from the figure X.20.1, $\overline{r_c}$ is a position vector belonging to an imaginary point (there is no element of the distribution placed on that position, unless it was randomly arranged like that).

Annex X.21 – DEFORMATION OF THE NATURAL MEDIA

The deformation of the natural media (NM - gases, liquids, solids etc.) under the action of external forces is a very vast subject, which is approached starting with the physics textbooks and continuing with the specialized studies focused on fields such as statics and fluid dynamics, strength of materials and many others.

This annex will show only few of the simple relations which determines the attributes values specific to a deformation (a state change), depending on the attributes of the agent which generates it. If we have a medium portion with a volume *V* (for example, with a spherical shape), by an application on the body surface of an even pressure *p*, a *ΔV* volume decrease is obtained. The ratio $\frac{\Delta V}{V}$ is the relative volume variation (variation of the volume unit). If the variations are elementary, the following amount is being defined:

$$\alpha = \frac{1}{E} = -\frac{1}{V}\frac{\partial V}{\partial p} \tag{X.21.1}$$

named *compressibility*. The reverse amount of the compressibility is the *elasticity modulus E*. The dimensions of *E* are the ones specific to a pressure. If the volume variation takes place as a result of a temperature variation, an isobar dilatation coefficient shall be analogously defined:

$$\beta = \frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_p \tag{X.21.2}$$

As for the solids, an amount is defined, being named *unitary strain*:

$$\bar{p} = \frac{d\bar{F}}{dA} \tag{X.21.3}$$

with the components $\bar{\sigma}$ (*normal unitary strain*) according to the direction of the normal's versor $\bar{n}$, and $\bar{\tau}$ (*unitary tangential strain*) into the plane of the element *dA*. Between the amounts *E* (*longitudinal elasticity modulus*), G (*transverse elasticity modulus*) and μ (*Poisson's coefficient* or *transverse contraction coefficient)* there is the following relation:

$$G = \frac{E}{2(1+\mu)} \tag{X.21.4}$$

Comment X.21.1: Attention! Do not mistake the symbol G for the transverse elasticity modulus with the notation for the G-type media class. The notion of *normal unitary strain* for S-type media is identical with the pressure one from the L or G-type media, involving the normal component of the variation of an energetic flux (a force) applied on a surface with an area A. According to the objectual philosophy, once with the introduction of the concept of *real bounding surface* (RBS) of a MS, in which the tangential flux components occur, the notion of tangential strain regains its original meaning, similar with the concept of normal effort, which is also a pressure, but this time, it occurs on the cross section of a RBS. Otherwise speaking, the tangential strain is not applied into the plane of the element *dA*, but on the element of the transverse section of RBS. According to the classic approach (through abstract surfaces), it is clear that the tangential strain could not be regarded as a pressure, because the normal area on the tangential strain was null. As regards the term of *transverse contraction*, another remark needs to be done. First of all, this term has a clear meaning for the stretching strains of the solid or liquid materials, and is caused by the property of these media to preserve their volume; consequently, an increase of a dimension (by means of traction) generates a decrease (contraction) of the cross section dimensions. In case of the compression strains, there is an obvious increase of the cross section sizes, therefore, a transverse dilatation occurs, rather than a contraction. If we shall consider the dilatation as a negative contraction (#), then, the term can still be used.

If there is a mean unitary strain $\sigma_m = \frac{1}{3}(\sigma_x + \sigma_y + \sigma_z)$ and the mean specific elongation $\varepsilon_m = \frac{1}{3}(\varepsilon_x + \varepsilon_y + \varepsilon_z)$, then, the following relation is applicable:

$$\frac{\sigma_m}{\varepsilon_m} = \frac{E}{1-2\mu} \tag{X.21.5}$$

The amounts ε_x, ε_y, ε_z represent *specific elongations* (as compared to the axes **X,Y,Z**) and the amounts γ_{xy}, γ_{yz} and γ_{zx} are angular deformations or *specific slides* against that axis as well. In case of the isotropic bodies, we have:

$$\varepsilon_x = \frac{1}{E}(\sigma_x - \mu(\sigma_y + \sigma_z)),\ \varepsilon_y = \frac{1}{E}(\sigma_y - \mu(\sigma_z + \sigma_x)),\ \varepsilon_z = \frac{1}{E}(\sigma_z - \mu(\sigma_x + \sigma_y)) \tag{X.21.6}$$

and:

$$\gamma_{xy} = \frac{\tau_{xy}}{G},\ \gamma_{yz} = \frac{\tau_{yz}}{G},\ \gamma_{zx} = \frac{\tau_{zx}}{G} \tag{X.21.7}$$

or vice versa, the relations between the unitary strains and the specific deformations:

$$\sigma_x = 2G(\varepsilon_x + \frac{3\mu}{1-2\mu}\varepsilon_m),\ \sigma_y = 2G(\varepsilon_y + \frac{3\mu}{1-2\mu}\varepsilon_m),\ \sigma_z = 2G(\varepsilon_z + \frac{3\mu}{1-2\mu}\varepsilon_m) \tag{X.21.8}$$

and:

$$\tau_{xy} = G\gamma_{xy},\ \tau_{yz} = G\gamma_{yz},\ \tau_{zx} = G\gamma_{zx} \tag{X.21.9}$$

The specific deformation's potential energy (the energy stored into the space unit) is:

$$W = \int_0^{\varepsilon_x} \sigma_x d\varepsilon_x + \int_0^{\varepsilon_y} \sigma_y d\varepsilon_y + \int_0^{\varepsilon_z} \sigma_z d\varepsilon_z + \int_0^{\gamma_{xy}} \tau_{xy} d\gamma_{xy} + \int_0^{\gamma_{yz}} \tau_{yz} d\gamma_{yz} + \int_0^{\gamma_{zx}} \tau_{zx} d\gamma_{zx} \tag{X.21.10}$$

and if the relations between the specific distortions are linear, the relation X.21.10 becomes:

$$W = \frac{1}{2}(\sigma_x\varepsilon_x + \sigma_y\varepsilon_y + \sigma_z\varepsilon_z + \tau_{xy}\gamma_{xy} + \tau_{yz}\gamma_{yz} + \tau_{zx}\gamma_{zx}) \tag{X.21.11}$$

The same energy may be written depending only on the unitary strains:

$$W = \frac{1}{2E}\left[\sigma_x^2 + \sigma_y^2 + \sigma_z^2 - 2\mu(\sigma_x\sigma_y + \sigma_y\sigma_z + \sigma_z\sigma_x) + 2(1+\mu)(\tau_{xy}^2 + \tau_{yz}^2 + \tau_{zx}^2)\right] \tag{X.21.12}$$

or on the specific deformations:

$$W = G\left[\varepsilon_x^2 + \varepsilon_y^2 + \varepsilon_z^2 + \frac{\mu}{1-2\mu}(\varepsilon_x + \varepsilon_y + \varepsilon_z)^2 + \frac{1}{2}(\gamma_{xy}^2 + \gamma_{yz}^2 + \gamma_{zx}^2)\right] \tag{X.21.13}$$

All these complicated and probably boring relations were mentioned with a clear purpose, namely, to underline the existence of a deformation of the material media depending on the action of some forces (of some energy fluxes). All these deformations have a common feature - they are proportional with the applied force, and they are a state attribute of the potential energy stored in that medium. Consequently, the objectual philosophy asserts that:

There cannot exist a material medium which is non-deformable.

The above mentioned statement, with a particular case, the non-existence of the incompressible media[112], can be demonstrated by the *reduction ad absurdum* method. If we are assuming that a non-deformable medium would exist, this means that it would have a null α compressivity according to the relation X.21.1, or accordingly, the infinite elasticity E

[112] The media compressibility is let aside in some papers (being considered as incompressible), but this aspect aims only to simplify the relations deployed in case of some processes, in which the compressibility is not important (such as, for instance, the motion of some bodies with low velocity through the fluid media).

modulus. This fact would attract on the one hand an infinite propagation velocity of the compression waves, and on the other hand, the impossibility of existing such waves because their specific local compression feature would not be able to exist. Furthermore, the potential energy cannot be stored and restored in a non-deformable medium, because the external state attribute for this kind of energy is even the medium deformation, as we have mentioned in chapter 7 and in the relations X.21.10…X.21.13.

The deformability of a specific medium depends on the type of the medium's elements, on the bonds type (interactions) between the elements, on the intensity, temporal distribution and anisotropy of these bonds. The most non-deformable (more rigid) media known so far (such as the diamond or some carbide types) however have finite elasticity modules and finite propagation velocity rates of the pressure waves.

Annex X.22 – POTENTIAL ENERGY

X.22.1 Interactions deployed between MS with potential energy

If there are two MS which own (where it is stored) the potential energy, and these MS are interacting one another (the two MS have a common RBS), a permanent energy exchange (through energetic fluxes) shall be generated between the two MS. This bilateral exchange process has the equilibrium state between two potential energy stockpiles as its final processual state, that is a state in which the energy flux (EF) density between the two MS are equal and consequently, the re-circulated EF between the systems are equal and in counter direction (the equilibrium surface of the two EF is motionless against an external reference).

The energy which is stored into a compressed air or into a resort are specific cases of potential energy stored in some MS. By considering a cylinder equipped with a mobile piston which separates in the left side a volume filled with a gas at the pressure *p*, and in the right side, a compressed spiral resort, so that the resort reaction to be able to balance the force exerted by the gas pressure (see figure X.22.1.1.a).

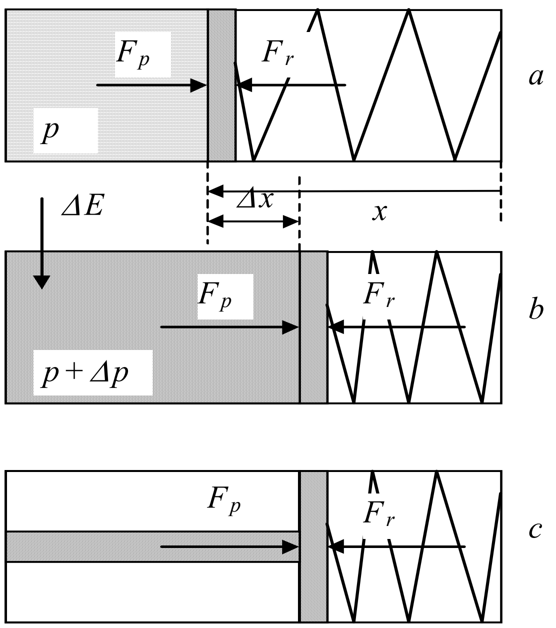

Fig. X.22.1.1

The energy state attribute of the potential energy stockpile in case of the compressed air is the pressure *p*, and in case of the resort, it is the deformation distance Δx (compression or extension) of the resort against its initial length (non-deformed).

Comment X.22.11.1: The usual energy state attribute for the potential energy of a gas is the pressure, but at the same time, it could be the piston's position *x* from the figure X.22.1.1.a (for a specific temperature and a specific molecule amount, a mole for instance). The same for the resort, the energy state attribute could be the tangential strain from the material (measured with a tensometer) for a specific transversal elasticity modulus G of the material. Obviously, on a case by case basis, the relations between the energy stockpile and the state attribute are different.

The force F_p which is generated by the gas pressure is balanced by the force F_r of the compressed resort, force which is given by the relation $F_r = k\Delta x$, where *k* is the constructive constant of the resort. Under an equilibrium state, situation displayed in the figure X.22.1.1.a, the two forces are equal, and the piston together its embedded equilibrium surface is also motionless.

Comment X.22.1.2: The major difference between the current physics and the objectual philosophy regarding the approach of this equilibrium state consists in the fact that the physics sustain that there is no energy exchange between the two systems during the equilibrium state, whereas the objectual philosophy asserts that on the contrary, there is an EF on both sides (therefore, a permanent energy exchange), but these fluxes are equal and oppositely directed. According to this approach, the EF source, both as an agent and a reaction, is an energy stockpile; if this stockpile is finite, it can be depleted at a certain intensity (power), and once with this depletion, the force (active or reactive) and the equilibrium state shall vanish as well. The permanent energy exchange between the two systems makes that the two energy stockpiles to remain constant (if the external escapes are null). Based on the issues mentioned into the annex X.10, as regards the equilibrium, an equitable energy transaction occurs between the two interactive systems.

If an energy intake ΔE is generated into the left-side volume, as a pressure increase Δp (see the figure X.22.1.1.b), the new force F_p shall be higher than the arc reaction, and consequently, the piston shall be displaced on a distance Δx, by compressing the resort until its reaction force will re-balance the gas force. The mechanical work carried by the active force F_p against the arc reaction is[113]:

$$\Delta W = F_p \Delta x = k \Delta x^2 \tag{X.22.1.1}$$

and it occurs until the flux density from the right side of the piston is equal with the left one, namely, until the energy surplus ΔE shall be evenly distributed to both media which own the potential energy. This fact means that:

$$\Delta W = \frac{\Delta E}{2} \tag{X.22.1.2}$$

relation applicable for this simplified case, in which there are only two material systems which own the potential energy, and these are under interaction. In relation X.22.1.1, we may see that the amount k is a second rank energetical capacitance for the potential energy stored into the arc, the energy state attribute being the deformation Δx. The energy stockpile surplus ΔW from the arc is supplied during the displacement of the equilibrium surface, by the force F_p which becomes active until the moment of equilibrium restore.

If the support media are homogeneous, the potential energy stockpile which may be found in both systems is evenly distributed, both in the gaseous medium and in the arc's material, in case of a cylindrical spiral resort, as a transversal strain on the section of the spiral-shaped rod. If we replace the gaseous medium with a rod made-up from a solid material (see the figure X.22.1.1.c), the potential energy of the compressed arc shall be balanced by the potential energy within the rod's solid medium, but because the solids compressibility is much more reduced than the gases compressibility, the deformation Δx of its length is undetectable by the human eye. But, even in the solids' case, there is also a deformation of the medium which is in proportion with the level of the potential energy stored in that medium (see the annex X.21).

X.22.2 Specific approach of the objectual philosophy on the interactions deployed by means of potential energy fields

Besides many other opinions which are different from the ones sustained by the current physics, the objectual philosophy presents totally different point of views concerning two aspects of the *potential energy* notion:

[113] The relation X.22.1.1 is valid only under the simplified assumption of a constant force F_p (which is independent from the position x); in fact, the situation is much more complicated, but for the purpose of this section, the accurate relation is not so important.

1) What is the object which owns (which stores) the potential energy?

2) What is the agent object in case of the energetic interactions deployed through potential energy fields with uneven distributions?

There is a clear answer to the question **1**, given by the objectual philosophy: by means of the definition 7.6.2.3, the potential energy is distributed (stored) into an EF with a null external coherent component, whose material support is a medium which is under an overall rest state against an external reference RS_e. The volume density of the potential energy is the *scalarized* FDV of the stochastic EF. As for the baric potential energy, this scalarized density is the *pressure*, and the Euler distribution of the pressure gradient into the support medium represents a *potential energy field* (evidently, a vectorial field).

First of all, we shall take into account the case of an even distribution of the energy density in a specific volume, such as, for instance, the pressure, and in this case the pressure gradient is null. In this case, an evenly distributed force shall be exerted against a MS "immersed" into this kind of medium (the medium's action against MS), that is a force to which MS shall reply in the same way, the reaction force of MS against the medium, which is also evenly distributed on the same RBS. Since the two forces (energy fluxes, according to the definition 7.6.6.4.1) are evenly distributed on the surface, their resultant shall be null, therefore, the body, together with its equilibrium surface shall be motionless both against the medium and also against the external reference system RS_e. If the distribution of the stochastic EF is radially uneven and the internal reference of this distribution is RS_s (considered as motionless against RS_e), this SR_s shall be the internal reference of an object called the *uneven radial field source*. Into a field like this, on the RBS of a MS "immersed" inside it, the resultant of the surface distribution of the stochastic EF quanta variation shall not be null any longer, but it will have the direction in opposition with the field gradient, and the resultant modulus shall be in direct proportion with the proximity of the field source. Since there is a non-zero resultant force (a coherent component of EF distributed on RBS), if the "immersed" MS is free, it will be accelerated (it will receive energy from the stochastic energetic field) on the direction of the resultant force, that is the opposite gradient's direction.

According to the current physics textbooks, in a situation like this, it is said that a MS which may be found in a field at a specific position $\overline{r}$ against the field source, "has the potential energy $E_p(\overline{r})$", which can be transformed into kinetic energy. The objectual philosophy states that <u>it is not the MS from the energy field which owns the potential energy, but the environment, the material support of the stochastic energy field.</u>

The answer given by the objectual philosophy to the question **2** is once again both clear and unexpected namely, the agent object, <u>the agent EF source</u> (according to the definition 7.3.3) which moves the "immersed" body <u>is the medium on whose elements the potential energy is distributed</u>, and not the MS which represents the source (cause) of the field unevenness. Between the source MS and the uneven field from the support medium of the potential energy, there is a relation of causality (a causal chain, see the annex X.19), because if no source MS would exist, the uneven field would not exist either. However, between the source MS and "the immersed" MS, there is no direct energy flux deployed in its field, therefore, there is no direct action either.

If there are two MS, which are both source of the same type of energy field, "immersed" in the same medium, then, in each point of the space occupied by the environment, there will be two gradient vectors which will have a vector composition, by resulting another field, "deformed" against the configuration of the initial fields. If we presume that the gradient direction of both sources is the same, for instance from the source to the outside, as a result of the composition of both fields, the gradient vectors will be subtracted in the space between sources, resulting a more reduced gradient, whereas in the rest of the space, the gradient vectors will be added. Consequently, through the integration on RBS of FE density of the two

MS, two forces will be generated with the direction against the local gradient (resultant), the so-called attraction or repulsion forces, although not the field sources are the direct source of EF which determine the forces generation, but the environment is the one which will "push" the two MS. But the uneven distribution of the potential energy from the support medium would not be able to exist without the existence of the field sources.

Comment X.22.2.1: According to the issues mentioned in annex X.19, the force which occurs on the RBS of an "immersed" MS into a medium with a non-even distribution of the potential energy density is the result of a causal chain, the medium's action against the body is the proximate cause of the force occurrence. However, the non-zero resultant of the medium's action (resultant force) could not occur if there was no uneven distribution of the pressure gradient, distribution whose cause is the field source. In other words, the MS which represents the source of the uneven field is the primordial cause which generates that force.

From an energetic point of view, the spatial states S_0 of the internal reference T of a MS "immersed" into an uneven energy field are states of null kinetic energy, but if MS is free and it can be found into a medium with Euler distribution of radial uneven EF, for each position $\overline{r}_k$ of MS[114], a related potential energy $E_{pk}(\overline{r}_k)$ of the medium can be defined (see the relation 7.6.4.1.3) so that:

$$\Delta E_{c21} = E_{p2}(\overline{r}_2) - E_{p1}(\overline{r}_1) \qquad \text{(X.22.2.1)}$$

where ΔE_{c21} is the variation of the kinetic energy of MS (kinetic energy received by MS from the medium) between the two spatial positions, an energy equal with the variation of the potential energy of the medium between those positions. EF which is generated by the external medium which acts on MS, correspond to the force exerted by that medium (medium's action against MS), and EF of the moving MS corresponds to the force with which MS acts on the medium (reaction). If MS is free, the force exerted by the medium becomes an active force, and its mechanical work will be converted into the kinetic energy of MS.

In chapter 7, section 7.3.3, where the action was described, the agent object was the source of the agent flux. In this case, we may say that we are dealing with a ***direct action*** between two objects - agent object and driven object. In case of a MS "immersed" into a medium with uneven energy distribution, the agent object (the agent EF source) is the environment, and the driven object is any MS placed at the position $\overline{r}_k$, and which, as a result of the medium's action, shall receive from it the energy ΔE_{c21} shown in the relation X.22.2.1, which will set it into motion. But the unevenness of FDV distribution of stochastic EF which may be found into the driven MS's medium is due to the presence of another MS which has generated this unevenness - source MS of the uneven distribution.

In this case, although there is no direct EF exchange between the source MS of the uneven field and the driven MS, we might say that an ***indirect action*** occurs between the source and the driven MS, because the source MS, by means of a causal chain, is the origin of the action carried out on the driven object, but having the common environment as its intermediate, in which both MS are being "immersed".

Comment X.22.2.2: The notions of *direct* and *indirect* action which were previously mentioned regarding the energetic actions may be easier understood by the reader by invoking once again the case of the informational actions deployed in the humans community. If the population of a country is assimilated with the stochastic medium in which the information fluxes run randomly between the individuals which interact through direct communication, written messages or other types of information fluxes (IF), we may say that this medium has a finite information amount (a stockpile) stored inside it. Each element of the society owns a part of this stock. A transfer (an IF) is possible to be performed from this individual stockpile, by means of the common language (transfer which was mentioned in chapter 9), to another member of the society. In this case, the IF source is the agent object, IF is the agent flux, and the flux receiver is the object which is informationally driven. This is a classic example of informational action, process in which IF runs directly from the source to the addressee, that is a reason why we are dealing

[114] $\overline{r}_k$ is the position vector of the internal reference T of MS against the internal reference T of the uneven radial field source.

with a *direct* informational action. If the central system (political power) wants to communicate a specific information to the population (such as a governmental decision), this information shall be broadcast through mass-media, that is a process similar with the propagation or diffusion. In this case, the IF which reaches to a certain member of the society (agent flux) is not coming directly from the main source, but through a series of agents. It is clear that we are dealing with a process of *indirect* informational action. It is worth noticing that in a DS, either it is a social medium, NM or PFM, the actions which are based on propagation or diffusion fluxes as their agent object, are indirect actions, with the propagation/diffusion medium as an intermediate agent.

Annex X.23 – VARIABLES CLASSES

X.23.1 Variables classes

As we have already seen in chapter 2, a variable *x* represents a qualitative property which may have more possible actual values (numerical, literal or other type), named as singular values. The total amount of these possible values makes-up a set. If the values are arranged in an ordered series (according to the numerical value or to other ordering relation), we shall be dealing with an ordered set. The ordered set of a variable may be represented by an abstract object such as:

$$\{x\} = \{x_1, x_{2,}, \ldots x_n\} \qquad \text{(X.23.1.1)}$$

where x_k $(k \in [1, n])$ is the *symbolical* (syntactical) *singular value* related to the individual abstract container (elementary, with the boundaries marked by commas) with the running number k, which belongs to the global container with the boundaries {} and the amount:

$$I = x_n - x_1 \qquad \text{(X.23.1.2)}$$

represents (only for numerical values) the *value interval* of the variable.

Within the relation X.23.1.1, *x* represents an abstract object such as the *m-ranked class of numerical values* (where *m* is the abstraction level of this kind of class). Since the numerical values may belong to various types (fractional, integers, natural, imaginary, prime, real, complex, etc), each of these identifiers (specific attributes) designates a particular class, an *instance* with the abstraction rank *m-p* of the class *x*. In this context, *p* is the integer number of specific attributes associated to the class *x*, in order to obtain a particular class (an instance with *m-p* rank).

Comment X.23.1.1: It is worth mentioning the connection between the term *instance* and the *particular* attribute. In case of a class of numerical values, such as the natural numbers, an instance of this class is any natural number (a singular, particular value). But a particular object (an instance) is also the class of natural numbers {N}, as one of the possible sub-classes of the set {R}.

The most general class of numerical values is {R}, the so-called set of real numbers. By adding a specific property to the model {R}, a subclass is generated, which is also a set of numerical values, but these values have a common specific property. If we are changing a model property from the model {R} which is valid for all the elements of the set, an equipotent class with {R} is obtained. For instance, the class of the imaginary numbers {I} is made-up from {R} by means of an artificial reverse of the symbol assignment convention for the result of the multiplication operation (see the annex X.3.1). Thus, a class of numerical values equipotent with {R} is formed, which has in common with {R} only the absolute internal reference (zero value), it is therefore a totally disjoint set and independent from {R}, that is a reason why its geometrical representation is a perpendicular axis on the axis of the real numbers.

If the property is specific to only a portion from {R} (a partition), then a subset shall result. For example, the class {Q} (class of the rational numbers) has a specific property in the fact that the elements of the class are the result of a ratio $\frac{m}{n}$ (where *m* and *n* are integers).

Comment X.23.1.2: Another important remark is that a property which is specific to a <u>class</u> of objects is a <u>model</u> property, common to all the class' objects, which allows the distinction (differentiation) between classes. In the above-mentioned examples, the properties which allow the distinction of the variable classes are clearly specific model properties.

An instance of one of these numerical value classes is a singular value from the set of possible values indicated in the right side of the relation X.23.1.1, that is a concrete numerical value. In case of the ordered sets, the attribute which is specific to a certain element is the running number of the individual container. This running number, although it is just a number, is a qualitative attribute which designates the position of the set element within the set (it is a structure attribute).

In chapter 2, we saw that a distribution is a set of assignment relations between the concrete values of two variable classes: the independent variable *x* and the dependent variable *y*, relations such as:

$$y_k = f_k(x_k) \tag{X.23.1.3}$$

or:

$$y_k = \rho_k x_k \tag{X.23.1.4}$$

The relations X.23.1.3 or X.23.1.4 represents abstract generating processes between the actual values y_k and the actual values x_k, processes which, in the most general case, are specific to each value x_k, which means that each assignment relation has another concrete syntactic value f_k or ρ_k. If all the concrete generating processes deployed between the objects from class *y* and the objects from class *x* have a common component, that is the same syntactic value *f* (the same symbol, same structure, independent from the concrete value x_k), then it may be written that $y = f(x)$. Therefore, the continuous algebraic functions are invariant abstract generating processes between two classes of variables, and the values' domain of the support variable which keeps the invariance of the syntactic value *f* is the function's continuity domain.

X.23.2 The support sets of the variables classes

As we have seen in chapter 9, each class of abstract objects represents a set of objects which have the same model, set which is called *support set* of that class. We have also noticed that the number of support elements (the set's cardinal) is direct proportional with the abstraction level, starting with the basic level - concrete object - which has only one element as its support.

As regards the case mentioned in the previous section, concerning the set {R} from mathematics, it is well-known that the support set of the class is infinite, both for the generic set {R} and for its particular subsets {Q},{N},{Z} etc., fact which makes impossible the comparison between the support sets of each distinct variable class. This comes from fact that according to the current mathematics, the different levels of infinite cannot be compared, although logically, we realize that a subset has fewer elements than the set which includes it. This kind of absurdity disappears in case of the set of real *realizable* numbers $\{R\}_\varepsilon$ (introduced in the annex X.3), set which contains a finite number of singular values in a finite interval. In this case, a however large but finite interval of $\{R\}_\varepsilon$ shall contain a finite number of singular values which may belong to any of the sets $\{Q\}_\varepsilon, \{N\}_\varepsilon, \{Z\}_\varepsilon$, all of them with a finite number of elements. Thus, the cardinal of each specific set of numerical values is finite and a comparison between them may be carried out.

Comment X.23.2.1: Because the sets $\{Q\}_\varepsilon, \{N\}_\varepsilon, \{Z\}_\varepsilon$ etc. are subsets of $\{R\}_\varepsilon$, this means that as regards a specific non-determination interval ε of the set $\{R\}_\varepsilon$, all the other subsets shall have the same ε as well.

Annex X.24 – THERMAL PHOTONS AND THERMAL ENERGY

X.24.1 Orbitals of EP

Based on the current knowledge regarding the atoms' internal structure, but by using the notions which are specific to this paper, we may identify *distributions, objects, processes* and internal *fluxes* belonging to these types of MS. The purpose of this annex is not to make a review on the nuclear internal structure, what really matters to us is just the assertion upheld by this paper, that the atomic nucleus (for a certain type of atom) has an invariant spatial structure, with an internal RS, structure which also determines the invariant configuration as well (for the same atom type) of the spatial distribution of the electron's orbitals which make-up the external (peripheral) DS[115] of the atom. As a result of this nuclear structural stiffness, the atomic peripheral DS, which is made-up from electrons only, has also a rigid structure[116], which means that it is a S-type DS (more exactly, S_R-type, in which the constitutive elements are maintained despite the alleged repulsion between them, by the powerful electrical interaction deployed with the central subsystem - the nucleus with its positive charges).

The main argument for the existence of the structural stiffness of the orbitals where the atomic electrons are found is even the stiffness of S-type media made-up from atoms or molecules, stiffness which could not exist if the covalent or ionic bonds (interactions) deployed between atoms would not have stable preferential directions and invariant spatial positions against the atomic internal RS. Within the peripheral electronic DS, the motion of each electron has unique and invariant state attributes (whose existential attributes make-up, among others, the so-called set of quantic numbers), although each of these electrons performs multiple motions (therefore, they are fluxes).

This means that the quantic numbers which defines the state of a specific electron are quantitative (existential) attributes of some invariant processual qualitative attributes, namely, they are parameters of some invariant fluxes. Since we are talking about fluxes, which are objects set in motion, it is clear that the position of the moving electron is non-determined, but in exchange, some invariant attributes for the velocity or the acceleration of the object can be defined (with its equivalent, that is the energy or the orbital frequency), for the spatial distribution of the flux line (plane, radius, orbital axis, position of the axis and of the orbital plane against the atomic RS, which coincides with the nuclear one), distance of the orbital plane against the nucleus (which is invariant for a certain electronic layer), etc. Consequently, if we cannot define the position of an electron, we can however define the position of the *orbital* on which it is placed.

Definition X.24.1.1: The abstract object made-up from the set of all the invariant state attributes of an EP bonded in a bi-particle system (proton-electron couple) is named **orbital.** The attributes are determined against the internal RS of the material system to which the couple belongs to.

Comment X.24.1.1: This definition marks another net distinction between the objectual philosophy and the current physics which states that the motion of the constitutive elements of an atom has a purely

[115] Both the external electrons of the atoms and the nucleons from the nucleus composition make-up DS, because only the elements from the close proximity interact one another. However, due to a low number of elements, they barely can be called as media, although internal propagation phenomena can also occur at DS with few elements.

[116] Attention! Rigidity not as regards the electrons position, but on the level of the orbitals occupied by these electrons. The same remark is also applicable for the nuclear rigidity.

probabilistic character (being defined by Schrodinger equation). The "orbital" concept may be also found in the current physics, but here, this abstract object defines a spatial domain in which a probability wave is being framed. As we have seen in chapter 7 and as we are going to see further, the objectual philosophy states that a constructive interaction between two components of a MS can exist if only there is a <u>close inter-correlation</u> between their fields, which cannot exist between two "probability waves".

The term of *bonded* EP means an EP which is part from a couple of EP with opposite charges, which deploy a permanent interaction, belonging to the atoms or neutrons composition; therefore, we shall have two orbital types - *atomic* and *neutronic* orbitals - with very different bond energy values, but which are similar in terms of model. Since we are talking about dynamic material systems (a static equilibrium cannot be conceived between two bonded EP with opposite charges), which means that the system's elements are in a continuous motion, it is clear that the individual position of the particles is non-determined, but there are state attributes S_x $(x\neq0)$ or derivatives from, which can be invariant during the bonding time interval.

Comment X..24.1.2: This kind of attributes may be observed at other system with a purely dynamic equilibrium - our planetary system. In this case also, the planets position against the internal RS of the planetary system is non-determined[117] (since they are in a continuous motion), but there are states attributes, such as the orbital frequency, spin frequency[118], direction of the orbital axis and of the spin one, the orbital and spin plane, the mean orbital radius etc. which may be considered as invariant (for specific temporal support intervals and for a non-disturbed system).

It is worth mentioning that in case of a bonded EP, each EP has its own orbital, but the attributes of the two orbitals are inter-correlated, as we are going to see later on (the same as the particles are coupled through their fields, their orbitals are „coupled" as well). The existential attributes of the model attributes which describe the *orbital* abstract object are settled during some natural interaction processes between the MS elements (we may say that they are *self-settled*), so that few compulsory conditions to be fulfilled.

Interaction between the elements of a couple must be constructive, condition which determines, among others, the velocity (energy) and the orbital radius of the elements, so that the frequency of the space-temporal modulation frequencies of the fields belonging to the couples' elements to be synphasic, otherwise speaking, the orbitals parameters of the two particles must be closely correlated. As a result of this inter-correlation between the parameters of the coupled orbitals, the re-circulated fluxes between the two bonded EP (fluxes which are carriers of the bonding energy) tend towards a maximum value, value which is reached in case of the orbital's fundamental state.

The spatial positions of the axes and orbital planes of the couples involved in the system are the result of the equilibrium between the re-circulated fluxes deployed both between the elements of the same couple, but most of all, between the elements of the <u>different but proximate couples</u> (moreover, between the satellite elements in case of the existence of some repulsion forces, when the elements, together with their orbitals will try to set a distance between them, as much as possible).

Because all the elements from the structure of a MS based on orbitals[119] are MS as well, with simultaneous existence, therefore, with a RBS and a specific volume, it is natural to exist a space-temporal exclusion both of the positions characteristic to the elements of this MS (positions which are non-determined but they are placed in the volume occupied by the orbital), as well as to the orbitals where they are located, the set of the existential attributes of these orbitals is therefore different for each element participating to this MS. The space-temporal exclusion of the orbital moving EP, is determined also by the fact that such

[117] The position of a planet on the sky seems to be determined because its continuous variation is much under the perception threshold of our visual system because of the enormous distances towards them.

[118] The term of *spin frequency* was introduced for the self-rotation frequency of the planet around its axis, even due to the similarity with EP which have also a rotation motion around its own axis with that denomination.

[119] The sytems which are based on orbitals are, for instance, NC, AT, MO but also PS, which are mostly MS whose elements are characterized by periodical movements.

movement generates a RBS with a non-permanent distribution of the permeability (see section 7.2.6), but this RBS behaves in some circumstances (for certain fluxes) as a material object.

If we shall take into account the classification of the internal fluxes of MS mentioned in chapter 7, it may be noticed that the EP orbitals involved into a MS (for example, an atomic one) may be divided in two categories:

– *Orbitals with a simultaneous existence*, where all EP with simultaneous existence from the composition of that MS can be found throughout the entire lifetime of a MS, these orbitals comply with the above-mentioned space-temporal exclusion rules, each of them is different, mostly (but not only) by means of their spatial attributes. According to the classification of the internal fluxes of MS, these orbitals are considered as *structural orbitals* (SO), because they contain structural fluxes which determine the spatial structure of MS.

– *Orbitals with disjoint energetic-temporal distributions* (on short, *energetic-temporal orbitals*), made-up from the set of the energy levels accessible to the same EP, placed on the same structural orbital from the composition of a MS, that EP being able to occupy at a certain moment, only a single orbital from this set; therefore, these orbitals are different mostly[120] due to the energy which EP has it at a given moment, and due to this reason, they may be called as *energetic orbitals* (EO), because these orbitals are actually different energetic *states* of a given SO. The set of these EO contains a *fundamental orbital* (the orbital where that particular EP may be found within a non-disturbed MS, in the absence of external energetic fluxes (EF), orbital where the energy of the occupant EP is minimum and the re-circulated EF with its partner is maximum), and more *excited orbitals*, which are different mostly due to the energy surplus of the occupying EP against the fundamental level, and accordingly, by decreasing the re-circulated EF. The relation between the EP's energy which occupies a specific EO and its bonding energy shared with its partner is inverse proportional, so that, if the energy surplus of EP reaches a certain level, the re-circulated flux is cancelled and EP leaves the system (see section 7.8, law IV).

It is worth mentioning that each SO is related to a series (a set) of EO, with the energy of each one depending on the intensity of the external energy fluxes which acts on that atom and on the quantity of energy which is sent by these fluxes to the particle which occupies the orbital.

Comment X.24.1.3: It is worth noticing that the numbers of structural electronic orbitals in case of an atom is Z, and each of these orbitals has a series of energetic orbitals; as regards the MS with a single electron, such as the hydrogen atom, it is clear that there is a single structural electronic orbital and a related series of the energetic orbitals which are accessible to this electron.

Let us presume that the sets of the model attributes which are characteristic to a couple $\{p_i, e_i\}$ $(i \in [1, Z])$ from the structure of an atom with an atomic number *Z*, placed on a pair of SO under fundamental energy state are:

$$\{e_{pi}O_{pi}\} = \{\{e_{p1}A_{p1}\}, \{e_{p2}A_{p2}\}, \ldots \{e_{pn}A_{pn}\}, \{e_{pf}E_p\}\} \tag{X.24.1.1}$$

for the protonic orbital and:

$$\{e_{ei}O_{ei}\} = \{\{e_{e1}A_{e1}\}, \{e_{e2}A_{e2}\}, \ldots \{e_{en}A_{en}\}, \{e_{ef}E_e\}\} \tag{X.24.1.2}$$

for the coupled electronic orbital. The abstract objects SO are written under the syntax of the abstract objects, in which e_{xk} $(k \in [1, n], x = p, e)$ represents the existential (quantitative) attribute conjointly associated to the qualitative attribute of structure A_{xk} (type of the state

[120] It is obvious that a structural orbital which is under a fundamental state and the same orbital subjected to an excited state must be different through other attributes (such as for example, the radius and the orbital frequency) but its arrangement (position of the spatial internal reference of the orbital) against the atomic RS remains invariant.

attribute[121] which is characteristic to a specific SO), with e_{pf} and e_{ef} as the energy amounts which are assigned to the two ECPs which are found on that SO, under a fundamental state (marked with the index *f*).

The existential attributes e_{xk} are sets of scalars (either they are integers or fractionals) which according to the current nomenclature is named „quantic numbers". The qualitative attributes associated to these sets of numbers are even the state attributes which are characteristic to a SO, aspects which were previously mentioned, and the values of the quantitative attributes associated to them are determined against an internal RS of the couple. For example, in case of a hydrogen atom (if a planetary model would be used only for simplicity reasons), the distance between particles *d* may be considered as an invariant attribute (under a fundamental state), distance which is divided in two intervals r_p and r_e, $(r_p + r_e = d)$ by the common mass-centre (internal *T* reference) of the system. By considering this reference T as center, the two particles deploy revolution motions in the same plane, with the common orbital frequency f_1 (in case of the non-disturbed system, which is under a fundamental state).

Comment X.24.1.4: In case of the motion of a single isolated couple of elements, the orbit's plane is indeed a common one. As regards the motion of more satellite elements between which there are no repulsion forces (such as the planetary system), there is also a single orbital plane for each couple consisting of central system-satellite. However, if the number of satellites is $N \geq 2$ and there are repulsion forces which are deployed between them (such as the case of the atomic electrons starting with He), then, the orbital planes of the elements engaged in the couple are not unique any longer, but they are kept at distance (an orbital plane for the central element and another one for the satellite element, but with a common orbital axis. The only thing which is really important for us right now is only the fact that the orbits' axis remains common as regards the elements of a couple, and its spatial (angular) position against an internal RS may be an invariant state attribute.

The two motions of the elements belonging to a couple of EP have also some associated attributes: the common orbital rotation axis, normal on the orbital plane, but most of all, the two frequency related to the motion of the two EP, frequency who modulates the intensity of the flux released by that particle.

Comment X.24.1.5: When we have described the generic MS model, we saw that the essence of the maintenance of such a system is the constructive interaction, process during which an EF exchange is carried out between the objects which make-up the system, fluxes which may be found anyway into the emerging fields from each MS, but in case of the constructive interaction, these fluxes lead to at least a partly compensation of the energy losses of the MS elements. Because the intensity of these fluxes in a specific point depends on the spatial position against the flux source, and on the temporal variations of this position, we might say that the density of that particular flux has a *space-temporal* distribution, which according to chapter 7, it is named *field*.

The constructive interaction between two MS takes place if the flux received by an element of the system from its partner is ***phased*** with its motion at that particular moment (this, as regards EF; in case of the structural fluxes (SF) the flux received must be phased with the partner's flux demand). To be phased (in terms of energy) means that the external traflux coming from the partner has the same sense as the coherent component of the internally stored flux of the driven MS, in other words, that received flux maintains the motion of the driven MS rather than making opposition. Since the internal motion processes of the elements of a dynamic MS are periodical processes, this means that the proper movements of the bound elements must be phased (at least at the harmonics level) so that a constructive interaction can be deployed.

Comment X.24.1.6: The problem of constructive interaction between two periodical processes is well-known by the ones who design oscillating systems. It is known that if an oscillation (of a mechanic or electric system) is needed to be maintained for an unlimited period, it must that the energy which is inherently dissipated by the system during each period to be compensated by an external source, and this compensation must be constructively carried out (namely, phased or otherwise called "with positive

[121] Attention ! We are talking about the state attributes which can exist simultaneously in a specific temporal interval. As we have mentioned in the chapters focused on objects and processes, the state attributes such as the position and velocity cannot exist simultaneously, neither two energetic levels of the same SO.

reaction"). This compensation can be done during each period, or at an integer number of periods. In the first case, we may say that there is a compensation made on the fundamental frequency, and in the second one, we are dealing with a compensation on harmonics[122](for example, in case of quartz stabilized oscillators, where the quartz has a frequency f_q and the oscillating circuit is adjusted on the frequency kf_q where $k=2, 3$...etc.). Therefore, in case of the total compensation of the energy loss occurred within a real periodical process with a basic frequency f_1, a finite energy "portion" ΔE_i must be provided to driven MS equal with the amount ΔE_e which is lost in a period, delivery which is also carried out with the frequency f_1 (in case of the total compensation).

If we are returning to the model of the hydrogen atom, as we have previously seen, if it is required that the interaction of the two EP to be constructive, the two space-temporal modulation frequency (due to the orbital motions of the two EP) must be either identical (such as the fundamental state, when the intensity of the re-circulated EF is maximum), or in proportion with the integer numbers (case of the meta-stable excited states, when the intensity of the interchange flux is reduced under the same integer ratio), but which are compulsorily phased.

X.24.2 Transitions between two energetic orbitals belonging to the same EP

The transition between two energetic orbitals (EO) of the same EP[123] is a state variation *process* of that particular EP which is placed on one of the structural orbitals (SO). We saw that an EP which lies on such a structural orbital, depending on the intensity of the external EF may have more energy levels which are associated with many EO. In case of the absence of the external fluxes (isolated system), the EP's energy which occupies a SO has the lowest level, being related to a fundamental EO. The condition which is required for the energy received by EP from the external EF is that the energy to be less than the EF which re-circulates between the couple's particles (bonding energy), otherwise, the driven EP shall be expelled from the system. The variation process of the state of an EP placed on SO, means a temporary desynchronisation process of a couple of EP placed on such orbitals, desynchronisation generated by the absorption of an external EF by one of the EP involved into the couple (usually, the external one). As long as the frequency rates of the space-temporal modulation of the EP participating to a couple are identical and synphasic, the electric fluxes (whose existential attribute is the electric charge) released by the two particles are entirely re-circulated between the two EP (there are no electric fluxes released outside the volume occupied by the two EP[124]). At the moment of receiving an EF from the outside, the receiver particle of that flux shall be desynchronized with its pair, and this desynchronization will last a while (at least as long as the disturbing flux is maintained).

The reaction of the EP ensemble at the incidence of an external EF is the same as the reaction of any MS: the incident flux shall be opposed to the reaction flux, until one of the fluxes (either the incident or the reaction one) would have been depleted its resources. If the energy provided by the external EF is higher than the EF re-circulated between the two EP (bonding energy), the couple shall be broken (the expulsion of the driven EP from system takes place), according to the law IV of MS formation (see section 7.8). If this energy is less-valued, EP which receives the flux shall be temporarily converted into an EO with a higher energy, excited orbital, (absorption-storage phase of the incident flux) until the incident EF would be finished, and then the reverse process of re-sending the energy surplus (EF

[122] It is clear that, in terms of quantity, the energy lost during k periods is higher than the energy lost in a single one, therefore, for maintaining the same oscillation level, the energy amount supplied for the harmonics compensation must be higher.

[123] The orbitals which are different, for example, by means of the harmonics rank where the synphase of the orbital frequency of the excited EP takes place.

[124] Fact which generates the external electric neutrality of this couple.

temporarily stored) shall come next, towards outside (reflection), with the returning on the fundamental EO.

If the energy state of a non-disturbed SO where the particle is placed is being noted with OE_1 (fundamental orbital), and with OE_k the orbital where it will be placed as a result of the absorption of the external EF (excited orbital), there will be two types of state *transitions* of the disturbed (driven) EP by the external flux, transitions which are symbolically represented by the transition operator $[\Rightarrow]$ in the following relations:

$$T_{Ak} = (OE_1 \Rightarrow OE_k) \tag{X.24.2.1}$$

and:

$$T_{Ek} = (OE_k \Rightarrow OE_1) \tag{X.24.2.2}$$

The first is the *absorption transition* (of receiving and storing of the external EF), and the second, *the emission* (reflection) *transition*. Between the energy variations implied by above mentioned transitions the following relation may be applied:

$$\Delta E(T_{Ak}) \cong -\Delta E(T_{Ek}) \tag{X.24.2.3}$$

where the *approximately equal* mark is noticed instead of the equality mark, because the reflected flux is always less than the incident one, but this thing is usually insignificant because there are quite little differences.

X.24.3 Atomic photon

Definition X.24.3.1: EF which is released during an emission transition by a couple of bonded EP with opposite charges, placed on a pair of structural atomic orbitals is named **atomic photon**.

Comment X.24.3.1: According to the objectual philosophy, the notion of *photon* has a totally different meaning than the one presented into the school textbooks, referring to only at electromagnetic energy fluxes with a constant effective section, emitted in conditions specified by definition X.24.3.1, fluxes which have a different model as compared with variable section electromagnetic fluxes (the usual electromagnetic waves produced by macroscopic radiators), although both of them are made-up from the same elements, but which are structured differently, in terms of space. As it can be found by looking at the definition X.24.3.1, the atomic photon is produced by a radiator made-up from a couple of bonded EP, placed at intra-atomic distances one another, couple which may consist either in a nuclear peripheral proton and the related electron on the peripheral electronic layers, or in a neutronic proton and its external electron. In the first case, we are dealing with the atomic photons and in the second one, with the neutronic photons. There is no structural (model) difference between the two photon classes, but there is a quantitative one, the energy domain of the atomic photons ranging within infrared and X-ray radiation, while the neutronic photons have energy values mainly within the γ radiation domain.

The underlining from the definition X.24.3.1 has the role to draw attention on the fact that the photon can be generated by a couple[125] of EP which are placed at intra-atomic distances one another (namely, under a specific threshold), and if that distance is exceeded, the radiated flux is not photonic any more, but a flux with a variable effective section, that is a regular electromagnetic wave.

According to the classification from the chapter 7 regarding the components of the fluxes decomposed by RBS belonging to a MS, the photon which is released by a couple of EP bound in a system is part of the class of reflected fluxes (refluxes), because it is released only as a result of receiving (incidence) of an external flux (however, with a temporary storage phase in the medium under the incidence - the unstable or metastable state), and an external incident photon on the EP couple belongs to the influx classes.

[125] In this section we are not talking about the case of the photons produced by the same type of EP, placed into a particle accelerator (for example, the synchrotronic radiation) which have another generation process, but keep the same specific attribute as the photons class - that is the constant effective section.

For the time being, we are only interested in this reflux (the released atomic photon) due to reasons which will become clear later on. This type of energy flux (electromagnetic type) has some special characteristics which are experimentally confirmed:

1. A photon which is released into a transition T_{Ek} (k is the running number of the excited EO as compared to the fundamental orbital from the relation X.24.2.1) by an atom AT_X, it will produce as a result of the impact with another atom AT_Y placed on the photon's direction, an absorption transition T_{Ak} followed by a transition T_{Ek}. Therefore, the energy contained into the photon released from the atom AT_X is preserved all the way, being entirely transmitted to the atom AT_Y, more exactly, to an EP from an external orbital which is able to receive the photon's energy. Because the distance between the atoms AT_X and AT_Y may reach millions of light-years, this means that **the photon is a flux of constant effective section** (as any corpuscular flux). The effective section of this flux σ_{efe} is equal with (or less than) the cross section of the volume in which the orbital of the receiving particle is included (because this is the only way which allows the total transfer of the photon's energy to this EP). We may also add that there is a theoretical cylindrical surface, with a cross section σ_{efe} and length $\tau_f c$ (where τ_f is the duration of the photon's emission and c is the propagation speed) which will contain inside all the electromagnetic energy stored into the photon, during its entire existence. Based on the above-mentioned facts, the size grade of σ_{efe} is equal at most (if no less), with the size grade of the cross section of the receiving atom (for the atomic photons) or with the one of the neutron's cross section (as regards the neutronic photons).

2. According to the general MS model, any type of motion (flux) deployed inside such a system must be maintained by means of a constant supply (constructively achieved) with an appropriate EF. The orbital and spin motion of EP are also this kind of motions, and the flux which is meant to maintain them must therefore contain, besides the common component of translation T, which is specific to all the fluxes, a rotation component R, as well. The flux (photon) which is released by an EP placed on an orbital (so, with a revolution motion) shall inherently contain a component R.

Comment X.24.3.2: By considering the generic MS model and taking into account the fact that this kind of system can be maintained only as a result of constructive interactions which imply synchronism, it is clear for the reader why the objectual philosophy cannot sustain the purely probabilistic hypothesis (dictated by the so-called "probability waves") of the EP motions on the occupied orbitals within the structure of an atom. Obviously, any deterministic motion (as we have seen in the chapter focused on fluxes) has also a non-determination degree (otherwise, it would not be realizable), but there is clearly a deterministic (invariant) component which gives stability to the atomic structure and to all the objects which they are able to make-up.

Consequently, the photon flux is a T+R flux; the component T is the translation one with the propagation speed, and the component R is the result of the vectorial composition of all the rotation and revolution motions of the releasing EP.

Comment X.24.3.3: The energy fluxes T+R (the photon fluxes also belong to this class) are not like they would seem to be some "exotic fluxes" which are specific only to the photons, but they are much more spread in the world. The first example of this kind of fluxes, which are very common in the material processing field are the splintering tools with rotation motion (borers, drills, so on) where the component T of the flux represents the axial advance motion of the tool, and the component R, its rotation (splintering) motion. Another very common example is the helicopters and propeller aircrafts, where the flux R of the propellers produces the flux T+R of the air, that is a flux which generates both the sustentation (in case of the helicopters) and the running of this kind of aircrafts. At last, if we are thinking well, most of the fluxes used for the propulsion of the objects through NM and which operate based on propellers or turbines, belong to T+R type. All the bullets shot by rifles are also T+R fluxes, the rotation motion generated by the rifled barrel having the role to provide a gyroscopic stabilization of the position of the bullet's axis along its pathway. Besides these examples from the "tangible" world, we have seen in chapters 6 and 7 that the atomic or molecular fluxes from the G media are T+R fluxes as well.

Since the photon is an open flux (on the propagation direction), it cannot be localized unless its propagation is deployed across a confined pathway, and in such case, the localization is possible within a volume which includes the pathway, as we have seen in the chapter about fluxes. Based on the above-mentioned issues and of the ones described in the chapter focused on fluxes, it is clear that a propagation flux can have a constant effective section only if there is a way to close it on the directions which are different from the propagation-displacement one, closure which can be related to the rotation component of the photon (the rotation, as a confinement method, was indicated in the chapter focused on fluxes).

Therefore, the photon has a finite energy content (given by the Plank's relation $\Delta E = h\nu$), which is limited, as we have mentioned at the point **1**, by a cylindrical theoretical surface which contains inside it all this energy amount.

Comment X.24.3.4: This is a quantic aspect which is accepted by the systemic philosophy, which means that the energy of a specific photon is finite and always the same if its frequency is always the same, but the interpretation of Plank's constant is much more different as compared to the current physics, across this paper, *h* being considered as a spectral energetic density and not an action quantum (it could not be otherwise if you have read the action's definition presented in chapter 7). The spectral energetic density has obviously the same dimensions (J·s=J/Hz). A spectrum is an abstract object consisting in an energetic distribution with a frequency support domain. Would you not consider more appropriate a combination between a frequency and a spectral density rather than a combination between a frequency and an action? We must take into account that at the moment when the Planck distribution of the thermal photon was conceived, there was no knowledge in the field of the spectral analysis as compared to the current one, but, in exchange, the mechanical thinking (with its concept of action) was prevalent.

X.24.4 The photonic perturbation of the bound EP states

In a previous section we have mentioned that the reaction of the electrons' ensemble bound in an atomic MS (electrons which make-up its peripheral medium), at the incidence of an external energy flux is the same for any type of MS: the incident flux shall be opposed to the reaction flux, until one of the fluxes (either the incident or the reaction one) would have been depleted its resources. If the energy provided by an external EF is higher than the EF re-circulated between the two EP, the couple shall split (the expulsion of the EP from the system shall be produced). If this energy is less, EP which receive the flux shall be temporarily transferred on a EO with a higher energy (absorption-storage stage of the incident EF), until the exhaustion of the EF, and then, the reverse process of resending the energy surplus (temporarily stored EF) to the outside (reflection) shall come next, also as a photon generated by the emission transition of the driven electron.

At this moment, the reader is invited to be very attentive because we shall talk about a process - that is the reflection of a photon on an atom (or on any other atom set which makes-up the surface of an object) - from a different perspective than the one specific to the current physics textbooks. Based on the above-mentioned facts, it may result that at the incidence of a photon on an atom (more exactly, on an electron placed on a peripheral orbital), which means that the photon is an incident EF, the first stage of absorption/storage of this EF shall exist, storage into the energy of the driven electron which passes on an excited orbital.

Attention! The photon's energy was entirely transferred to the electron placed on the excited orbital, otherwise speaking, starting with this moment, the incident photon does no longer exist, but its energy does, even if this energy is under another form (without the component T). The process which is equivalent with the transformation of the coherent incident flux into a stochastic or periodical flux, without the component T of the initial photon[126], took place. After the storage interval (which is shorter in case of the instable excited orbital, or non-determined in terms of time in case of a metastable orbital), the emission transition takes place, that is a process in which the couple *excited electron_proton*

[126] In case of the excited electron, the flux stored without the component T is also a coherent but rotational flux (periodical), that is the electron's orbital motion deployed on the excited orbital.

partner shall generate to the outside a photon with the energy equal with the temporarily stored one. But, once again, pay attention, the generated photon (equivalent with the reflected EF) is not the same with the incident photon but it is generated into the electronic medium of the atom which was previously driven by the former incident photon.

This fact explains in a natural and coherent manner why a photonic flux reflected by the surface of a body carries with oneself some data about the chemical composition of the body; this is natural, because the reflected photons are generated by the atoms of that particular body, while the incident photons are produced into the source of the incident photonic flux.

X.24.5 Mechanical perturbation of the bound EP states

So far, we have discussed about the perturbation occurred on the state of a bound EP, generated by a photonic flux. Let us imagine that a complete atom which has all its model elements, which means that it is not even partly dissociated (ionized) is neuter in terms of electricity, that is, its outer electric field is null (practically ranging from few Van der Waals radii to infinity). This mean that from electrical p.o.v., two neuter atoms do not interact at all if they are placed at a certain distance over that limit, and if we let aside the gravitational interaction, the two atoms may be considered as isolated. Since they are isolated, by assuming that they have an initial kinetic energy and with all the freedom degrees, it must exist a barrier which has to turn them away when they reach it (a RBS), having the role to keep them in a specific volume, and this is the way how the two atoms will make-up a G system. Besides the interaction with the maintenance barrier (which will be momentarily let aside), there is a probability different from zero that the two atoms to intersect their pathways, which means to collide one another. Well, this collision is the moment we were waiting for!

With all the apologies for the boring and finical approach, we have to minutely analyze this collision process of two neuter atoms, and you will see that the outcome of this review worths all the efforts. Due to simplicity reasons, we may assume that the two atoms are identical and belong to an inert gas (namely, they do not make-up molecular systems as a result of collision), that the velocity before the collision is equal and with opposite directions, and that we are dealing with an axial collision. As we said before, until the moment when the neuter atoms reach to a distance of several Van der Waals radii (about 10^{-5} m), their interaction is insignificant, but once they are close to this distance, the electric field (residual) of the electrons from the composition of the external layers of both atoms starts to manifest. But, it is too late, the two atoms with their kinetic translation energy (as regards the collision, these are the only ones which matters) have been already intersecting their bounding surfaces made-up exclusively from the fluxes of the electrons belonging to the external layers. This inter-penetration of the two electronic media takes place until the initial kinetic coherent flux (impulse) of the atoms is totally converted into a stochastic flux (compression flux, without the component T) of the elements belonging to the two atoms, and this is the moment when the two atoms remain perplexed (#) and motionless, and then, the stochastic fluxes stored in the two atoms shall be turned into kinetic (coherent) fluxes, the two atoms moving along opposite directions as compared to the initial ones. But, my dear reader, the forced penetration of the two electronic media means a real disaster for the above-mentioned synchronism of EP placed on the fundamental orbitals, each electron which is involved in collision must absorb a part of the atomic kinetic flux. After the collision is completed, each of these disturbed electrons will release a photon in order to return to the fundamental state; and because the share of EF received by each of them is not the same, the released photons will have different frequency and emission directions. Therefore, in case of a collision between two atoms, even if it is “perfectly elastic”, as it is considered the collision between two atoms of inert gas, besides the kinetic fluxes involved in collision, there are also two “bouquets” of different photons (released by both atoms).

Well, according to the objectual philosophy, these photons make-up ***the class of thermal photons,*** that is a type of atomic photons produced rather by means of “mechanic” excitation than by means of photonic excitation, as a result of collision, vibration processes, generally, after a relative motion of an atom against its neighbours, with consequences on the state of the peripheral electronic medium of the atoms, or of the systems made-up from atoms, processes which lead to the mutual perturbation of the state of electrons which are located on the external layers of the atoms.

X.24.6 Thermal photons and thermal energy

Since the collision of only two atoms, as we have seen before, leads to the simultaneous emission of more photons, but which have different energy and directions[127], in case of a set of atoms which make-up a NM and in which the collision parameters and the specific energy rates may have a continuous distribution, it is very clear that the energy distribution (and of the frequency rates as well) of the thermal photons shall also be continuous, but uneven.

First, we have to clear up one thing, the thermal photons are not different from other photons[128] in terms of model, but they are differentiated only by the way how they are produced, and as a result of this generation method, by means of the frequency distribution type which they have it when they make-up a photonic medium - *Plank’s distribution*. Otherwise, one of the attributes which are specific to the photons class - that is the effective constant section - is also applicable for the thermal photons. In the previous section, we have seen that this effective section is at most equal (possibly, much more less) with the cross section of the volume where the radiator is placed (for the atomic thermal photons, the radiator is a couple *{p,e}*, where the proton is part of the nucleus and the electron belongs to the peripheral electronic medium). Since this effective section is so small, this means that a photon released from an atom may be propagated through the interstitial space, between the atoms of a NM, until the moment of its absorption and the re-emission of another photon by a peripheral electron which is on the way. Because there are reasons which make us to believe that the photons have a weak interaction[129], this means that the amount of the thermal photons which can be simultaneously found in the interstitial space of an atomic or molecular medium make-up a G[130] medium. Well, the energy exclusively contained (distributed) in this photonic medium is considered to be *thermal energy*, according to the objectual philosophy.

Definition X.24.6.1: The energy distributed on the G medium of the thermal photons which exists in the interstitial space of an atomic or molecular medium is named **thermal energy** (synonym - **heat**) contained in that particular medium.

Comment X.24.6.1: Definition X.24.6.1 means a clear dissociation as compared with the heat definition presented in the current physics textbooks, dissociation imposed by the objectual analysis of the two energy forms: *baric*[131] and *thermal*. Whereas according to the classic approach (presented in textbooks), the thermal energy of a medium means the kinetic energy of the atoms or molecules, but divided on the degrees of freedom, according to the objectual approach, the two forms of energy are clearly separated, since they are distributions of the same attribute - energy - but with totally different

[127] Energy values and directions which correspond to all the electrons (and SO where they are located) disturbed from the fundamental state by the external kinetic flux.

[128] Such as, for example, the monochromatic ones, produced in a laser.

[129] Because of the lateral confinement, which is able to limit the flux on the normal direction across the pathway;

[130] Alongside all the attributes specific to this kind of medium, such as the mean free path, forced maintenance, high compressibility, so forth.

[131] The term of *baric energy* is being introduced for the kinetic energy T distributed on the set of the atoms or molecules of a medium, the global specific attribute of this energy being the *pressure*.

carrier MS. The kinetic energy of the atoms (baric) has as carriers the set of atoms' kinetic fluxes and the pressure, as scalarized global attribute, while thermal energy has the interstitial thermal photons as carriers, and its global attribute is the temperature. It is clear that this approach on the thermal energy could not be conceived without a close connection with the isotomic character of the photonic EF, by establishing a maximum value for their effective section (which allows their propagation in the interstitial space between the atoms), by also considering that the interactions between the atomic EP must be synchronic, resulting therefore, the possibility of photons release by means of a simple collision between atoms, so on.

The definition X.24.6.1 is mainly consistent as regards the heat conveyance processes (thermal fluxes), real processes, which were experimentally divided in three categories[132]: *radiation, conduction* and *convection*. Let us make a short analysis of these heat conveyance processes, by taking into account the flux categories presented in chapter 5.

1) *Radiation* is a heat conveyance process whose support - the flux elements - are acknowledged even by the current physics to be thermal photons, which means that there is no atom or molecules flux across the flux pathway. Well, my dear reader, we have seen that a flux means the transfer of an amount, but that amount which is about to be submitted must also have a material support (the objects which own the property). If the support of the thermal energy would be also the atoms (with their energy divided into degrees of freedom), how is it possible to convey the heat without the support atoms? This flagrant contradiction which was let aside and not analyzed by textbooks was also the starting point of redefining the thermal energy.

2) *Conduction* is a heat conveyance process which is similar to the propagation, also characterized by the non-existence of coherent atoms or molecules fluxes on the direction of the thermal flux. In this case, we may argue that the translation/vibration motions of the elements from the atomic medium (symbolized by the so-called "phonons") are transmissible, similarly to the acoustic waves, which is very true, but the perturbations of these motions are transmitted with the sound propagation speed through that medium, whereas the heat conveyance is made at much slower rates. If we are taking into account the above-mentioned issues, the reason for this low transmittance rate becomes obvious: the medium of the thermal photons is forced to diffuse through the interstitial space between atoms, which means that it is subject to many absorptions and re-emissions[133], with numerous direction changes and unavoidable energy losses. Moreover, it is a well-known fact that the diffusion is much more slower than the propagation.

3) *Convection* as an ultimate type of thermal flux is different from the other two types because there is a coherent atomic (molecular) flux which is guided in a certain direction, flux which carries the heat much more efficient and faster than the conduction. According to this paper, this flux type is nothing but the motion of the whole medium, together with the medium of the interstitial photons, and in this way, the coherent displacement component being added to the diffusion speed, the thermal photons medium having the same common (coherent) component on the flowing direction.

So far, we have seen that the thermal photons are able to reach to a specific zone of an atomic or molecular medium, either due to the local production (by means of the mechanical interactions deployed between NM elements placed in that zone), or through the thermal fluxes which already reached that area, fluxes released from another source (through the three above-mentioned flux types).

[132] There is also another category of thermal process - that is the phase transition - which momentarily is let aside because it is much more complicated and irrelevant for the purpose of this section.

[133] In the previous sections, we have seen that each storage phase of an absorbed photon has a finite duration which depends on the type of the excited orbital. If we are taking into account the fact that all these durations are added to the propagation process of the photonic flux deployed through the interstitial spaces of the atomic medium, it seems to be very clear why the diffusion of this flux is so slow.

Definition X.24.6.2: The thermal energy which is associated to the medium of the thermal photons exclusively generated by means of direct (kinetic) interaction between the atoms or molecules of a medium is named **thermal contribution** of that particular medium.

The text underlined in the definition X.24.6.2 have the role to highlight the fact that the thermal photons which are found at a given moment into a specific medium may be generated either from the outside (in this case, they are produced in other part, the medium had a zero contribution to their generation), or from inside the medium by means of the repeated interactions deployed between the elements, and in such case, their energy is the thermal contribution of the medium. For example, the heating of a gas by means of compression, without an external heat input and without losses (adiabatic compression), occurs only as a result of the thermal contribution of that medium. Obviously, the process could not be possible without an external EF which produces the compression (piston motion), but this external flux is kinetic, non thermal (the heat transfer between the kinetic flux - that is the moving piston - and the compressed medium may be neglected because the piston may be considered in a thermal equilibrium with the medium before the compression).

There is a major difference between the thermal energy due to the thermal contribution of the medium and the one which is due to some external fluxes of thermal photons (external heat sources), difference which is not related to the carrier medium or to the generating process but it is focused on the transfer rate of this energy into the space occupied by that medium. If the external thermal flux is transmitted to the medium's elements through diffusion (in case of thermal conduction), that is a very slow process, the thermal flux which is generated through thermal contribution (due to the pressure variations) is transmitted with a velocity having a size grade similar with the propagation rate of the pressure variation (sound speed) in that medium. Otherwise speaking, the temperature variations caused by the pressure variations are much more faster than the temperature variations caused by the thermal conduction.

Comment X.24.6.2: The concept of *thermal contribution* of a NM, introduced by the objectual philosophy is very useful for a coherent (logical) understanding of some processes deployed into the real world, processes which are explained by the current science community in a way which is not agreed by the present paper. It all starts from the net delimitation introduced by the objectual philosophy between the *thermal energy*, which has as carriers (support material objects) exclusively the thermal photons, and the *baric energy,* with carriers such as EP, NE, NC, AT, MO etc. which are MS with a rest mass ("heavy ones"). Both energy "forms" are distributed on some stochastic material fluxes which are inter-penetrated (they claim the same spatial domain) and which, due to this reason, undergo a close interaction process. Since there are two distinct media, there are also two different parameters which characterize the energy status of the two media: the *temperature*, specific to the photonic medium and the *pressure*, specific to the baric medium. For a certain type of NM, made-up from the same type of atoms, under equilibrium conditions, in which the EF re-circulated between the atomic and photonic medium are equal (and in counter direction) and there is no energy exchange deployed with the exterior, at a certain value of the pressure parameter will correspond a specific value of the temperature parameter. The existence of the interaction process between the photonic and baric media also creates an interdependence between temperature and pressure (such as, for instance, the ideal gas law for the atomic G media which shall be described later on). As a result of the interdependence between the temperature and the pressure of a medium, an adiabatic pressure variation leads to a variation with the same temperature trend, that is a variation which is much more faster than the temperature variations obtained as a result of a heat transfer (an external output of thermal photons). This temperature leap which reflects a leap of the thermal energy contained into the photonic medium is generated even by means of a thermal contribution of the baric medium, namely, the generation of thermal photons as a result of the mechanical excitation of the peripheral EP. The interdependence process between pressure and temperature is evident for both directions of the pressure variations. The instantaneous melting of the meteorites at the impact with the solid surface of a planet, auto-ignition of the fuel mixture through the rapid compression into the Diesel engines, the metals welding as a result of the shock wave produced by an explosion, are just few of the examples which prove the rapid temperature increase (without external thermal input) caused by a rapid pressure increase. A special case belonging to this category is represented by the huge temperature increase as a result of the cavitation (the implosion of a cavity which is temporarily made-up into the L_A-type media), an increase which may reach to 10^4 K and generates the so-called sonoluminiscence or, in some cases even a temperature level of 10^6 K, at which even the nuclear dissociation processes are triggered[68]. If a coherent fluid flux (a stream) is deliberately generated into a thermally balanced G or L medium, the static pressure (thermal contribution generator) into the moving area shall be more reduced and consequently, the temperature in this area shall be reduced. We may find this process by ourselves if we blow strongly on one of our hands; we shall instantly feel a sensation of coldness in the area which is under the incidence of the air flux. For explaining this fact, your teachers who taught you when you were children gave you a funny explanation: the temperature drop is due to the vaporization of water which is on the surface of the skin. But, my dear reader, try to make the same experiment by covering your hand with a thin dry plastic bag and in this way, the water vaporization is out of the question. You will observe the same temperature drop into the area of the air flux, and this decrease is proportional with the flux intensity.

At the end of this section, let us summarize the hypotheses which have led to the model adopted by the objectual philosophy for the thermal energy:

1) The photon model as EF with an invariant effective section, equal or less than the cross section of the volume in which the generating EP orbital is located.

2) The generation of some photons by the atomic peripheral electrons by means of emission transitions (of returning to the fundamental state) which follow after some absorption transitions by means of mechanical excitation, which means that the absorption transition takes place as a result of the incidence on the peripheral electronic shell of some kinetic fluxes belonging to the proximity atoms (or to the conduction electrons), (T, R or T+R fluxes). Since the incidence parameters may have any value, the generated photons shall have a continuous but unevenly distributed energy (therefore, the frequency). These are thermal photons, with a specific frequency energy distribution - that is Plank's distribution.

3) As a result of the fact that the photon's effective cross section (including the thermal photons one) is so small, it is likely that these photons to be propagated through the interstitial space between the atoms of a medium (even if this space is reduced, such as the case of S or L-type of media). Therefore, the space of existence and propagation of the thermal photons is the interstitial space of the atomic (or molecular) medium, the set of the thermal photons which can be found in this space at a given moment being the set of the support (carrier) elements of the thermal energy from that particular atomic medium.

X.24.7 The equilibrium between the thermal and baric flux

The medium of the thermal photons and the atomic or molecular medium are two media which occupy the same volume (the same spatial resource), and due to the distributed motions of the constitutive elements, they make-up two categories of stochastic fluxes - the stochastic caloric and the stochastic baric[135] flux. Each of these two media has its own global attribute which is specific to the stochastic flux: the photonic one has the *temperature*, and the baric (atomic) medium has the *pressure*.

These two stochastic fluxes continuously interact one another (through the direct interactions of the elements between the two fluxes), by supplying energy one to another, the relative motion of the atoms generating thermal photons, and due to their extremely large number (much larger than the number of atoms from the atomic medium), the thermal photons are able to generate the atoms motion. The equilibrium between the two flux categories is illustrated in the more simple case of an atomic G medium, with the general equation of the ideal gases:

$$pV = nRT = nN_A kT \qquad \text{(X.24.7.1)}$$

where p is the pressure of an ideal gas contained into a precinct with a volume V, n is the number of moles, R the ideal gas constant, N_A Avogadro's number, k Boltzmann's constant and T the temperature inside the precinct. The relation X.24.7.1 shows the equality (under thermal isolation conditions, after an initial energy input and a temporal interval for setting

[68] R.P. Taleyarkhan et al. - *Evidence for Nuclear Emissions During Acoustic Cavitation*, Science 295 (2002)

[135] We discuss the case of an atomic or molecular medium which is under a rest state.

the balance) between the baric energy (whose support material is the set of the atoms making-up the ideal gas) and the thermal energy (whose material support is represented by the set of the interstitial thermal photons). The energy which is contained inside the system and which is auto-distributed to the elements of the two media, was initially brought by means of an external heat input (influx) or through compression, and then, it was maintained through the thermal contribution of the atomic medium. The two energy forms are contained in the two types of stochastic fluxes, the atomic and photonic one.

X.24.8 The internal energy distributions of NM

The set of the thermal photons interacts only with the atomic electrons (they are continuously produced and absorbed by these electrons), and this interaction lasts as long as there is heat inside that NM. There is a common component between these two media which are characterized by a permanent interaction - the atomic and photonic media - namely, the fact that the energy is continuously distributed on the medium's elements, but, because the energy carriers are much different, we shall be dealing with other distribution types of the energy stockpile across the elements of that particular medium. As for the energy distributed on the elements of the photonic interstitial medium, we shall have Plank's distribution, and for the energy distributed on the elements of the atomic or molecular medium we shall have Maxwell distribution.

X.24.8.1 Plank Distribution

According to the specialized treatises[136], the power released on the area unit, by a black body[137], which have the temperature T, within an elementary interval of wavelengths $[\lambda, \lambda + d\lambda)$ is:

$$dP(\lambda, T) = \rho(\lambda, T) d\lambda \tag{X.24.8.1.1}$$

where $\rho(\lambda, T)$ is given by the following relation:

$$\rho(\lambda, T) = \frac{8\pi hc}{\lambda^5} \cdot \frac{1}{e^{\frac{hc}{\lambda kT}} - 1} \tag{X.24.8.1.2}$$

h is the Plank's constant, *k* is the Boltzmann's constant, and *c*, the light speed. The relation X.24.8.1.2 is the well-known *Plank distribution* of the thermal photons released by a black body which have the temperature *T*, the support of this distribution being the infinite interval of the photonic wave lengths.

The above-mentioned relations, converted for the frequency domain may become:

$$dP(\nu, T) = \rho(\nu, T) d\nu \tag{X.24.8.1.3}$$

and the frequency (spectral) density of the released power is:

$$\rho(\nu, T) = \frac{8\pi h\nu^3}{c^3} \cdot \frac{1}{e^{\frac{h\nu}{kT}} - 1} \tag{X.24.8.1.4}$$

It is worth reminding that in terms of the abstract object type, the Plank distribution, with its frequency attribute support (or wave length) represents a *spectrum*. The graphical plotting of this spectrum, in which both the support frequency attribute and the distributed attribute are

[136] **P. W. Atkins** – *Tratat de chimie fizică*, Editura Tehnică, 1996, **B. H. Bransden, C.J. Joachain** – *Fizica atomului şi a moleculei*, Editura Tehnică, 1998

[137] By using the specific terms of this paper, the notion of *black body* is translated as a hypothetical material system whose bounding surface shows an unitary permeability to the photon fluxes. However, we have seen that by definition, the material systems own a RBS and they always have a sub-unitary permeability in relation to the real fluxes. This means that this black body is an abstract object, that is only a theoretical model.

substituted (represented) by the spatial position attribute, becomes however a *2D form* of the spectrum.

We may recognize the term $h\nu$ used in the relation X.24.8.1.4 as the energy contained in a photon with the frequency ν, and the term *kT* (from the ideal gas equation) also means energy, the thermal energy mentioned into the equation X.24.7.1. For the time being, we know that this energy *kT* has an invariant value if the temperature of the black body is invariant, and according to this value, the form of Plank distribution is invariant as well. As a result of these explanations, we may notice that the exponent of *e* from the above mentioned relation is a dimensionless amount (a number, the ratio of two energy types) which is noted with *x* and which has a variation domain also by $[0,\infty)$. Once with this variable change, the relation X.24.8.1.4 becomes:

$$\rho(x,T)=\frac{8\pi k^4T^4}{h^3c^3}\cdot\frac{x^3}{e^x-1}=C\cdot T^4\cdot f(x) \qquad \text{(X.24.8.1.5)}$$

where $f(x)=\frac{x^3}{e^x-1}$ is an unique relation for all the Plank distributions. According to this paper, the relation X.24.8.1.5 is named *normalized Plank distribution*. The function *f(x)* which is integrated on its support domain $[0,\infty)$ has a finite value, equal to $\frac{\pi^4}{15}$. This means that the total power which is radiated on the area unit by a black body at the temperature T is:

$$P(T)=\frac{8\pi^5k^4}{15h^3c^3}\cdot T^4 \qquad \text{(X.24.8.1.6)}$$

power which means the intensity of the radiated thermal energy flux, that is an energy contained in the thermal photons released by that particular body. The relation X.24.8.1.6 written as:

$$P(T)=e\sigma T^4 \qquad \text{(X.24.8.1.7)}$$

where *e* is a coefficient called emissivity[138] $(e\le 1)$ of the body surface (that is equal to one as regards the black body), and $\sigma=\frac{8\pi^5k^4}{15h^3c^3}$ a constant named the Stefan's constant, becomes Stefan-Boltzmann relation. In this relation, the reader may note that, in terms specific to the objectual philosophy, this emissivity coefficient *e* is nothing else but the RBS permeability of the radiating body to the inner influx of thermal photons.

But, let us return to the function *f(x)* whose illustration is given in the figure X.24.8.1.1, where we may also find the graphical plotting of the derivative *f'(x)*, for making much visible the position of the peak value of this function.

As it may be observed from the figure, the crossing through zero of the derivative (which is related to the peak value *f(x)*) occurs for a value x_R which is the solution of the equation resulted from the null of the derivative *f'(x)* :

$$xe^x-3e^x+3=0 \qquad \text{(X.24.8.1.8)}$$

By means of numerical methods, as regards the non-trivial solution (the trivial one is *x=0*) we have a value $x_R\cong 2.82144$. Therefore, the normalized Plank distribution has a peak value which corresponds to this unique value for any distribution of this kind. As we have seen in the chapters focused on distributions and objects, this distribution is also an abstract object which must be differentiated from other abstract objects from the same class, which has an internal reference, reference which represents the object within its external relations. Since

[138] This *e* must not be mistaken with the basis of the natural logarithms *e* from *f(x)*.

the position of the maximum value specific to all the normalized Plank distributions is always the same, according to the value:

$$x_R = \frac{h\,\nu_R}{k\,T}, \qquad (X.24.8.1.8)$$

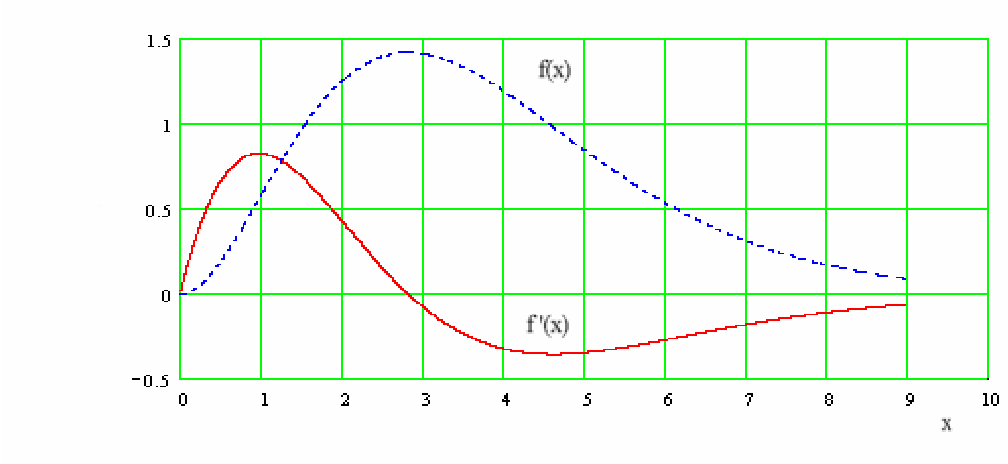

Fig. X.24.8.1.1

resulting that the only attribute type which makes the difference between two Plank distribution is the value of this maximum (density's amplitude) which corresponds to the support value x_R (according to the specific terms of this paper, it is the value of the attribute distributed on the singular value x_R). However, we saw that a value which is invariant for a class of objects, against which the objects attributes may be determined, represents itself a reference. Therefore, x_R is an internal reference, also because its value is not imposed by an IPS, but it is auto-settled as a result of the interactions between the elements of the atomic medium and the ones of the medium of the interstitial thermal photons, which means that x_R is a *natural reference*.

X.24.8.2 Maxwell distribution

As regards the atomic medium (for simplicity, we take the case of an inert gas which does not produce molecules), the state attribute of the energy which is attributed to an element (by considering equal masses for all the atoms) is the velocity, and since we are talking about energy, only the modulus of this velocity is relevant. Because we are discussing about the modulus of the atoms velocity, in case of a medium which reaches a certain temperature, we know that there is a distribution of this modulus on the total atoms' set, that is *Maxwell distribution*.

Comment X.24.8.2.1: If we are taking into account the definition of the abstract object called *distribution*, which was mentioned in chapter 2 of the present paper, by also identifying according to this definition, which is the support attribute and which is the distributed attribute, as regards the Maxwell distribution, we shall find that the velocity is the support attribute (independent variable) and the distributed attribute (dependent) is the number of atoms (atomic population) which have the velocity rate ranged within the elementary support interval. Therefore, we cannot talk about the distribution of the atoms velocity (because not the velocity is the distributed attribute), but about the distribution of the number of atoms across the support domain of their *velocity modulus*. If we actually consider that the distribution depending on velocity is a representation of the atoms impulse distribution, we may say that the Maxwell distribution is in fact a precursor of the energy distribution of the atoms from a medium, in this case, the kinetic energy is the distribution's support attribute. Also, the support attribute (velocity) in case of Maxwell distribution has the positive line of the axis of real numbers as its range of values, which is therefore a continuous set, whereas the distributed attribute (the finite set of the medium's atoms) has a positive segment of the set of integers (natural numbers) as its values which is therefore a discrete set. However, because the atoms numbers involved into the distribution are very high, they can be written only by using the scientific notation (with decimal mantissa and exponent), the domain of the distributed values seems to be continuous.

The density of this distribution on an elementary support domain with a dv size and with the internal reference reaching the value v (density which means the number $n(v)$ of atoms which have its velocity included within the associated support domain) is (according to the textbooks of statistic physics[139]):

$$n(v) = 4\pi C e^{-\frac{1}{2}\beta m v^2} v^2 \qquad \text{(X.24.8.2.1)}$$

where:

$$\beta = \frac{1}{k\,T} \qquad \text{(X.24.8.2.2)}$$

and:

$$C = N\left(\frac{\beta\, m}{2\,\pi}\right)^{3/2} \qquad \text{(X.24.8.2.3)}$$

N is the total number of atoms inside the medium, m is the atoms mass, T the medium's temperature and k Boltzmann's constant. If we are making (similarly to the case of Plank distribution) a variable change in the relation X.24.8.2.1:

$$x = \frac{m\,v^2}{2kT} = \frac{E_C}{E_T} \qquad \text{(X.24.8.2.4)}$$

where x is also a scalar quantity (ratio of the two energies per element, the kinetic and thermal one), we shall get a *normalized Maxwell distribution*:

$$n(x) = \frac{2N}{\sqrt{\pi}}\sqrt{x}\,e^{-x} = \frac{2N}{\sqrt{\pi}} f(x) \qquad \text{(X.24.8.2.5)}$$

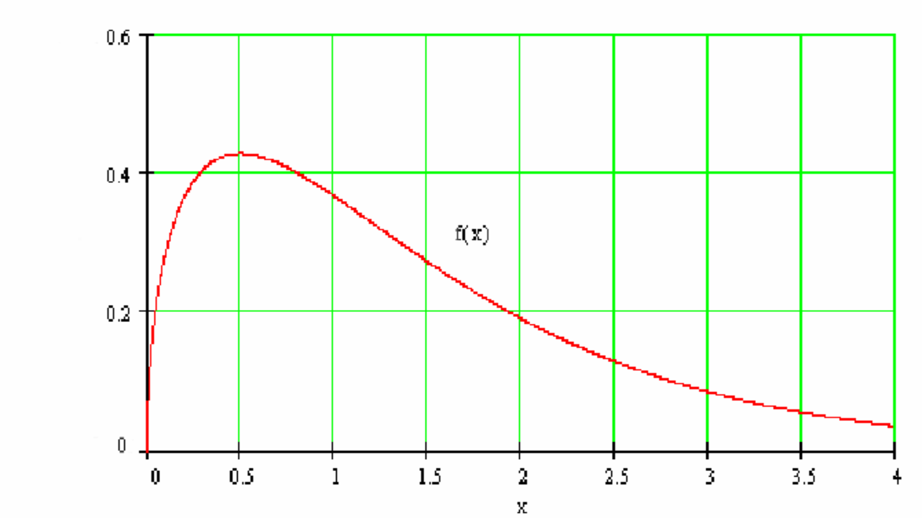

Fig. X.24.8.2.1

where $f(x) = \sqrt{x}\,e^{-x}$ is displayed in the figure X.24.8.2.1, with a maximum peak at the value $x_R = 0.5$ (the internal reference of the normalized distribution), namely, when the kinetic free translation energy per element of atomic G medium (which corresponds to the distribution's density of this energy on the atoms set) is half from the energy kT, contained into the photonic medium which is under an equilibrium state. This fact shows us that, in order to exist an

[139] 69 **F. Reif** - *Cursul de fizică Berkeley vol. V - Fizică statistică*, Editura Didactică şi Pedagogică - Bucureşti, 1983

equilibrium between the thermal energy density (which has both the component T[140] and R), and the density of the kinetic energy deployed by atoms, the rest of the thermal energy (the component R of the photons) must be in equilibrium with the component R of the atoms' kinetic energy (free energy as well).

Comment X.24.8.2.2: According to the classification of the media in the three fundamental classes S, L and G, now we know that a free translation energy is specific only to the elements of G media, so that the thermal energy from the inner photonic medium shall be distributed to the two possible types of kinetic energy (T and R). In case of the L media, the free translation is not allowed any longer, so that the thermal energy must be in equilibrium only with the kinetic energy (quasi-free) R of the atoms and with the forced vibration energy T. In case of S media, where neither the free motion R is allowed, the thermal energy shall be in equilibrium only with the forced vibration energy (both T and R). The above mentioned assertions are valid for atomic media; for the molecular media, the intramolecular vibrations must be added, each one with specific energy T and R.

As we have seen in the previous sections, the density of the thermal energy (density of the photonic stochastic EF) in a specific medium does not depend on the medium type, but only on its temperature, the thermal energy being exclusively contained into the interstitial medium of the thermal photons. The condition required so that this flux density to be in equilibrium with the density of the kinetic fluxes per element of the atomic or molecular medium, makes however that this equilibrium to be reached in different conditions, at the same amount of thermal energy input, the kinetic parameters of the medium's elements and the equilibrium temperature depending on the medium type. Otherwise speaking, in a medium (for instance, an atomic one) which is theoretically placed at absolute zero temperature (which means that there are no thermal photons inside it), if we are injecting a quantity of thermal energy (an external thermal photon flux), and in case that the heat losses of the medium are insignificant, this thermal energy shall be distributed due to repeated interactions between the photonic and atomic medium. As a result of this auto-distribution, when the equilibrium state between the photonic stochastic flux and the atomic stochastic flux will be reached, we shall be dealing (depending on the medium type S, L or G) with more energy categories:

- Thermal energy (evidenced by temperature);
- Free T energy (evidenced by pressure and which can be found only into the G media);
- Free R energy (existing only to the G and L media);
- Vibration energy (T and/or R depending on the medium type G, L or S).

Obviously, the sum of all these energy components shall be equal to the thermal energy amount which was initially introduced and which is supposed to be preserved within the medium.

Comment X.24.8.2.3: The above-mentioned discussion on the thermal energy distribution into other energy forms does not depend on the type of atoms which make-up the atomic medium, but a significant remark must be done. Depending on the heat amount which is inserted into the atomic medium, as a result of its distribution into all the possible above-mentioned energy forms, the atom type which creates the medium is very important as regards the medium class (S, L, G) which would result at the moment when the thermal equilibrium is reached. This dependence is due to the uneven spatial distribution (except the atoms of the inert gases) of the electronic orbitals placed on the last layer (the external one), distribution which will produce one or more preferential directions of the future interactions with the other atoms. The more directional and powerful these interactions will be, the more reduced will be the means of subsequent rotation of its elements (for example, the case of the hardly fusible materials or the carbon).

We must clearly underline that the Maxwell distribution is valid only for G media, because, as we have mentioned before, only these media can have a free translation of the medium's elements. As for the other class of media (S, L), only forced translations (vibrating ones, because there are permanent interactions between elements) can be found. The fact that the distribution of the velocity rates was established as regards the atoms or molecules of

[140] Attention ! Do not mistake the symbol T of the translation (normal font) with the symbol *T* of the temperature (italics).

some solids or liquids, it does not mean that that particular distribution was valid during the vapour phase of those substances.

Comment X.24.8.2.4: It couldn't be different anyway, because the velocity selector used for the determination of the atomic or molecular speed rates runs only with atomic or molecular beams (beams of the single elements of the substance) generated by the gaseous phase of the trial substance.

X.24.9 Temperature

As we have seen in chapter 7, the balance of the fluxes generated by the interaction process (collision) of a MS couple shows two pairs of equal and opposites directions fluxes, the fluxes which are normal on RBS into the impact point and the tangential fluxes (whose direction is parallel with the tangent plane on RBS at the same impact point). The medium where this composition of fluxes takes place (the medium located into the transition volume of RBS) is the peripheral medium of the atoms, namely, of the peripheral electrons. It is clear that these fluxes, once they enter into the electronic medium, will be able to disturb the state of the electrons involved in this process. The mutual perturbation process of the peripheral electrons within the two systems, perturbation which is partly "mechanical", as we have seen in the previous sections, and partly photonic, leads to the emission of photons which represents the interstitial photonic medium (the support of the thermal energy stored in that particular medium), and the emergent flux of these photons through RBS of that medium (internal traflux) represents the thermal equilibrium radiation of the equivalent black body. Therefore, there is no thermal radiation in the absence of the interactions (collisions) between the elements of a distributed material system. Accordingly, it is improper to talk about "the temperature of a single electron", statement which is used more frequently regarding the particles released by the sun.

Comment X.24.9.1: It is true that the dimensions of the term kT from the ideal gas equation are the ones specific to an energy, but this fact does not mean that every time we talk about energy, we must associate it with the temperature; it is absurd to discuss about the temperature of an isolated EP and which moves across a non-disturbed rectilinear pathway (without collisions), which is obviously owner of a kinetic translation energy, but this energy does not belong to any of the thermal photons, therefore, according to the definitions presented so far, we cannot talk about thermal energy and about its specific attribute, that is the temperature. Although the thermal photons are the support of the thermal energy, its temperature is also out of question in case of an isolated thermal photon. A flux of thermal photons (the flux radiated by a warm body) has a Plank distribution which is in correspondence with a certain temperature of the flux source, but this temperature is an attribute of the medium of thermal photons contained into the source body and not of the photon flux which emerges from the body. Otherwise speaking, the frequency distribution of the photons from a radiating flux coming from a specific body is an information associated to that body, information concerning its thermal state.

According to a preliminary analysis, the temperature is a statistic amount, characteristic to a set of MS (such as AT, MO or EP) which are under interaction, and it is proportional with the global energy density of the photonic flux produced and stored into that set as a result of the collisions deployed between the system's elements, or coming from the outside, but which is under equilibrium with that set. It is impossible during this phase of phrasing the temperature definition to establish exactly what is the specific weight (contribution) of the two components of the kinetic (baric) impact flux (the normal and tangential component), however, one may clearly state that:

1) The normal component of the variation on RBS of the impact kinetic fluxes (T component collinear with a common normal line of the two inter-penetrated RBS at the moment of impact) is the main cause of the statistic attribute called pressure belonging to the support medium of these fluxes.

2) The fluxes of the photons released as a result of these impacts make-up the medium of the interstitial thermal photons, that is a carrier medium of the thermal energy (energy made-up from the thermal contribution of the atomic or molecular media, as well as from the external heat intake).

3) Under isolation conditions, without an external intake of fluxes, but also without flux losses towards outside, the two internal energy fluxes stored inside the medium - stochastic atomic (or molecular) EF and photonic stochastic EF - must be balanced, the mean intensity of the atomic kinetic flux (T+R) being equal and counter marked with the mean intensity of the opposition flux exerted by the thermal photons (also T+R).

4) The pressure attribute, as it was defined in chapter 7, also belongs to the fluxes of thermal photons (and they also have a variation of the normal T component on the impact orbital), but the weight of this component is much reduced as compared to the kinetic component T of the atoms. In other words, there is also a baric contribution of the thermal photons medium, but this contribution is insignificant as compared to the baric contribution of the atomic impulses (under the common conditions found at the surface of Earth but not into the stars' core).

5) The main energetic component of the photons is the component R which is able to transmit rotation fluxes towards the driven object (electron or group of neighbor electrons), fluxes which may have common components across the RBS of an atom (namely, a partly R coherency). These common components may lead to the activation of some full rotations of the atom, rotations which may exceed the common vibration rates (becoming irreversible) and which can therefore cause the phase change of the atomic medium, from S into L (melting) or from L into G (vaporization, see the criteria of media classification from the chapter 6).

6) The temperature, as an attribute specific to the thermal photons medium, attribute which is characteristic to a set of photons with the energy per element strictly depending on its frequency, cannot be separated even by the fact that the energy contained in this set is distributed on a frequency support. As we have seen in the chapter focused on objects, each abstract object of such kind has an internal reference system (either abstract or natural one), which represents that object within its external relations.

Well, this is the starting point for an objectual definition of temperature, taking into account the fact that the thermal energy is a distributed attribute, and that distribution (Plank distribution) has the thermal photons frequency as its support.

X.24.9.1 Temperature's objectual definition

According to the definition X.24.6.1, the heat contained into an atomic or molecular medium (NM) has a finite set of thermal photons as its support, and they are kept (partly confined) into the interstitial volume of that medium. Based on the facts presented so far in this annex, these photons are material objects with a finite energy stockpile depending only on the photons frequency, stockpile which is distributed into a finite volume with a constant cross section on the propagation direction. The energy distribution of the heat's support photonic medium is uneven and specific - Plank distribution. As we saw in the chapters focused on distributions and objects, a set of objects from the same class (in this case, photons) have a common model (the class model) and specific attributes (for the objects differentiation). These specific attributes are determined against an unique reference value for the entire set of objects with a simultaneous existence.

As for the thermal photons, we have noticed that the frequency is the distinctive attribute, but it is also likely that the volume occupied at a given moment by a singular photon to be distinct as well (the space-temporal exclusion to be valid). For the time being, we are only interested in the frequency attribute because it is the decisive attribute of the photons energy, and a similar type of reference (a frequency as well) is required for its evaluation. If the absolute artificial references (with zero value) are mostly used in the scientific papers, as regards the material natural systems, there are references which are auto-set as a result of a very large number of interactions deployed between the elements of the material system. In the previous section, we saw that there is a natural reference applicable even for the energy attribute contained by a thermal photon, reference which is associated to the peak value of Plank distribution, that is an energy which according to the relation X.13.8.1.8 is related to the following frequency:

$$\nu_R = \frac{x_R\, k}{h} T = C_T\, T \qquad \text{(X.24.9.1.1)}$$

As a result of replacing the values of the component parts constants, the value of constant C_T results to be $C_T \cong 5.878959\ 10^{10}$ [Hz/K]. The relation X.24.9.1.1 shows a direct dependence between the reference frequency of the normalized Plank distribution and the absolute temperature, the Kelvin units being simple numerical values by which the value C_T is multiplying.

Definition X.24.9.1.1: **The temperature** is a global attribute of the stochastic medium of the thermal photons, medium which is in equilibrium with a NM and placed into its interstitial space, attribute which is direct proportional with the internal reference frequency of the spectral distribution of the photonic medium.

Comment X.24.9.1.1: This way of defining the temperature is consistent with one of the basic properties of this attribute, namely the fact that, the temperature, as well as the frequency, do not have additive features. As it is known, neither the temperature nor the frequency can be added, but they can be compared (by means of subtraction) and the difference between them can be also determined. As for the absolute temperature, any value of the temperature is a simple multiplication factor of the frequency which is associated with a Kelvin, value which is given by the constant C_T. The definition of temperature as a frequency reference of a set of thermal photons which coexist with the elements of a NM has another advantage: the renunciation to a fundamental amount - *temperature* - is possible, together with its units of measure, and the utilization of the frequency units only (or energy associated with this frequency).

For the reader, it is obvious that, taking into account the direct dependence relation (Plank relation $E = h\nu$) between the frequency of a photon and the energy stored inside it, an energy $E_R = h\nu_R$ shall correspond to a reference frequency ν_R, the energy of most of the thermal photons from the photonic medium with the temperature T (given by the relation X.24.9.1.1). Otherwise speaking, the temperature of a NM represents a global attribute of the potential caloric energy contained into the stochastic medium of the thermal photons included in that particular medium.

X.24.10 Conclusions

1) Through its models, objects and specific fundamental processes, the objectual philosophy upholds the Newton model of the *corpuscular photon* and moreover, of the photons as material systems which deploy a weak interaction between them. Obviously, a coherent explanation is also required for the "wave" aspect of the photonic behaviour, but this explanation[141] is in this case similar for all the types of MS (electrons, protons, neutrons, photons etc.) which are all characterized by the interference and diffraction phenomena Consequently, according to the objectual philosophy, the long-debated corpuscle/wave dualism from the official physics does not exist any longer.

2) Due to the specific principles and axioms, the objectual philosophy does not uphold the purely probabilistic model (of the probability waves), promoted by Schrödinger model, but it states a determinisim and a very close inter-correlation between the fluxes generated by the particles from the atom's structure, interrelation which is mandatory for developing a constructive interaction.

3) The orbitals-based structure of the bi-particle systems (made-up from EP with complementary charges) and of the systems made-up from this kind of elements (atomic

[141] Explanation which is not yet sufficiently elaborated and which will be the topic of another paper or annex.

kernels, atoms, molecules etc.) makes that an external energy flux which is incident on one of the constitutive EP, to be able to disturb the synchronism characteristic to the fundamental state, state in which that particular MS is electrically neuter in the external space. As a result of the action exerted by the external flux, an absorption transition (temporary storage) takes place, followed by an emission transition (returning, reflection), processes through which, the couple of excited EP emits a photon with surplus energy and it returns to the fundamental state.

4) The disturbing incident flux of the fundamental state's synchronism can be any type of energy flux (photon, impulse of an EP or moving atom etc.) but the flux which is reflected (re-emitted) shall be always made-up from a photon (for each couple of excited EP), and from a kinetic flux (overall motion) of the EP system.

5) The fact that the intensity variation of the direct interaction between the neuter atoms (collision, vibration, compression etc.) leads also to the photons emission is the main cause of the thermal phenomena deployed within NM. The continuous (but uneven) distribution of the parameters specific to this variations makes that the energy' frequency distribution of the released thermal photons to be continuous and uneven.

6) The fact that the effective cross section of the photons (including the thermal ones) is extremely low, allows them to propagate through the interstitial space between the atoms of an atomic or molecular medium.

7) The multiple absorption processes, temporary storage, re-emission, to which all the thermal photons are subjected during the interactions with the atomic medium, makes that the heat transmission (the evenness process of the flux density of the internal photonic medium) to be deployed very slowly, although the thermal photons are propagated into the interstitial space with a velocity close to *c*.

RESERVED WORDS AND EXPRESSIONS

A

B

C

D

R

S

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V