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A 6D space framework for the description of distributed systems

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Abstract. This paper proposes a six-dimensional (6D) space framework and an appropriate reference entity for the description of organizations and realization of identifiable matter. The aim was to compose and present a new differentiable and well-structured syntactic reference entity on the basis of a general 4D space-time system. The entity should be visual, capable of providing people who develop, integrate or analyse distributed motional applications with basic means for navigation and adequate comprehension of motion. The common *length*, *width* and *height* dimensions determine the 3D subspace for definition of the geographic points of the motional concept. *Time* and the newly-founded *content* and *merit* dimensions together form a 3D realization space that inherently describes existence of motion outside the geographic points. The *content* dimension is used to declare the quantitative values of the quantities and properties of motion. The *merit* dimension is used to declare the qualities of quantities and properties. The transformation in the dynamic realization space is defined by the named quantities and properties. The *time* dimension is used to define the dynamic channels for the valuable content of a named quantity or a property of motion. The temporal content values of the named quantities and properties of matter are defined at the geographic points. Symbolic names of the axes of the new 6D axis system are: *length*, *width*, *height*, *time*, and the newly introduced *content* and *merit*. An ontology is proposed by the author to define the hierarchy of the merital names. The c*ontent* axis uses the basic hierarchy with Arabic numerals to define the quantitative values of the quantities (properties). The 6D axis system that is semantically interpreted as a syntactic reference item is universally usable to describe the motion of a distributed concept, a model or a real entity, including transformation between different qualities of motion. Potential usage of the new 6D axis system together with the ontology is described. An example in the field of electrical engineering and industrial automation technology is presented. A visual user interface is discussed.

Key words: 6D space, organization, realization, merit, ontology, synergy, distributed system, electrical engineering, automation.

1. INTRODUCTION

The world around us has changed because the industrial age is over. The information in millions of conference papers and web sites is presented to young learners in a way that serves not only learners, but is also of interest to other groups. Knowledge of an individual is heavily influenced by other individuals. Current teaching and learning methods fail to keep abreast of huge amounts of information. Traditional tools like conferences and learning environments increasingly fail to meet the changed needs of our students and professionals [1]. In the information age new tools are needed to return the power of knowledge to those people who need it most.

As a recent development, energy systems, called *SmartGrid*, have been implemented. Using information technology means and electrical power distribution equipment, these systems are intended to integrate potentially a very large number of electrical generators, storage devices and loads [2]. Future humanistic intelligent solutions integrate signal processing in such advanced systems with natural capabilities of the human body and mind, thus allowing constancy of human-machine interactions [3–5]. System architects, who develop such complex solutions that include heterogeneous hardware modules and intellectual property components, need new engineering methods and tools.

The challenge, facing modern life, where good many processes are computerized, is how to build a realistic semantic framework for specification and representation of intrinsically complex mental, automatic control and distributed physical entities that operate in conjunction. There is a need for a larger ontological unity and a suitable reference entity that would support straightforward description and control in the mentioned domains. One essential concept that includes historic input from philosophy and physics is *dimension*. There is plenty of literature covering the concept of dimension. Dimensions provide a framework for designers who compose and construct devices or unified field theories. There also exists an understanding that carefully composed dimensions are basically an important invention and the corresponding axis system is the useful reference object [6]. Physicists have played an integral part in the development of dimensions and our understanding of the nature of space-time and (material) objects. René Descartes proposed the x, y and z axes system and visual diagrams to model an object room. In 1843 the mathematician William R. Hamilton proposed the four-dimensional *space-time* model [7]. The fundamental constant c (speed of light) allows users to geometrize the time dimension (ct). The standardized space-time framework is now used to identify and present content values of motion of any simple or bounded object.

Technology architects, working with modern distributed (technical) solutions, sometimes think that they need even more than four dimensions to accomplish this. Scientists have been looking for an extra dimension to be added to the general theory of relativity since 1920, when Theodor Kaluza and Oskar Klein suggested relativity, which includes a fifth dimension. In today's modern theories of unification it is well known that space is higher-dimensional and elementary particles are there not as points but as very tiny strings [8]. Currently the Space−Time−Matter theory with an extra dimension, proposed by P. S. Wesson and colleagues is also under investigation. A realization of this theory is that all the matter fields in 4D can arise from a higher-dimensional vacuum [9,10]. Attempts have been made to unite space-time with the phenomena of electromagnetism by using the fifth dimension [11,12]. These theories are infrequently used by engineers. In practice, the electromagnetic effects are used by electrical engineers, because complex human-machine systems cannot be described using only terms, constants and formulas of 4D physics.

Another present day problem is that technical designers are mostly trained to handle four basic dimensions when measuring the content values of quantities and properties, describing or synthesizing the motion of mental, modelled or physical objects. The quantities and properties of motion under discussion are associated with the 4D space framework. Commonly, temporal value of motion is defined in a 3D space. No acknowledged training or technical engineering methodologies available are based on the six basic dimensions.

Perhaps we already are using a six-dimensional framework to describe the complex motion of objects every day but it is rendered applicable in an unrecognizable form? The aim of this paper is to present a six-dimensional space framework and the corresponding axis system that is virtually usable to describe the motion of complex entities in space that include humanistic subjects, control systems and energetic objects. The hypothesis of the paper is that the composition and realization of entities in space can be effectively described by using six dimensions if we take into account the ontology that is associated with each dimension. The ontology of each defined dimension refers to hierarchical relationships that exist between resources within the 6D space. Resources in the 6D space are sometimes described by 6D points or hexels [13].

When an ontology is defined somewhere on the Web, intranet, or extranet, it is possible for machines and people to retrieve the semantic information, associated with each resource, to find, present, and act on data in meaningful ways. Sticking to just six dimensions keeps the proposed framework within realms of experimental science, which deals with measurements of different quantities. In fact, an undefined fifth dimension and an appropriate fifth axis are used to represent the quantity of the content of a measurement. The numerical values of the content, received during measurements, are based on the theory of numbers. The sixth dimension and the appropriate sixth axis are defined in the next sections of the paper. The new axis system should be simple and understandable for a wide audience. In those circumstances a wider angle of vision is needed and a philosophy that can provide an adequate view on this area of research is also applied.

In Section 2, some terms, commonly used for the organization and architecture of a formal language, systems, theories, models and also a space framework or the axis system are described. Then, in Section 3, the action principle is defined and expanded together with the new dimensions. In Sections 4 and 5, the action principle and the new merit dimension are introduced in visual form. In Section 6, basic realization views of an entity are explained using the 6D axis system and appropriate graphic figures. For instance, some documented views from existing software products, quite close to the basic views of the new framework, are introduced. Finally, in Section 7, a possible usage of the framework in the field of electrical engineering and industrial automation is discussed.

2. BRIEF INTRODUCTION TO A FORMAL LANGUAGE AND A FORMAL SYSTEM

Language acquisition is the abstract process by which people or machines acquire the capacity to perceive and comprehend information as well as to produce and consume words or other types of symbols to communicate with each other or with computers. Motion of content behind the symbols between subjects and objects in space always results in the interpretation (dismember or construction) of valuable (material and energetical) properties of matter the symbols represent. The capacity to use language in different situations requires people or the computer to pick up a range of tools and methods. The tools include syntax analysers that do not take into account the meaning of the used words and semantics analysers that provide interpreted meanings to the symbols of a formal language. The tools are used in a combined way, e.g., a symbolic expression meets with a value of real content.

Next, some important terms are explained. *Syntax* is associated and concerned with the rules (or grammar) used to construct or transform the symbols and words of a language, composition of texts or graphic pictures in a formal language, in contrast to the *semantics* of a language, which is concerned with its meaning. In modern computer science, syntax is the term that refers to the rules, governing the composition of a meaningful text and pictures in a formal language, such as a programming language, i.e., those texts or/and graphics (pictures) for which it makes sense to define the semantics or otherwise provide an interpretation [14]. Formal languages used in mathematics, logic and computer science are defined in syntactic terms and they do not have any meaning until they are given some interpretation using additional (available to the subject) information from a context.

A *symbol* is a mark or a set of marks, which forms a particular pattern. To form a mark or some kind of a trace, energy or material is needed. Symbols of a formal language must be capable of being specified without any reference to any interpretation of them. Symbols of a formal language represent an abstract idea, concept, term, real entity or nothing real. *Syntactic entities* are the alphabetic or graphic symbols, formulas, theorems, algorithms, theories and other entities, expressed in formal languages, whose properties may be studied without regard to any meaning they may give to us or to other subjects. The architecture of syntactic entities cannot be seen directly with eyes.

Symbols and syntactic entities can be visualized, e.g. geometrized. For geometrized entities first we apply our eyes or ears and then brains using formation rules. For example, logical constraints, which do not refer to any idea but rather serve as a form of punctuation in the language (e.g. we include and use parentheses or square brackets in syntactic entities). *Formation rules* are a precise description of which strings of symbols are the well-formed formulas of a formal language. A formal language is based on well-formed formulas. A character or graphical symbol or string of symbols may comprise a well-formed formula if the formulation is consistent with the formation rules of the language.

A *formal language* is a syntactic entity, which consists of a set of finite strings of characters and/or graphic symbols, which are its words (called its well-formed formulas). By which strings of symbols is a word determined by the creator of the language.

After creating words in a formal language, the user can start to give them some meaning. For that action a formal system is needed. So the user defines the domain or boundary conditions for a future theory.

A *formal system* uses a formal language as the base and additionally includes a deductive apparatus (system). The user of words of a formal language defines a formal system that includes all necessary axioms, theorems, non-theorems, and functions. The deductive apparatus may consist of a set of axioms or transformation rules or have both. The *transformation rules* describe connections between different syntactic entities that have been defined by a set of properties (links). Some content should be transferred (transformed) by these connections.

A deductive system is intended to preserve deductive qualities in the formulas that are expressed in the system. Usually the quality we are concerned with is truth as opposed to falsehood. In order to sustain its deductive integrity, a *deductive apparatus* must be defined without reference to any intended interpretation of the language. The aim is to ensure that each line of a derivation is merely a syntactic consequence of the syntax of the lines that precede it. There should be no element of any interpretation of the language that gets involved in the deductive nature of the system. A formal system is syntactically complete if no unprovable axioms can be added to it as an axiom without introducing an inconsistency. A formal system is used to derive one sentence (expression) from one or more other sentences (expressions). Formal systems, like other syntactic entities, may be defined without any interpretation given to it (as being, e.g., a system of arithmetic, geometric or topologic entities). The mentioned rules constitute also the well-formed formulas of a formal system. A *theorem* within a formal system is a formula capable of providing proof through a finite sequence of well-formed formulas, each of which is either an axiom or inferred from earlier formulas.

In this way, logic, the axiomatic method (such as that employed in geometry), and semiotics (the general science of signs) is converged toward metalogic. The axiomatic method proceeds in a sequence of steps, beginning with a set of primitive concepts and propositions and then defining or deducing all other concepts and propositions in the theory from them.

Theorems and non-theorems form a logical (a qualitative) level of the language. Quite often, a simple formal system that a user creates will define all of its well-formed formula as theorems. Figure 1 presents a 3D view of syntactic entities, organized around a formal language. One should comprehend that terms (and expressions) of a formal language (shown in Fig. 1) have a specific content value called quality. Merits of symbolic terms are different. Thus, a new dimension is needed to define the value of the quality of symbolic content.

A *theory* is a formal system that includes a set of sentences in a formal language. Scientists are dealing with formal theories. Scientific theories are generally more complex than laws or rules; they have many components, and are more likely to be changed as available experimental data and analysis develops. To prove a theoretical proposition they use real experiments. Here a theory is a scientific tool. Scientists or other subjects "look" at interesting objects or even at their different real properties through "theoretical glasses". The observer is connected to the real material entities through a symbolic entity. The structure of a formal mask is visualized in Fig. 1. Imagine that a scientist looks at an interesting real object through a syntactic entity ("3D formal mask") shown in Fig. 2.

A well-known theoretical system, based on five axioms, is that of the Euclid for geometry. In a manner similar to that of Euclid, every scientific theory involves a body of meaningful concepts and a collection of true or believed

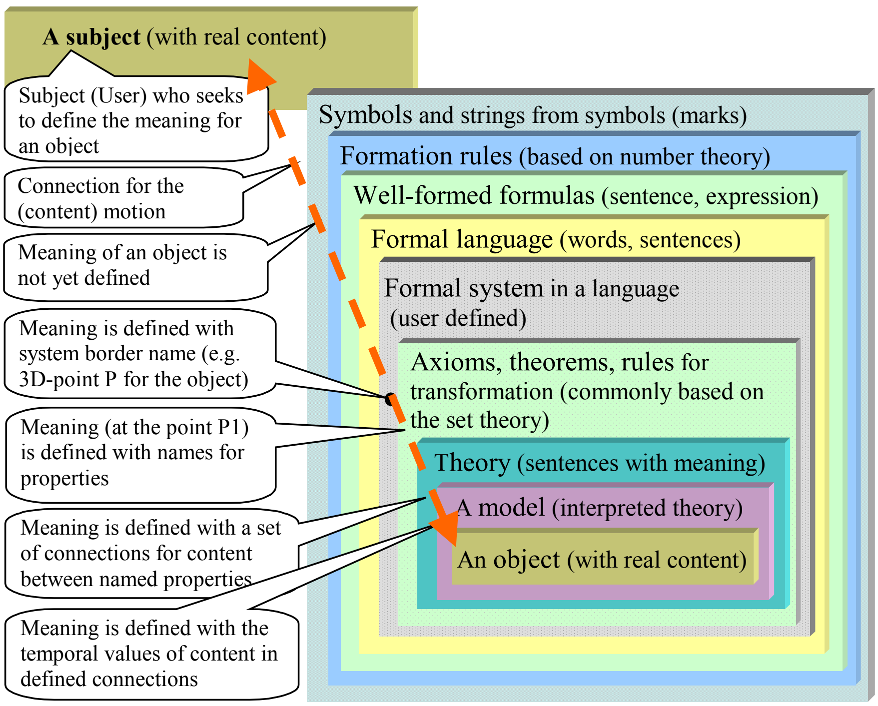

Fig. 1. Organization of syntactic entities; top-quality level of a formal entity is a model.

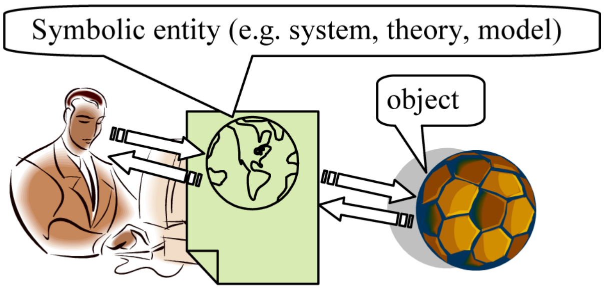

Fig. 2. Formal theory is a “semitransparent symbolic mask”.

assertions. It is possible to construct a bare logical theory. A metaphysical theory is more restrictive, i.e., fewer things are metaphysically possible than are logically possible. A metaphysical theory can reflect some underlying deep facts about the world. Its exact relation to physics and physical possibility is a matter of some dispute.

An *interpretation* of a formal system is the assignment of meanings to the symbols and truth values to the sentences of a formal system. The study of interpretations is called formal semantics. *Giving an interpretation* is synonymous with *constructing a model*. The parts and connections of a model have defined names and meaning. An interpretation is commonly expressed in a metalanguage, which may itself be a formal language, and as such it is a syntactic entity.

Meaning of concepts (e.g., words, terms) is explained using a glossary or a thesaurus. The meaning of a concept can often be explained or defined in terms of other concepts, and, similarly, the truth of an assertion or the reason for believing it can usually be clarified by indicating (with reference to a source) that it can be deducted from certain other assertions already accepted.

Mathematician Descartes outlined the union of algebra and geometry. Riemann began with an abstract space of n dimensions. It was in the 1850s when mathematicians and mathematical physicists began to use n-dimensional Euclidean space to describe the motions of systems. Today the energetic properties of motion are mostly defined using the action principle. Formal theory defines the boundaries for the actions of motion.

Physicist Einstein improved Newton’s description of gravitation as a force that attracts distant masses to each other through Euclidean space, adding a principle of least effort, or shortest (temporal) path for motion along the geodesics of a curved space. Our mental and material worlds run along.

Quantification is an important construct that specifies the quantity of instances in the domain. Quantification is used to measure a certain property defined in the theory about an object. Quantification has several senses. In mathematics (in the number theory) and empirical science, it is the action of counting and measuring that maps human sense observations and experiences into members of some set of numbers.

Quantification is fundamental to the scientific measurement method. In modern logic, quantification is the binding of a variable quantity or property, ranging over a domain of discourse. The property thereby becomes bound by a formal system operator called a *quantifier*. One property can be bound also to another property of a domain using some transformation (function). Discussion of quantification refers more often to that meaning of the term than the preceding one.

In grammar, a *quantifier* is a type of a determiner, such as *the*, *all* or *many*, that indicates the quantity of a property. All known human languages make use of quantification. Properties of real motion quantified in a geometric space are internally different. They are not geometrical. Suppose here that the least effort applies differently, for example, for sense data, mechanical energy or substance. When a user creates a union of (internally complex) motion in which a connection uses 3D geometry or topology, he/she creates the formal theory.

By the definition, 3D geometric space is a subspace of the 6D space. 3D points define (quantify) infinitely small locations in a 6D space. There exists also a motion between these 3D points. The cause of the motion always exists outside these 3D points. In the 6D space model there exists a multiple path (that can be geometrized) for different properties of motion of entities that by a minimum have two points. In the next sections, the new 6D space model and some properties of motion between a subject and an object are described.

3. CONCEPTS OF THE FRAMEWORK

The goal of this chapter is to clarify the main concepts that are elementary to describe the framework.

The term *concept* is declared as an elementary operating (active) entity of the mental system. General parts of the operating concept are a *subject* and an *object* (or in other words a *source* and a *resource*) which are "glued" or "bound" together. The operating concept is real and its dyadic form can represent a phenomenon of an energetic/physical (material) entity. Connected dyadic concepts form a space.

Suppose that a motion between these operating parts is described with three major identifiers: (logistic) *content*, (logic) *name* and (temporal) *time*, the values of which are designated by symbols. According to Ludwig Wittgenstein's so-called picture theory, a picture as the model is recognizable by a human if it has an identical "logic form" with real objects [15]. This means that the subject part of a concept, e.g., that created in our mind, has "spatial bindings" or "spatial membrane" to the object part, e.g., our memory. On analogy, an engineer realizes "spatial bindings" from his/her subjective memory to objects that are modelled in an industrial controller. These objects are usually called *tags* [16]. The tags of an operating industrial controller (as sources) can control different automated devices (as massive resources). Different interacting concepts together form value networks.

Action is a particular quantity in a concept, a model or a physical system that is used to describe its dynamic operation or evolution. The *action principle* is one of the important (great) generalizations in physical science. The action method is intended for black box identification. It is derivative-free in the sense that it neither computes nor even attempts to evaluate derivatives. The method is designed to use only function values and requires only a symbolic value of the objective; no knowledge about the internal structure of the problem solution is needed. The action yields the same results as using differential equations, which specify how a variable quantity of the content of objects changes from its present value with infinitesimally small changes in time, geographic position of a subject or some other (named) quantity. Action $S[q(t)]$ only requires the *state* of a variable quantity to be specified at two points of evolution, called the *initial* q_1 and *final* q_2 states. For a 4D physical object the points of evolution $q_1 = q(t_1)$ and $q_2 = q(t_2)$ of the content can be experimentally defined by using a geographic (3D) axis system and time etalons.

The action principle was stated slightly differently by G. Leibniz, L. Euler, Hamilton and others. Hamilton's principle states that the differential equations of motion for any physical system can be reformulated as equivalent integral equations. His principle applies not only to the classical mechanics of a single particle, but to classical electromagnetic and gravitational fields and has also been extended to quantum mechanics and quantum field theory [[17]]. Physicists are engaged in most fundamental actions. In physics, the fundamental action is called *energy* and the unit of the action is now known as Planck's constant h. Numerically, $h = 6.6 \times 10^{-34}$ kg m^2/s. The units of Plank's constant are momentum p, multiplied by distance, or energy, multiplied by time. The product of mass and speed is the momentum p [[6]]. If the evolution of the concept is stationary, then its total energy E is conserved. Then the Hamilton's action function can be solved with the additive separation of variables of action

$$S(q_1, \ldots, q_N, t) = W(q_1, \ldots, q_N) - Et, \tag{1}$$

where the time-independent function $W(q_1, \ldots, q_N)$ is called Hamilton's characteristic function. The physical meaning of this function is understood by taking its total time derivative

$$\frac{dW}{dt} = \frac{\partial W}{\partial q_i} \dot{q}_i = p_i \dot{q}_i. \tag{2}$$

This can be integrated to give

$$W(q_1, ..., q_N) = \int p_i q_i dt = \int p_i dq_i, \tag{3}$$

which is the abbreviated action. These formulas also show specific relations between different dimensions of a 4D framework.

Quantitative value of a quantity (also property) of a concept can be characterized or even measured by using the etalon. As a result of measurement, a subject obtains the *symbolic values of motional content* for initial and final states of the object. The content value of the variable quantity of the concept at all intermediate points may then be determined by "minimizing" the action [[17]]. The claim seems to lead to an interesting fundamental conclusion that the content of the acting matter even of the smallest "minimized" concept is not located directly in geometrized (symbolic) points but within reach.

Geometric points of a subject and an object of the concept are defined in a 3D subspace and relate to the material (stored) content that actually exists in a 6D space, i.e. in the realization space. A subject and an object that are identified by 3D points can "see" the real action of the concept through "formal language glasses" that were described in the previous section. Content, logic name, and temporal links to the action of the concept are realized outside the 3D points. The geometrized 6D action is illustrated (visualized) in Fig. 3.

A set of steadily bounded different actions of a concept is generally called (named) a *motion*. A motion can be "minimized". Motion is a term that is used in physics, philosophy as well as in social sciences.

The content value of the motion of a concept depends on the measurement method that the subject uses. The obtained quantitative value of a content is always symbolic (e.g. numerical). The *name* value of action (or motion) is symbolic and is commonly visualized with a word (or an expression) of the formal language. Nouns normally represent the organization and verbs the realization of a structured action of a concept. The named groups of action of a concept are, e.g., logic (information), energetic and massive.

The name of a concept is defined by the system an author uses, employing the method that seems quite similar to the method used by physicists for the action principle. The proposed method is used to differentiate a specific action or sets of (bounded) actions of the concept. Thus, the name of a quantity of the acting concept is to be specified at two specific points called the *opening* and the *closing*. These points for the name are not geographic as for the value of physical content. Opening and closing for a name of the concept are predefined by very

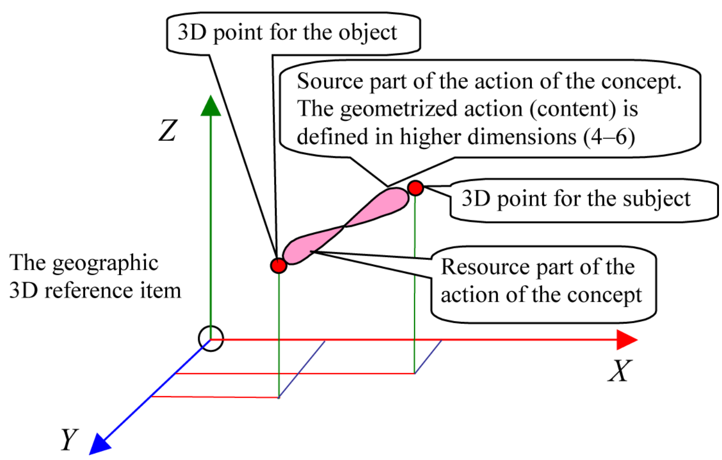

Fig. 3. Geometrization and visualization of higher-dimensional content of a concept.

special symbols of the used language. The opening for names, e.g., that is used in modern World Wide Web, can additionally include symbolic *attributes*. The subject (active) and object (passive) sides of a concept are named by an observer using a configured etalon. In some domains of discourse, e.g., in the Internet technology, the universal etalon (configuration space) is called *namespace* [[18]]. Such a namespace is normally structured to define exact meanings for different names.

Why do we use different names for actions? What do we have in mind when we declare, identify and define an object? Can we clarify (argument) the usage of the names for a concept using the today's 4D space framework? No, because a 4D framework cannot provide a subject with sufficient freedom necessary to define a real existing motion.

The *named action* of a concept is visualized (geometrized) as a complex 3D dipole in Fig. 4. Actually a substantial part of the (geometrized) concept exists in dimensions *T* (No. 4), *V* (No. 5), and *L* (No. 6). The 2D figure is axonometric. This visual action is described by six independent dimensions. The 6D-form has the identified source and the resource parts (sides).

The long name of an actual quantity of a complex concept or a model or a device can be replaced (similarly to elementary mathematics or algebraic modelling rules) with a single symbol. Doing so, we surely hide or even lose some part of the meaning of the concept. For example, the action name *torque* that characterizes the variable quantity of an electric machine can be replaced with a character *T*. In real life designers declare and define rather different actions, e.g., current (action label *I*), electromotive force, tension (action label *F*), power (action label *P*), energy (action label *E*).

In discussions regarding complex information-theoretical concepts we often find it useful to consider graphic (visual) blocks rather than individual character

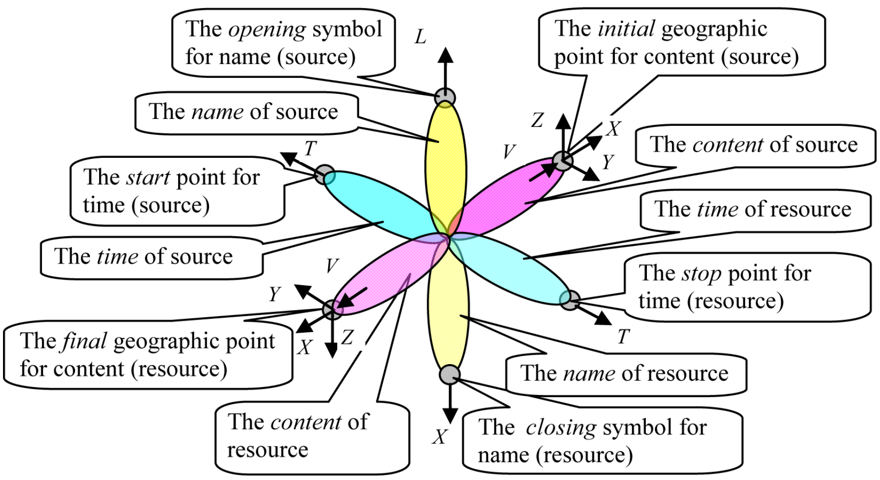

Fig. 4. Visual explanation of the 6D action.

symbols, satisfying a restriction known as the prefix condition [19]. Graphic blocks are widely used for programming (modelling) complex actions that are later realized in industrial controllers. Logic, energetic and physical values of a motional concept cannot be defined and identified (itemized) in one (geographic and temporal) point. For instance, speed of a massive object is quantifiable if we make sequential measurements in two 3D geometric positions as a minimum. Heisenberg has also formulated the uncertainty principle. Different actions of a complex concept named, e.g., task, process, application, game, project, programme, life, dream, are realized together. They are bounded. The action bundle is defined in the 6D space model using the 3D realization model associated with the geometric 3D subspace model. The evolution of actions is expressed through three different types of spatial connections that exist between the subjects and objects or rephrase between sources and resources. The common classical world description does not care about the influence of an observer but a quantum particle has no properties without an observer. Every living observer actually identifies and defines the universe.

Today's geographic space and time identifiers of an action of a concept are sufficiently monosemantic, but the action name identifier is polymorphic. For example, the verb can expose a specific action of motion plus its ability to influence other (in the vicinity, adjacent) actions of a concept. The structure of the named actions of a complex concept is visualized in Fig. 5.

Concepts with similar geographic (3D) organization may have different actions. Objects with similar geographic topology may have completely different architecture of actions (functions). For example, an IBM-compatible and an Apple computer may have even a similar look and organization but their realization architectures (operating systems) differ markedly. Realizations of the architecture of an Allen-Bradley controller and a Siemens controller also differ a

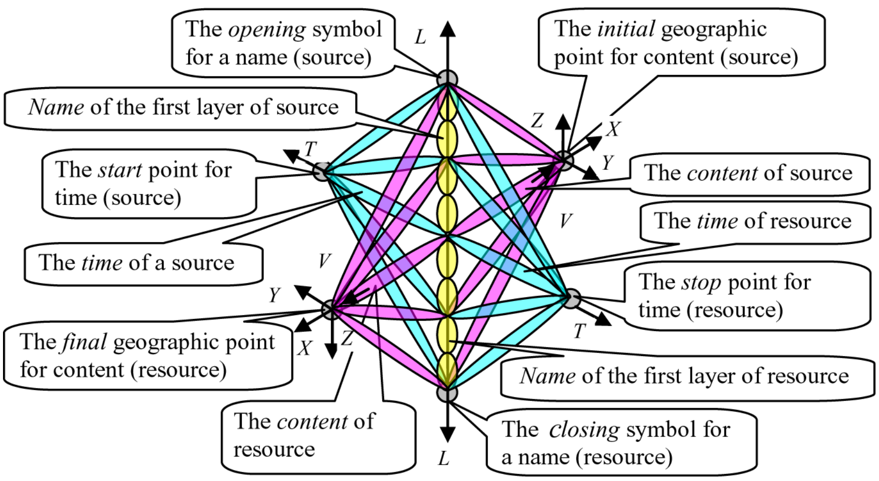

Fig. 5. Actions of a complex concept distributed in a 6D space.

great deal. So the meanings of names used for motion need further clarification. A *connection* consists of at least two links (rays) and some matter that jointly forms a channel for concept realization. In Fig. 5 the links of connection for different contents are represented (visualized) by violet colour; the links of connection for different time are represented by blue colour; and the links for different names are represented by yellow colour.

Source link describes part of an action identified with terms: initial point, start point and opening symbol. *Resource link* describes part of an action identified with terms: final point, stop point, and closing symbol.

A *channel* can have one or many connections. The channel of a concept is characterized by logistic, logic and temporal aspects.

The *logistic* aspect of a channel clarifies the transfer of the content of an action, e.g., mass (label m) or energy (label E). The direction of a logistic channel is identified by the pair of geographic coordinates (value labels x, y, z). The initial geographic point (link) identifies the source and the final point of the resource part of an action of a concept. The quantitative value for content is normally marked with sign "+" if direction is from source to resource. A *merital* (also named *logic* or *quality*) aspect clarifies the connections and transformation of matter that exists between actions of a concept with different names. The merital aspect is used to declare the merital (named) layers of a concept. Different actions should have different names. The transformation of matter is identified by a sequence of *opening* and *closing* links (addresses). According to the mathematician and philosopher Gottlob Frege, the *logic connections* are independent of our thinking, so they are also natural [15]. The *temporal* aspect clarifies the third direction of the action of the concept. *Start* point identifies the source of a concept and *stop* denotes the resource part of a temporal connection. Earlier temporal and higher merital level values of a source part define (open/close) a channel for lower level logistic content and logic transformation. Interpretation of the 6D theory adds semantics (logic, meaning) to its concepts.

It is now appropriate to point out that the 6D space framework for the concept includes the *geographic dimensions* (X, Y, Z) and the *realization dimensions* (L, T, V). They are bound together but not at one single point.

4. GEOMETRIZATION OF DYNAMIC MATTER

The content value of an action of a concept is related to the geometric values. Dynamic matter is geometrized with the aid of the fundamental constants, e.g., speed of light and with geometrical quantities such as length [6]. Three-dimensional *geographic space framework* is used to describe the organization of acting concepts. The geographic reference entity (the 3D geographic axis group) can be used to describe natural items, models as well as concepts created in the mind of a neighbouring subject. A geographic organization of the complex (motional) concept is best explained by the general term – *topology*. The simplified path for the content of an action is geographic but as we look at the sample concept, visualized in Fig. 5, it also depends on the type of the action of the motion. To be more precise, the path for the content of a concept is *logistic*, that means 6-dimensional. The geographic axis group and a geometrized content of the concept are interpreted (visualized) in Fig. 6.

Geographic models are commonly restricted to space-partitioning regression functions. These functions are often called piecewise regression functions because they approximate the desired function (motion) by partitioning the space and matching a simple local model to each region [5].

A distributed item is not broken to individual parts. The distribution method is helpful because an observer can sense at a time moment the content values of the actions of motion for every local part of a geometrical system. A distributed entity may sometimes miss out some logistic connections between its source and resource parts. As a result of measurement, we will find that, e.g., content value of energetic or massive action is numerically 0. But at the same time there may exist a higher merital level data connection. Kinematical connections are used to describe the existing restrictions for the motion of a concept, for example, joints of a robot.

The organization (architecture) of a 3D system is described using names (type: noun), e.g., *point*, *element*, *component*, and *module*. Actions between such organized parts of a system are described again using names (type: verb). Assume that the 4D space framework is capable of describing logistic and temporal connections (2D bindings) that matter realizes for the named actions of the named item. If these actions follow only along the one-dimensional path, the equations of motion can be used [20].

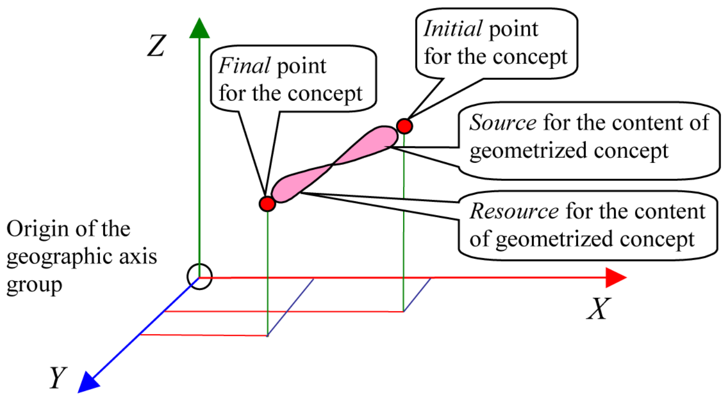

Fig. 6. Geographic axis group and logistic content of a concept.

5. SIX-DIMENSIONAL SPACE FRAMEWORK

As a step towards improved space framework, the name *merit* was given to the new dimension and the new axis that concerns the architecture of motion. The merit dimension helps us to better understand the qualities (the freedom of transformation) of matter. In simple terms, the sixth dimension can be used to model the complexity of the motion of a concept. Human brain is capable of sensing the merits of a subject and an object. The merits are not cognizable using simpler sense organs.

The meaning of the word *merit* is close to that of a substance, one's portion, nature, achievement, virtue and also the quality of being. *Merit* is a rather common term in our everyday thinking but unfortunately its importance and connection to the time and content dimensions is not profoundly comprehended in our mental systems, neither is it precisely used in technical manuals.

Content value of an action of the motion of a geometrical concept is defined by the *content axis* and the temporal value of the action is defined by the *time axis*. Merital value (name) of actions of motion of the concept is defined by the help of a *merit axis*. The independent merit, content and time axes together form a new complex reference item *LTV* visualized in Fig. 7.

The realization axis group (axis system) can be used for complex measurements of the motion between the subject and the object parts of a concept. Because the realization is distributed, we obtain the corresponding content, time and merital values for every (different) action of the concept.

Detailed organization and architecture of the axis system is represented in Fig. 8. The named vertical arrows represent the organization and architecture of

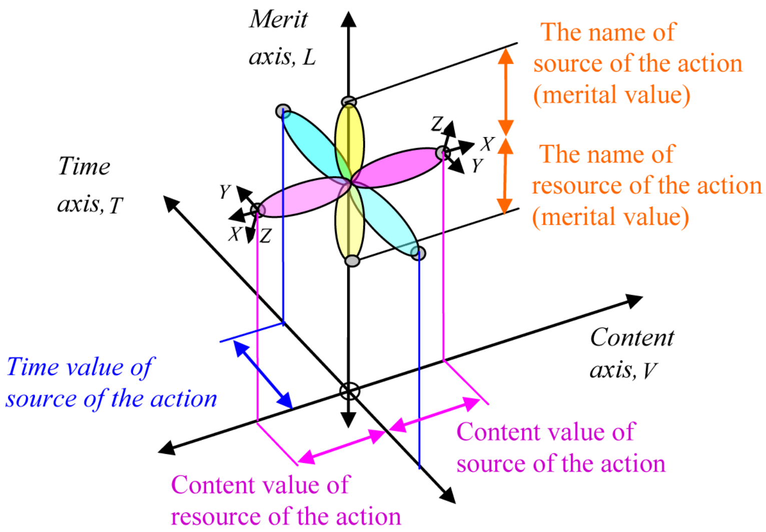

Fig. 7. The realization axis group.

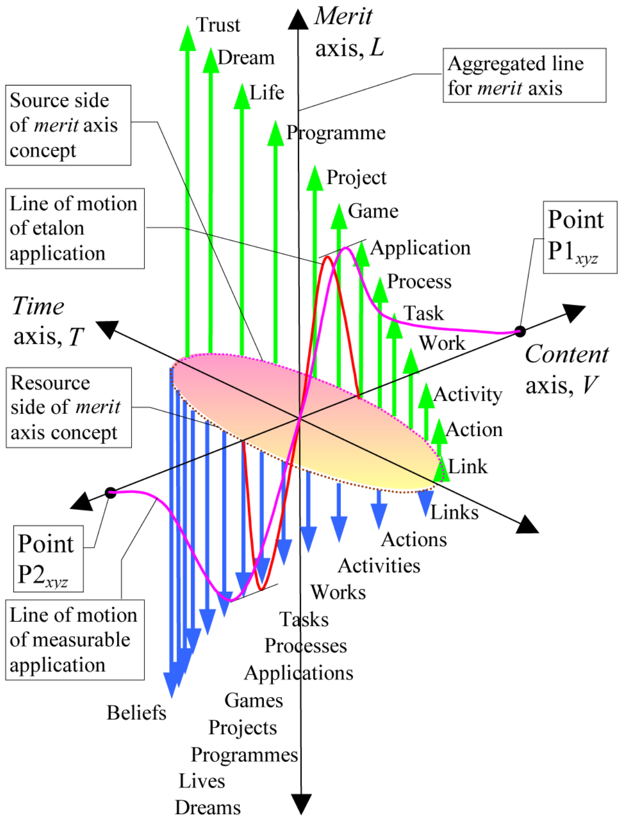

Fig. 8. Organization and architecture of the *merit* axis concept.

the merit axis *L*. Axes *V* and *T* are not detailed. The content of the motion of the etalon and a sample application concept (identified with geometric points $P1_{xyz}$ and $P2_{xyz}$) are visually represented (by lines) in the central area of Fig. 8.

The source and resource parts of the merit axis item can be represented in a more compact form (Fig. 9). Every scalar (name) in the visual array has lower and higher neighbours. Signs "+" in Fig. 9 represent channels between the merital (logic) layers for the transformation of matter.

The organization and architecture of the merit axis can be used by a system designer for a function classifier or ontology design. An intelligent system can use the classifier, e.g., to create the data schemas of an application function.

The realization axis entity provides a method for the measurement of clustered solutions. Clusters are represented by their associated etalons (names located in a nameroom). Each of the functional cluster or subgroup should be as homogeneous as possible. A generic merital type is, e.g., simple, arrayed or structured. The exact definition of the clustering problem differs slightly from field to field.

Stationary action means that there is a balance between the corresponding source and the resource of a given concept. For example, for a future smart

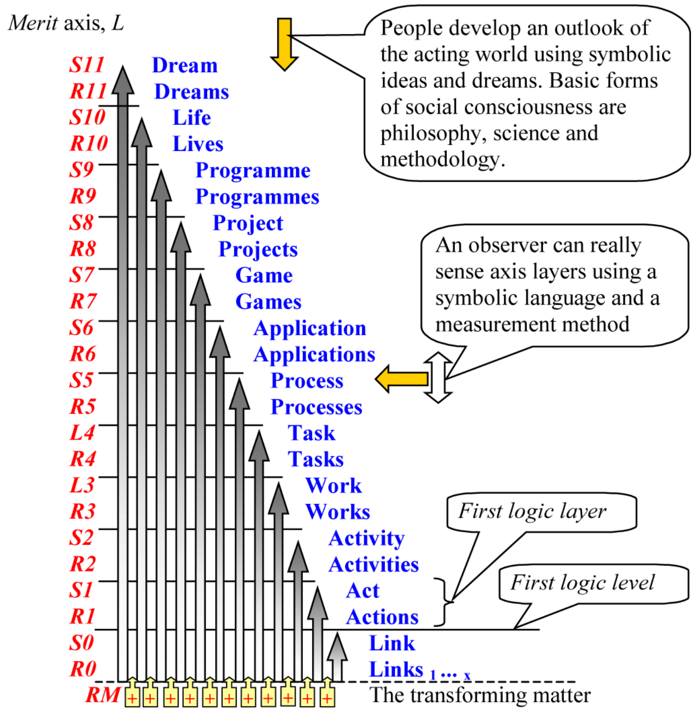

Fig. 9. Organization and architecture of the *merit* axis. A source (*S*-level) and corresponding resource (*R*-level) together with the matter form the logic layer.

electricity network it can be declared as the cluster of information-energetic-massive actions. A smart electricity cluster has the supply side (generators and line links) and the demand side (loads and line links). Between the electricity suppliers and consumers (at the connection places) smart electricity metering devices that measure content values of different actions, e.g., current, tension (voltage), power, energy, emergency events will be installed. The defined actions belong to their merit levels.

A geographically defined concept, model or a device can be more precisely described by the symbolic (merital) action name value, the action content value (commonly numeric) and the time value.

The proposed merit axis can be integrated into an axis system that is used to model a future smart electricity grid or complex automated production equipment. Such an integrated development, design or simulation environment helps not only to navigate in concepts (including subjects and objects) under discussion but also to understand the structure of the dynamics of the system. It is useful to implement the proposed architecture for simplicity of learning, and for reasons of economy and safety of performance.

6. SIX BASIC VIEWS IN THE SIX-DIMENSIONAL SPACE

There are six basic viewpoints that can be used to describe a mental concept, a model or a physical device. A geographic picture of the physical object is achieved by the first three basic views that are perpendicular to the planes formed by the common axis pairs *X*-*Y*, *X*-*Z* and *Z*-*Y*. The origin of a geographic axis group is identified with the base point of a particular system.

A motion of the conceptual system, a model or a physical device and their internal counterparts can be described by the next three views and the corresponding diagram types, which are developed to describe the motion, especially distribution of the motion in a concept. Next, the realization aspects are visualized using 2D planes. Orthogonal *merit* axis *L*, *time* axis *T* and (*motion*) *content* axis *V* are geometrized. A geographically identified object (here identified with a base point P_{xyz}) is shown in Fig. 10. Viewpoints of an observer (who is the subject of the defined concept) can be shifted alongside the realization axis system.

The fourth basic view in the 6D space is oriented perpendicularly to the axes: (motion) content *V* and time *T* (plane *V*-*T*). This widely used trend diagram is familiar to the majority of engineers. An observer looking from this viewpoint (at the time moment) to the point-object (P_{xyz}) can see that all the names of (different) actions of the motion are in (possibly hierarchical) stack. This means that the named actions are realized paraxial to the (motion) *content* axis. The logistic content values of the motion at point P are distributed onto the merit layer, or in other words, during different measurements the observer logically "drills down" or "rises up" alongside the merit axis *L*. This method allows us to describe "deep" physical phenomena of the object or reach up the "highest" real, meaningful abstract levels of action – *life* and *dream*. Human innovation, for example, starts normally with dreams. The above very simple outline means that the corresponding time value of the motion of the object is also in reality distributed alongside the merit axis *L* (Fig. 10).

The trends diagram (Fig. 11a) shows how the content value of the electrical current *i* of the motor of an industrial robot changes during the speed-up. Also, admissible deviations of the current value are visualized. The state of the current values of motors (at a fixed time moment) is visualized in Fig. 11b. These figures do not show the logic level for the current *i* because previously the merit axis was practically not in use.

The fifth basic view is oriented perpendicular to the axis pair: merit *L* and (motion) content *V* (plane *L*-*V*). The view shows the subject how an object (organizational unit) functions (acts) at a time moment. When a subject uses the proposed *merit* axis as the reference object, he/she can visualize (see) the named actions of an observed object in an order. The order of different actions of an object can be predefined and documented in the nameroom. The specification is called *ontology*. Logically high-level and logically low-level actions are visualized in different places. When the subject follows the time line, he/she can see how the content values of different (named) actions of the object change.

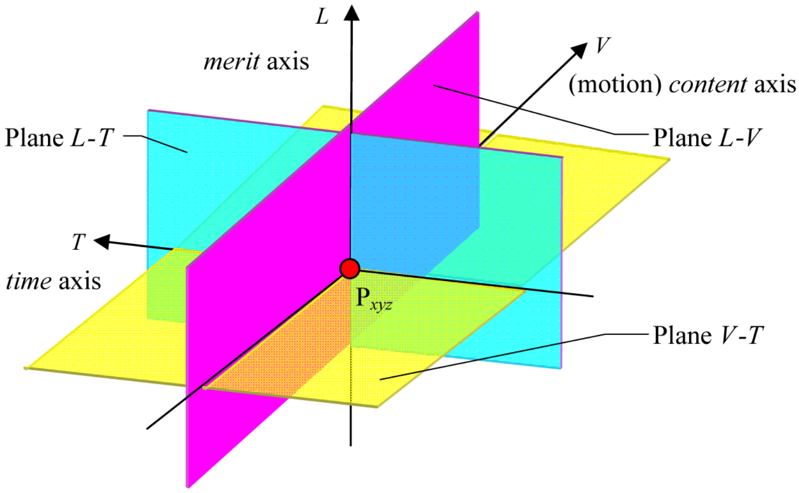

Fig. 10. Main aspects of realization of a geographic object.

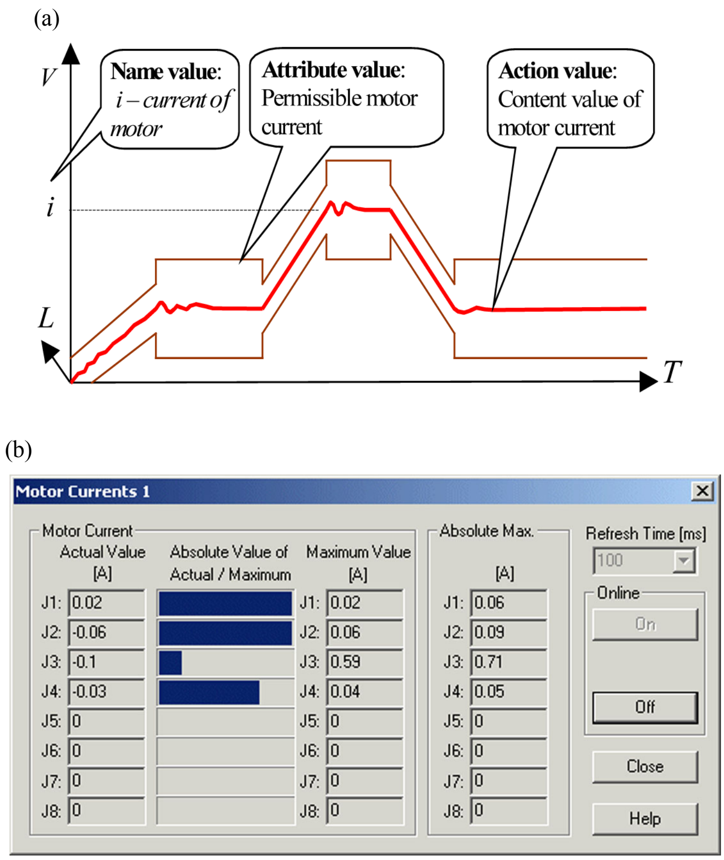

Fig. 11. View of the current values of a loaded robot motor.

This view is called *functional*. It is used by engineers, for instance, during simulations of a system. If we use a larger geographic object, the screen of a computer, to visualize different actions of another object, we can see the picture consisting of many pixels. Different *merit* (-level) actions of the motion of an object can be visualized as a graphic function block diagram (represented as the geographic cluster of pixels). The numeric values of the content of actions can be visualized at the input and output points of function blocks. These values can be visualized by different colours. Connections between function blocks are visualized using (geometrized) lines. Actually, the lines belong to the 5th or the 6th dimension. The segments of connected lines that are oriented parallel to the (motion) *content* axis visualize the logistic aspect of the named actions of objects. Connected line segments that are parallel to the *merit* axis visualize the logic aspect (the transformation of the actions) of a motional object. The named logically high-level actions of the motion of an object should be visualized at the top part of the (geometrized) function blocks. This means that different logic "weights" or "qualities" of actions can be measured using the *merit* axis and that the logistic content and merits of the motion are distributed.

The content value of an object motion can be measured using the *content* and *merit* axes together (as the complex etalon). One can also calculate or measure the derivatives of the motion, e.g., geographic speed, using additionally axes *X*, *Y*, *Z* and the time axis *T*. This view can be used to show merital (logic transformation) value and logistic content value of actions of the "smart" electricity grid. A subject (an observer) that is connected to a generator line and also to load line objects of an electricity grid can measure the power (during the time interval) using "smart" power meters and then calculate and visualize the transfer of portion of electric energy in a geographic space.

On the pure *L*-*V* view a subject cannot exactly see the temporal values (defined by *starting* and *stopping* points) of the action, because the corresponding time axis and also the geometrized values (*ct*) are hidden.

The fifth view indicates how different functions (or function block networks) are displaced (distributed) onto corresponding *merit* layers and how distributed intelligent, energetic and physical resources are connected to the other resources in the 6D environment. The high-level logic, logistic and temporal aspects of motion together can be described by the general term *flux*.

Figure 12 represents axes *L* and *V* and an example of the function block diagram for personal data manipulation. This picture is created using the existing software tool [21].

The sixth basic view is based on the merit *L* and time *T* axes pair (*L*-*T* plane). The view is oriented perpendicular to the geometrized axis pair *L*-*T*. This view is something quite new for an electrical or mechanical engineer who measures things in the geographic space but may be quite common for an information technology specialist or a project manager.

So what can a subject "see" or measure from the sixth viewpoint if he/she is associated with an identified active object point P_{xyz} at a time moment? The

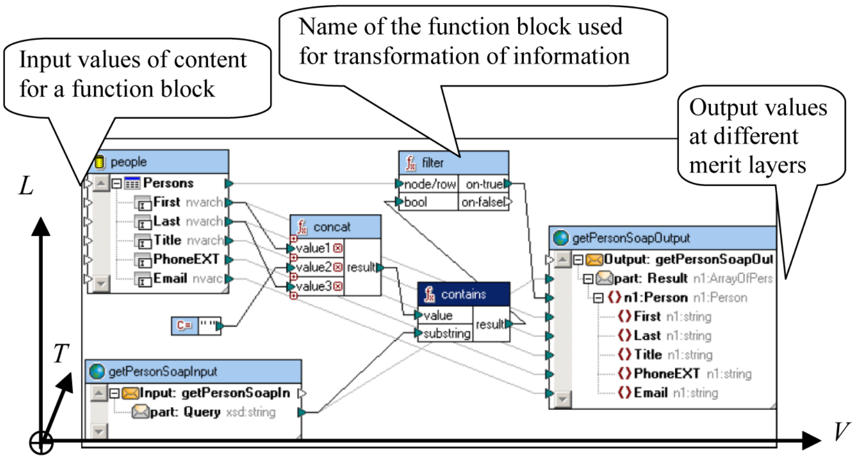

Fig. 12. Functional diagram of a part of an information system.

subject sees the "minimized" snapshot of the object motion. Names of actions of the motion are located (distributed) at different layers of the *merit* axis. In this view a subject cannot see divisions on the (motion) *content* axis. So the logistic value of the motion (the real content value of actions) is fully hidden.

Temporal cluster of the named actions is called a *realization schema*. Each name in the cluster is declared by opening and closing symbols. High-level (4th–11th *merit* layers) meaningful clusters are mostly informative. Very high-level (named) actions are identified as subject dreams. A subject can think in the 6D space if he/she is alive, so he/she has logistic, merital (logic) and temporal connections to his/her main geographic object named *body*. We think always we start and stop (named) actions, transform values of logic and transfer (logistic) content at different merit layers. At lower merit layers we transform and transfer physical energy.

The name *energy* (also *work*) is used for a cluster of actions at the 3rd layer of merit. The name *power* (also *activity*) is used for action(s) that happen at the 2nd layer of merit. The name *tension* (also *voltage*, *pressure*, *stress*) is used for action(s) that can exist at the 1st layer of merit. Finally, the name *current* (also *flow*, *stream*, *movement*) is used for material actions that exist at the zero layer of merit.

The temporal channels (temporal connection) for the named content of actions of a concept can be identified using *starting* and *stopping* points (and temporal values) of matter. Temporal values (the time) measured at lower merit layers of the concept can be used to identify geographic (logistic) transfer of data, energy, power, tension and current.

A *data schema* represents temporal composition and merital (logic) architecture of a concept, a model or a device. Names of every element of the human-made data schema describe (realize the meaning) of the corresponding content. The data schema of an object can be composed using the rules of a formal language, e.g.

Extended Markup Language (XML). The structure of an XML schema includes components, elements, compositors and connections [18, 22]. The meaning of compositors in the data schema is to show the sequence or choice of temporal actions for the processor. In a control system, the sequence or choice of temporal actions is realized automatically according to the predefined program. Putting temporal snapshots of actions of the object into continuous series and integrating them on a diagram, the creator obtains as a result of the well-known *Cantt chart* used by many project managers [23].

7. COMPLEX VIEW OF A CONCEPT

The data schema of a concept or a functioning item can be differentiated into subject (source, input) and object (resource, output) groups. The complex (visual) data schema that represents both the geographic organization and architecture and the realization organization and architecture of the concept and the invented axis system, is represented in Fig. 13. This data schema can be created using software XMLSpy [22]. The origin of the 6D axis system is hidden in (deep) matter. *Merit*, *time* and (motion) *content* axes traverse the geographic space.

A subject defines the content value of the motion of a corresponding object using a measurement method that applies the *merit L*, *time T*, *content V*, *lengths X*, *Y* and *Z* etalons.

Depending on the direction and level of abstraction of an observer's adjusted view, he/she sees more or less. The complex 6D view can be used for the temporal representation of the named content values of motion. For example, a 6D view of a small part of an electrical system (organization of the concept is

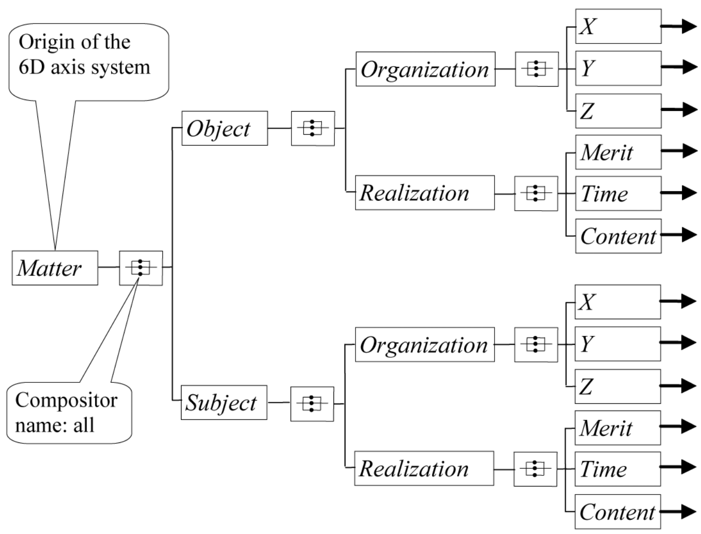

Fig. 13. Data schema of the 6D axis system of the concept.

described with geographic points P1$_{xyz}$ and P2$_{xyz}$ and its realization is described with merit, time and content dimensions) is represented in Fig. 14. Figure 14 also shows (geometrized) realization space that is defined in the area (Δl, Δt, Δv). In geometric space the Δv represents a quantified length (distance).

Structure of the motion of the electrical system is built up using actions, activities, works and tasks. The common symbols (names) of properties (parameters) of an electrical system are shown in Fig. 14. Transformation and transfer of energy *E* in the electrical system is controlled by the switch concept *S*. The 6D view is useful for understanding and description of the structure of the motion and the dynamic interconnections that exist at the time slice (or even series of time slices). The complex geometrized projection of information is meaningful, because we can show the high-dimensional aspects of motion in a single geographic space. But remember that only two points, P1 and P2, are located in the common 3D space. The points are the system delimiters of the formal language. Such proposed complex view can be used by engineers who develop or enhance existing engineering methodology for distributed systems. Connection of the data structure of a subject to the corresponding object data structure and to the neutral (intermediate) merit axis format can be described using the existing conversion tool [21].

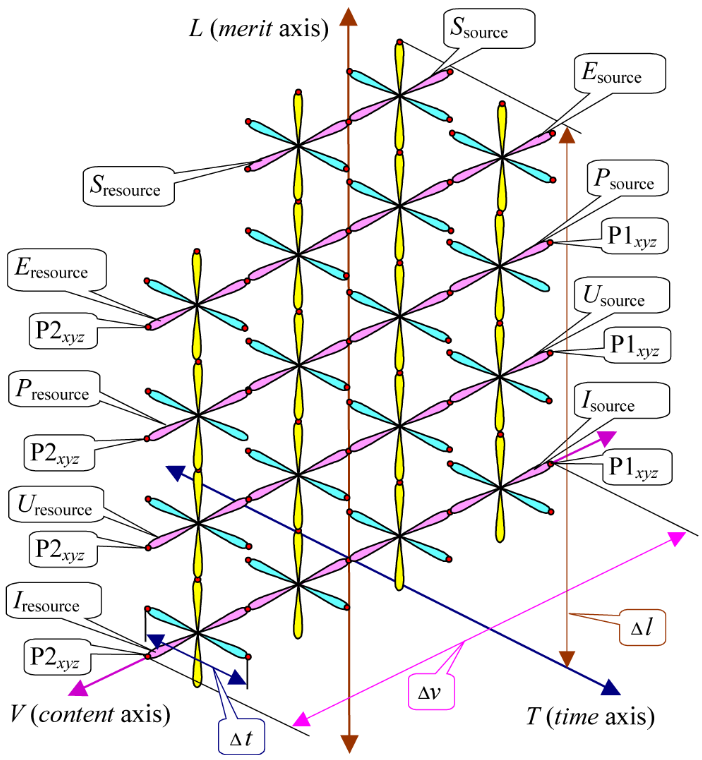

Fig. 14. Use of the *merit* dimension for the description of a complex activity.

8. STRUCTURE OF NUMBERS AND THEIR RELATION TO CONTENT AXIS

In mathematics we use natural and real numbers to represent the measured content values of an action of a motion. Organization and architecture of a (meaningful) number imply the *merit* axis. In the number, the *merit* axis is formally hidden. The meaning and sequence of the logic levels of the number are defined in a separate nameroom. The nameroom (the ontology) was defined probably thousands of years ago. Visual explanation of the value of the natural number 8964 is given in Fig. 15.

To model the numerical value for the content of a (possibly complex) concept, names and numbers are used on predefined positions. Also, connections (the logic and logistic links and matter) are needed to compose a full picture.

In natural numbers, the *merit* levels (of measured action) are expressed verbally (one, ten, hundred and thousand …) and the content value is expressed numerically (0, 1, 2, 3, 4, 5, 6, 7, 8, 9). Each decimal number consists of (replaces) a short series of elements (1) and once (0). The element (1) represents the value of the content etalon of the action of a concept. In the developed space framework, a meaningful (hierarchical) set of realization names, such as **action**, **activity**, **work**, **task**, **process**, **application**, **game**, **project**, **programme**, **life**, and **dream**, is proposed for most general (qualitative) levels of the *merit* axis. The names are not usable for the quantity or property names of a concept. A merit axis item can be characterized as neutral or intermediate.

The names of merit levels can be used to define the information models of subjects and objects. The models are used, for instance, to describe information produced and consumed by applications and to exchange information with intelligent electronic devices [24].

The hierarchy proposed seems appropriate to start a standardization process that would lead to a platform-neutral standard to be established. Obviously, as with most classifications, this one should not be considered as a fixed standard for all intelligent studies, but rather as a guide for reference as we make our judgements and analysis. These proposed general names are used very

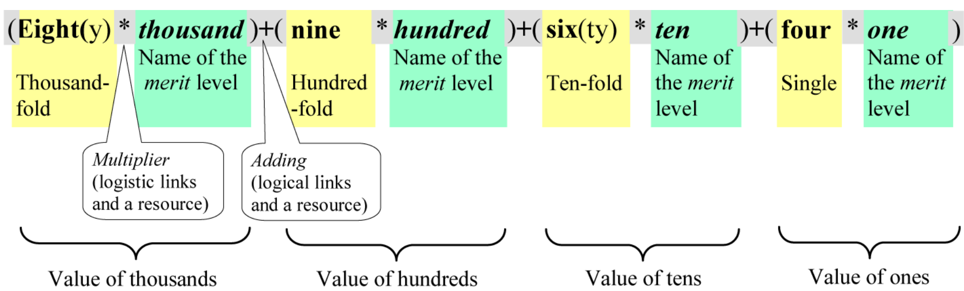

Fig. 15. Organization and architecture of the natural number.

frequently. In industry automation, for example, to complete an **application** some predefined **processes** are activated. The process includes some **tasks**. Each task is realized by workers who do some **works**. For each work some **activities** are needed. An activity starts one or more **actions**. To realize actions some **links** are connected. Names, and natural and real numbers can be thereof used to define the (logistic) content value of work, activity or action of motion.

9. SYMBOLIC DESCRIPTION OF REALIZATION

The framework proposed above is based on an analysis of the use of words and terms by humans in different real-life situations and in written texts of different documents and software tools. The findings result from the study conducted during several years. People use a symbolic language to sense the existing reality in six dimensions. One reason why people at all use symbolic languages is the need to explain why motion of an object comes into being in so many different forms (different quantities, properties), and why a property value appears at a particular moment and at a particular geographic place.

A meaningful technical text (composed by a subject) that describes an object realization also clarifies the levels (hierarchy) of the *merit* axis. Many people (also students and scientists) unconsciously use the merit dimension in complex everyday situations. But they are not clearly informed about this six-dimensional space model and as a result, use the same terms in a system in a different order.

In this paper in the discussion of a six-dimensional framework, major attention is paid to the content value of the motion of (real) matter. The content value is not separable from the description of a system.

The six-dimensional basic framework for a concept (declared with two geometric points) is visually represented and explained in Fig. 16. Layers of geometrized motion are represented by different colour 3D boxes. Every measured physical, energetic or logic value belongs to a defined merit layer (and box). Remember that stacked boxes in Fig. 16 are visualizing the concept **realization**, not its geometry.

The geographic Point 1_{xyz} and Point 2_{xyz} can be associated with parts of a (formal language) system, representing, for example, an element, a component, and a module of a real device. An element is a so-called black box, consisting of at least two points (each including some matter), two internal links and a portion of acting matter between them. The matter has a role to transform also foreign motions that belong (stay) outside the system (Fig. 17). During the motion, matter is transferred between the geographic points of a system. Mass is a property of a physical object that mainly quantifies the amount of **matter** and **energy** it contains. According to many physicists [25], today mass of a free

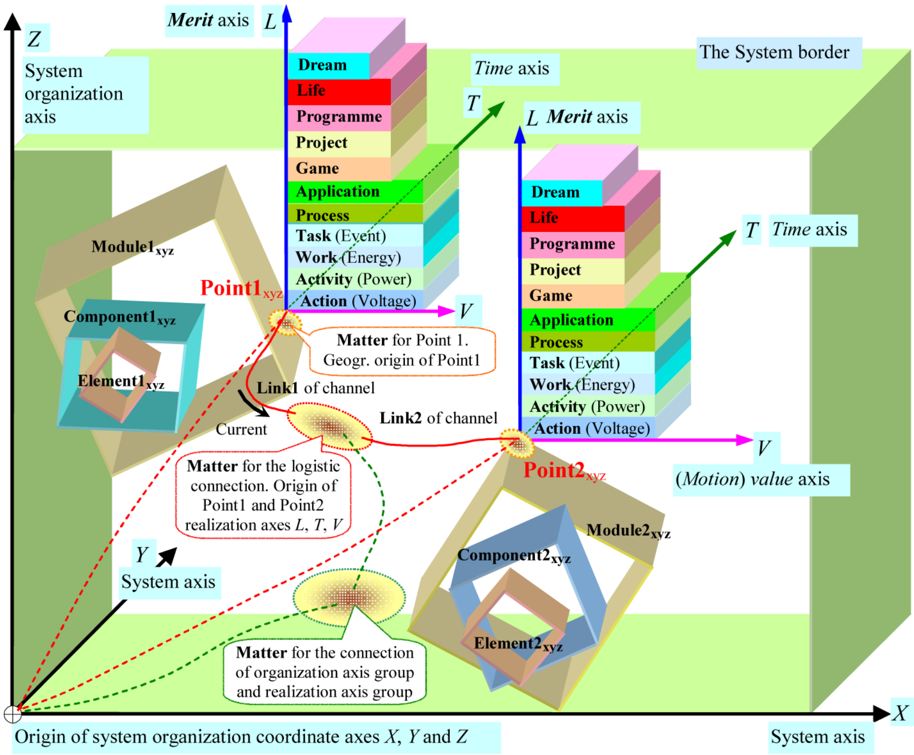

Fig. 16. Visualization of a six-dimensional space framework.

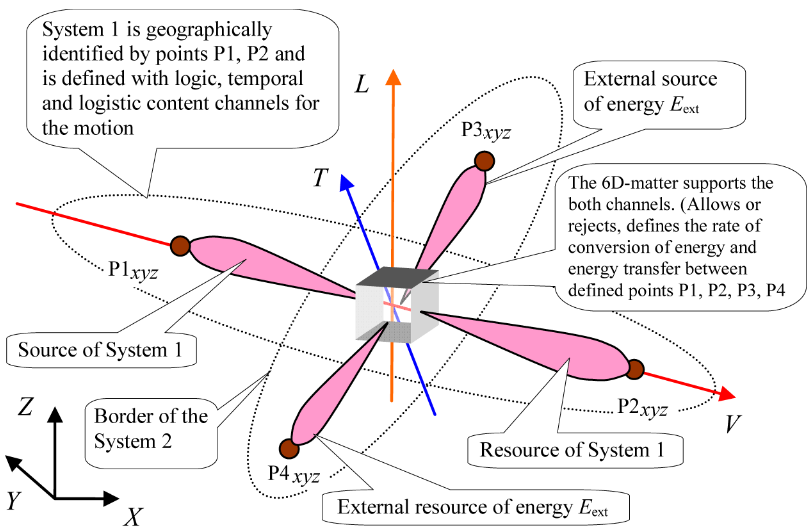

Fig. 17. Logistic connections for the external energy E_{ext} from System 2 to System 1.

particle (m), energy (E) and momentum (p) (when momentum p is much smaller than mc) are related, as expressed by the following Taylor's formula:

$$E = mc^2 + \frac{p^2}{2m} + \ldots, \tag{4}$$

where the leading term mc^2 is the *rest energy* of the object, c is the speed of light. The second term is the classical expression of the kinetic energy of a particle and the higher-order terms in the formula are basically relativistic corrections for the kinetic energy. These corrections are also real and include more intelligent content than the rest energy or the kinetic energy. For a macroscopic object, the rest energy includes also thermal energy. The rest energy liberated in the nuclear fusion or fission is transformed into the kinetic energy of reaction products.

Suppose that kinetic energy of an object is realized (*stored* if the action of a concept is stationary) in the third *merit* layer. The new *merit* dimension puts physical actions into a platform-independent order and expresses the meaning of much higher-order relativistic actions (that are intelligent). The *merit* dimension can be used to describe concepts or networks of the connected concepts keeping in mind the following:

- Motion can be logically differentiated (actions are expressed by differently named layers).
- Human brain can sense the declared *merit* dimension and is capable of creating and representing mental systems, e.g. the 6D axis system.
- The base point of the proposed 6D axis system is hidden in deep matter.
- The most low-level actions of matter are unknown to today's physicists.
- Massive logistic connection should be defined below the first merit (logic) level.
- Life is the name for a high logic layer of the merit axis. Dream is the name for the layer that is even higher than life.
- Life cycle is the term that describes also life level actions of a concept, a model or a body.
- Mental systems of an active subject have propensity to be realized (as models or objects).
- Function blocks can include meritally high-level sources and resources. Application function blocks can be managed by management function blocks.

The formal system is a mental entity but it always leaves something outside. Dreams render outside (meritally very high-level) views to our real life. The dream level quality is based on a life level. You should be *alive* when wittingly pushing a control panel button or designing a new solution to an electronic device. The term *life* is more complex than the term *programme.* The term *programme* is more complex than the term *project.* A programme describes several projects. The term *project* is more complex than the term *play*. A project is realized as the composition of several plays. The term *play* is described using several simpler terms like *application*. The term *application* is more complex than the term *process*. The term *process* is realized using logically lower *tasks*. The term *task* is more complex than the term *work*. The term *work* is more complex than *activity*. The smallest defined part of motion is action.

10. DESCRIPTION OF A SIMPLE ELECTRICAL SYSTEM

In Fig. 18 a small part of an electrical schema is presented. Electrical current I_{load} measured between (geographic) connection points P1 and P2 is caused by the complex motion that is composed from different (merit level) actions:

- higher (fourth) level **switching event** *S*,
- slightly lower (third) level **energy** $E_{P1\text{-}P2}$,
- still lower (second) level **power** $P_{P1\text{-}P2}$ and
- the first level **voltage** $U_{P1\text{-}P2}$.

In mechanical sciences the analogy is: a switch, potential energy, applied power and tension. The subject with measurement instruments and the measured object (System 1) are influenced by an external energy from source E_{ext} (System 2) that is connected to System 1 using the common matter of the logistic channels (Fig. 18).

Thus, connections between the geographic points of the systems are complex. To describe the complexity of electrical phenomena, the *merit* axis is needed. For example, to put the switch *S* (Fig. 18) into action the following condition should be fulfilled: the 4th layer should contain the connections for (logistic) content, merital conversion and temporal action. Such a complex realization channel is

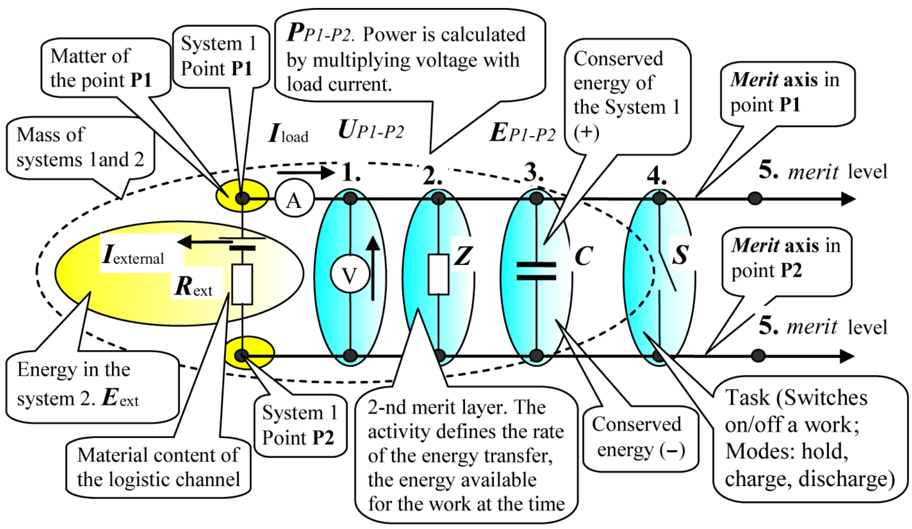

Fig. 18. Electrical schema. Visualization of different *merit* layers of a very simple object.

materialized at geographic points P1 and P2 of System 1, which can open or close the channels for energy, power, tension and current flow on lower merit levels from System 2 (defined with points P3 and P4). Causes for activation of the switch S1 can be geometrized (stored or transferred) at a higher-level source and resource of System 1. The rest of reasons may be located outside the electrical system.

11. GUIDELINES FOR FUTURE DEVELOPMENT

Fragments of the proposed 6D framework are perceptible or already used in some form in information technology tools, e.g., in many industry standards [26–28]. They identify terms and rules for a human-made engineering game. Focus of these technical standards is on process automation and control. If we play according to the rules of these standards, we should obtain compatible technical applications for automated control of distributed technological or other devices. New software tools, based on information technology standards and the proposed framework can be realized.

Sometimes people are not aware of the analogy of adjacent sciences and series of their terms: information, events, energy, power, tension (voltage), current, and mass or matter. There is still no single widely acknowledged theory or ontology framework, linking together organization, realization and architecture terms important to us or computers that control semantic web applications.

The proposed framework helps one to make descriptions shorter and clear (monosemantic). But prior to the implementation of the 6D space in different sciences, a common standard (independent of a science platform) is needed.

More compact teaching methods and software tools for students, designers and operators can be created. In the future, we can offer the users principally new navigation means, so that they can visualize, view at and work with the content of the system or its parts using all the proposed six dimensions. Philosophically speaking, an observer can see object motion also from different merit levels. Today we still declare the dynamic action (quantity or property of motion) in the 3D geographic space. In many cases the merital structure of actions (properties) of a dynamic item is not clear. Using all the organization and proposed realization views together adds new dynamics.

A meaningful description of a geographic concept is achieved when an observer makes a certain "mental walk" or follows a visual path that shows the object and all its realization views (its phenomena) using axes X, Y, Z, L, T, and V together. Such a 6D scenario can be very powerful. A sample visual interface that explains a user object is given in Fig. 19.

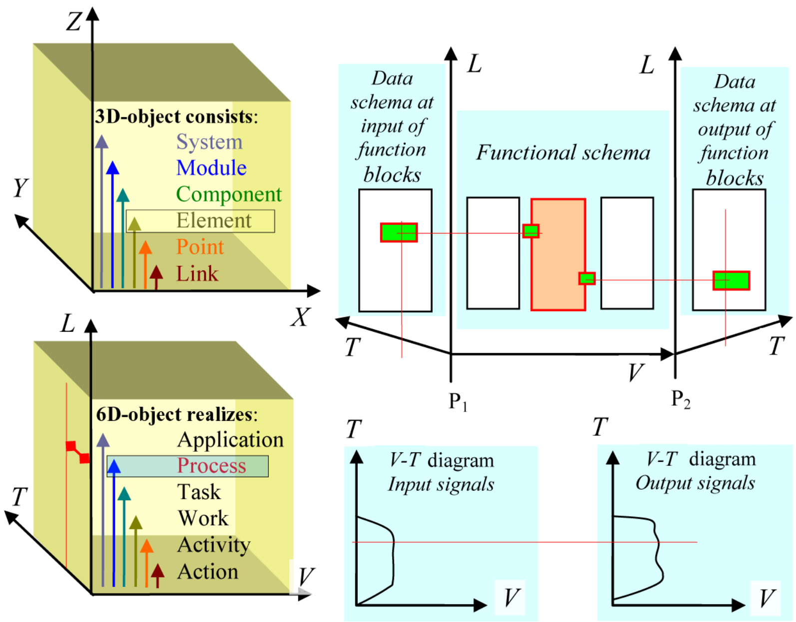

Fig. 19. Visual (graphic) representation of an object organization and realization.

12. CONCLUSIONS

The proposed six-dimensional framework and the corresponding axis system incorporate common geographic axes, time axis, and the new content and merit axes. The time axis, content axis, and merit axis together form a new group of realization dimensions. Organization and architecture of the content and merit axis are defined and explained. The action principle is improved with the merit dimension. The action principle models more precisely elements of the motion of the dynamic concept, model or device. The meaning of the name of action of the concept is clarified. The structure of complex motional concept actions is visualized.

Six basic views, describing the 6D space, are proposed and defined. Special attention is paid to the aspects of a geographic object realization.

Organization and architecture of natural numbers that normally represent the content values of an action are clarified. The meaning and sequence of the logic names of the natural number are commented. A visual example and an explanation of the value of a natural number are provided.

The hierarchical (qualitative) order of realization names, such as action, activity, work (energy), task, process, application, game, project, programme, life, and dream is proposed for general ontology of the merit axis. The name hierarchy proposed seems appropriate to start a process that would lead to the science-neutral ontology to be established.

Within engineering context, the meaning for the term energy is expanded and described. The term acquires a meaning that is not only purely physical but additionally intelligent. The 6D reference entity is used to describe a sample electrical system. Energetic terms are used to introduce merital distribution and explain the transformations in electrical engineering.

The new framework can serve as a foundation for improving the engineering and control methodology of complex distributed systems and for perfecting teaching methods in different fields, for instance, in electrical engineering education.

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Kuuemõõtmeline ruumimudel hajussüsteemide kirjeldamiseks

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On kirjeldatud kuuemõõtmelist ruumimudelit ja koordinaatteljestikku, mida arendajad võivad kasutada hajussüsteemide arendusmetoodikas mõistete, mudelite või seadmete koostise ning teostuse struktureeritud kirjeldamiseks. Eesmärgiks oli luua liikuvate (teostuvate) objektide sisulise tähenduse esitamiseks uus, diferentseeritav, hästi struktureeritud süntaktiline mõiste, mille aluseks on üldtuntud neljamõõtmeline ruumimudel, mida on laiendatud sisu kvantiteedi ja liikumisomaduste kvaliteedi määramise dimensioonidega.

Tuntud *pikkuse*, *laiuse* ja *kõrguse* dimensioonid piiritlevad kolmemõõtmelise alamruumi liikuva objekti geomeetriliste punktide määramiseks. Tuntud *aja* ja uute *sisu* ning *kvaliteedi* (ingl. k. *merit*) mõõtmete koostamisega moodustub uus kolmemõõtmeline teostusruum, mis võimaldab kirjeldada liikumise omadusi väljaspool geomeetrilisi punkte. Ajaliselt võimaliku liikumise nimeliste omaduste väärtused määratakse geograafiliste punktide juures, kasutades formaalsel keelel põhinevat semantilist abivahendit.

Aja mõõdet kasutatakse geograafiliste ruumipunktide vahelise teostusruumi liikumiskanalite piiritlemisel ja mateeria erinevate liikumise omaduste määramiseks; *sisu*-nimelist mõõdet objekti ajalise liikumise omaduste sisu kvantitatiivsete väärtuste määramisel; *kvaliteedi*-nimelist mõõdet ajalise liikumise piiritletud sisuga omaduste kvaliteedi määramisel.

Kuuemõõtmelise teljestiku telgede nimetused on: *pikkus*, *laius*, *kõrgus*, *aeg*, *sisu* ja *kvaliteet*. *Kvaliteedi*-telje tasandite kirjeldamiseks ja nende põhijaotiste nimetuste väärtuste määratlemiseks on loodud uus ontoloogia. Põhijaotiste väärtusteks on artiklis esitatud järgmised terminid (alates madalamast): mateeria, ühendus, toiming, tegevus, töö (energia), ülesanne, protsess, rakendus, mäng, projekt, programm, elu ja unistus.

Sisu-telje põhijaotiste ja objekti sisuliste omaduste väärtuste kirjeldamiseks kasutatakse araabia numbrite süsteemi.

Kuuedimensioonilise ruumi potentsiaalse rakendusvõimaluse selgitamiseks on esitatud näide elektrotehnika ja tootmise automatiseerimise kasutajaliidese loomise valdkonnast. Uut ruumimudelit ja vastavat koordinaatteljestikku saab rakendada õppematerjalide loomisel.