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Social Technologies of Work with Knowledge and Information for Engineering Design and Education Activities

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Introduction

Society existences by socialization of young generations. Usually it is carried out through system of education (SE). In today's Russia and in the countries of CIS "to socialize" it is necessary not only youth, but also many adults.

Today among threats to National safety on the first place leaves inadequacy of national system of education with the modern requirements to socialization of the individual. The transition from system "of scientific education" to system "of scientific-technological education – STO" is necessary now. This task can be considered as the social order for methodologist and politicians of education. Now scientists from Academician Scientific Council for Social Technologies in Education (ASC STE) well understanding the named problem. The results of study by this collective of STE problems are submitted in the report [1] and in the paper [2].

Character of paper. The paper carries character of target setting. Its main idea consists in association in uniform social-technological system of three probable approaches to construction of education systems (ES):

- "Knowledge", the approach (KA), putting before SE the purpose of transfer from the teachers and the mastering by the schoolboys as is possible of a lot as it is possible better of knowledge. This approach dominated by centuries. It is constructed, we shall name it so, scientific education (SE).
- "Activity", the approach (AA) [3], when the basic attention addresses on preparation of the pupils to activity (first of all, design). This approach does not exclude development of knowledge. But there is the deep distinction of design activity (DA) from research activity (RA). AA is most advanced in Great Britain – in the form of technological education (TE).
- The "information" approach (IA), when the main attention is given to application in ES information technologies. It occurs on our eyes and the comments does not require.

Uniting beginning. Three named approaches derivate three various classes of processes in ES. It is more correct to speak about them as about various social technologies (ST) in education [4]. ST answer a question: "as it is a lot of and well to do". And to do – together with other people and with application of all treasury of human knowledge. This concept – firm conclusion of the people from the ASC STE received in a course of thinking during decades of their educational, scientific, teaching, engineering, inventive, design, methodological and scientific – organizational activity. Not all agree with us. By present paper we, after the report [5], invite all interested on development of the serious and argued scientific discussion: written and oral, in a network and in physical space, public and confidential.

But there is one more basis of activity – principles of believe of the actor. The authors trust in the Man. The ST concept – for the believer that the main, key factor of any development – in family, at university and in Science – are the human qualities.

Human qualities in the knowledge society. As ST are created for businesses of the man, it is reasonable to address to the People of Business. One of such figures is Aurelio Pechei, the founder of the Roman club and Institute of system researches. That he writes: "… the exclusive importance is got now inherent by all … to the people of a planet by internal human qualities …. You see, in effect, these qualities are the most important resource of mankind comparable unless with … by that energy, which so generously is sent us by the sun". On our sight, the human qualities are realized through an item.

For 35 years there were so global changes, both in communications technique, and in volume of knowledge, that began to speak about a society based on knowledge ("a society of knowledge") and about information century. Ours credo: knowledge and information (we shall add also art) – everyone can not ensure activity of the Man. Obviously, their synthesis is necessary. Our version – synthesis can and should be carried out in space of technologies of activity – in space of social technologies.

Statement of a task

Our statement of a task follows from an inspiring example of the British Academy of sciences (Royal Society – RS).

Technologies of activity and fundamental sciences: organization and management of the information, knowledge and technologies. The exclusive importance of Engineering Design (ED) for socio economic development of the country has forced the President RS to recognize, that ED a lot of more serious attention of Academy is worthy, and that it requires fundamental scientific maintenance. There is simultaneously recognized, that the existing science is not sufficient for this purpose.

Another science is necessary, and RS promised actively to be engaged in its creation. This problem today is discussed all over the world. One of ways to an ultimate goal also is already found. It consists in search "of cardinally new ways of organization both management of the information and knowledge".

Having added in this super task "... ***and technologies***", we make the following step in a way to the decision of this task.

Definitions of key concepts. To give precise scientific definitions to the considered terms - task not from easy, you see there are many tens definitions. It is clear: there are a few concepts, which would be so all penetrating and general, as named. In the general view it is possible to give the following characteristics of a context, in which we consider the given concepts:

a. The man differs from other inhabitants of the Earth by that actively learns the World. The knowledge can be treated as result of this learning.
b. The man differs also by that he unique has taken possession of art (and science?) purposefully to change the World, adapting it to the needs. His activity has made the modern world with weight of artificial elements so convenient and beautiful.
c. The man has invented and has mastered weight of symbol-sign systems: hundreds colloquial languages, language of mathematics and tens subject scientific languages. All this – for display, transfer and transformation important for his life of the items of information. With their help the Man uses the formalized information already many thousand years.

Let's give the following working definitions of the named above key categories of the ST concept (we shall emphasize, that they can change depending on real contexts of soluble tasks):

Activity – set of systems of purposeful actions of the men directed on satisfaction of his various needs and on the decision of tasks, necessary and – or useful to his life and development.

Knowledge (individual, personal) – set of fixed (in neuron connections of a brain) representations of the given individual about the world, environmental him, and its laws and assisting to him to conduct activity. ***Knowledge (social)*** – set of personal knowledge of the people in a society, and knowledge fixed on carriers of the information.

The information – formalized display of set of individual and social knowledge, and also acts of activity in this or that system of marks and symbols, clear its users. The information helps the people to conduct cumulative activity.

Classification of social technologies of activity

Heuristics of statement. To receive the system description of all three kinds of education, it is necessary to enter into consideration space uniting in a single unit space of knowledge, space of the information and space of activities. Let's enter into consideration set of processes accompanying action of the individual man both groups of the people, and forming his/their activity. It is possible to name them as "intelligence-activities" processes (IAP).

The majority of IAP can be presented as certain technological the processes, in which by a resource (raw material) and product (result) serve elements entered above spaces. For the beginning we shall allocate among them the elementary subclass of processes, in which the elements of one or two sets participate. As both resource and product are elements of the named above sets, the pair interactions can be submitted by a matrix, lines and columns with which are the named three classes.

Such matrix is submitted on Table 1. In its cells the almost obvious variant of interpretation of nine kinds (on number of cells) various processes of pair interactions are given. Other interpretations are possible also.

Table 1. Structure of space of processes of pair interactions in a triad "Knowledge – Information – Activity"

The basic product / The Basic resource	Knowledge	The information	Activity
Knowledge	Reflections, thinking (Empire of reason)	A spelling of the texts. Formulation of speeches Subjects of art	Competent practice
The information	Scientific education	Processing of the information (Empire of computers)	Informational supplied practice
Methodology of activity	Technological and design education	Research, Design, Management	Social - technological practice (Empire of life)

This classification is idealized, modeling. Real vital processes differ from IAP (Table 1) by that both resources, and the products can include elements of two and more types. Thus, in result the set from 9 ways of construction of technologies in space of "Knowledge – Information – Activity" turns out. Rather interesting thus the presence of asymmetry in structure of these technologies occurring is represented that the different areas of this space have by the basis different "Pictures of the World".

At last, it is uneasy to see, that the named processes, are some kind of "technological elements" for construction of complex technologies of management of knowledge, information and activity at a level of a society – that is, form by itself, as a matter of fact, "social technologies".

Thus, it is possible to give the following working definition to social technologies: "Social technologies – ST – are by itself the ordered set of ways and methods of transformations of knowledge, information and activity in social systems".

A number of examples for the description of the approaches to the decision of various tasks arising at different stages in modern SE are below considered.

Classification of the information about object and subject

As shown in [2], the activity can be submitted as translation (set of translations) object of activity (OA) from one status in another and - or from replacement of one process in OA on another. For successful modeling of integral activity it is necessary to be able to divide and to describe different statuses OA and processes occurring in it. The procedure of this division should be "technological", that is represent a sequence of steps allowing to reach result – classification of statuses and processes for OA. Thus it is important, that the technological circuit became invariant for a wide range of tasks.

We shall use further term "information" in a broad sense, switching in its volume both textual documents and data. Status of object of activity (present or planned) we shall characterize by a set of events.

Thus, the data on any event can be divided into eight not crossed among themselves classes of the information. The schematically described technology of splitting of any database on classes of the information is submitted in Table 2.

Table 2. Information space of the object

The data on object	The data on a class of similar events (generalizing components of the information)	Basic elements of a class (structure, topology)	Static	Str-Stat
			Dinamic	Str - Din
		Border between the given class and others	Static	Bor-Stat
			Dinamic	Bor-Din
	Data on this event (detailed components of the information)	Event as individual and unique	Static	Obj-Stat
			Dinamic	Obj-Din
		Connections of this event with others, similar to it	Static	Con-Stat
			Dinamic	Con-Din

Definition. As information space we shall name set of attribute parameters and relevant characteristics, which allow with the necessary degree of unambiguity to describe OA. Extremely interesting that circumstance is, that in accuracy to the described above information space, in which already on construction the basis from 8 components of the information is allocated, it is possible to reach by two ways: from the general theory of systems (proceeding from definition of the term "system"), and from the description hierarchical (itself organized) systems. It allows to distribute the described above classification and on the subject of activity, for which the work on modelling a picture of the world (hierarchically organized), expressed as the hierarchically organized system of the terms, "of basic concepts" and – or "of symbols of believe" is characteristic.

The subject of process of activity – separate individual and – or social group – in quality of "intermediary" between the real world and internal picture of the world, within the framework of which occurs thinking activity and the decisions are accepted, uses words and models. A part of words the individual uses as the abstract terms and concepts, forming from them hierarchical system of the terms constructed on a principle of realization of logic connections between elements and – or by hierarchical levels. Thus, the typical subject of activity forms an image of the future action (or estimation of the last action, or taking place at the present moment of activity) in frameworks and terms of hierarchical system. Therefore also there is a necessity by consideration of the act of activity in the description of hierarchical system in the general view.

In frameworks of the activity approach to the description of the individual and – or of social group it is possible to offer procedure of unification of the description of object and subject of activity. Most simply to make it so: "The Activity of the man and – or of social group is described within the framework of change (on one or several of basic) component of the information about OA. For this purpose the information space OA, appropriate to a task, considered by us is under construction, and is made comparison of the components of information about object up to – and after – act of activity".

Within the framework of the described approach it is possible to give the following working ***definition of activity***: "as Activity the change of processes and – or of status in considered object consisting in change as a minimum by one of a component of the information, describing OA refers to as caused by purposeful activity of the subject of activity.

Let's consider an example of use of information space in engineering design (ED).

Engineering Design: dualism of description, multicriterion approach to the statement, resolving contradictions

The ancients believed the world to rest on three whales. We want to make use of this model when building the picture of engineering activity. We are to select three key elements of the methodology. The search for a technical solution (TS) is realized by means of TS generation: by first broadening the search region and then narrowing it by discarding the worst TSs – those which are less efficient than the others. We believe that the key elements of this strategy are:

- the way of organizing the search region – a set of solutions;
- the criteria for narrowing the region – truncation of the set of solutions;
- the principle of organizing the search cycles.

The formation of these techniques is an important task of engineering training.

The first professional technique is a "dual" description of technical solutions. This is a technique of organizing the search region of TS. It is obvious that it is necessary to specify the space of their signs. We consider it methodologically necessary to divide those signs into qualitative and quantitative ones (see Table 3). It is natural to name qualitative signs TS parameters. The latter include geometrical dimensions of the elements of the construction, the nominal values of the electronic circuit elements, etc. A set of TSs differing only in the values of' their parameters is characterized by a certain qualitative generality. We name it TS pattern. No mathematical operation describing the familiar pattern of TS can result in the birth of a new pattern. Hence, the influence of optimization on technical progress is strictly restricted by the known set of patterns. The principal mechanism of progress is the perfection of patterns.

Table 3. "Dualism" in engineering activity

Type of description	**Parametric**	**Pattern**
Character of description	Quantitative	Qualitative
Character of processing	Analytical	Figurative
Character of innovation	Continuous	Stepwise
Mechanism of innovation	Optimization	Heuristic search
Innovation result	Optimal	Invention
Effect estimation	20 7 2 %	2 10 100 times

The second professional procedure - multicriterion statement and truncation. The conceptual aim of the truncation is to provide the highest possible TS quality, i.e. the best functions, the maximum resources expenditure and the least magnitudes of harmful effects. We do believe: to accomplish such a description of qualities a set of parameters is needed; let us call them quotients of quality (QQs). QQ is a quantitative parameter of the designed object, which is monotonically related (with the condition of other QQs constancy) with its quality [6].

QQ has been introduced for the formalization of the choice and truncation. One should retain those variants of TSs with higher QQs, and discard those which are worse. It should be stressed that if the number of QQs is two or more, the notion "worse/better" becomes less obvious than in the case of one QQ (7,8). The principal factor specifying an engineer's creative role is the number of QQs. If one QQ has been chosen or several QQs are reduced to one criterion, the problem loses its creative character to a considerable degree (see Table 4).

Table 4. Comparison of quality concepts

Number of QQs	**One**	**Several**
Principle of processing	Optimization	Truncation
Processing result	One - the best	"Image quality" of the pattern
Pattern comparison	Trivial - in numbers	Visual
Contradictions	Hidden	Disclosed
Taking a solution	Not necessary	Necessary
Information for further search	Almost lacking	Completely available

The TS pattern can be characterized by a so-called "quality image" (QI), a multidimensional surface in the space of QQs consisting of non-worst solutions. Comparison of various TS patterns is reduced to the comparison of their QI. Operations with images are more natural for a designer of new patterns. It allows the designer to make use of the third technique.

***The third professional technique – analysis of technical contradictions*.** Technical contradiction (TC) between two or more QQs is considered such a situation when any change of parameters aimed at the change of one QQ within accepted restrictions unavoidably lead to the worsening of minimum one of the rest QQs.

The above named QI discloses and quantitatively describes system of technical contradictions. An engineer observes which pairs of QQs are in contradiction and where the contradiction lies – between QQs or between QQ and the restrictions assumed in the statement of the problem. The system of TCs is immovable within the frames of a fixed TS pattern. Only by changing the TS pattern you can change or eliminate TCs. But pattern change is an invention. The advantage of the third professional technique is that an engineer processing the result of the multicriterion truncation – QI – is given an opportunity to create at a principally new level – "standing on the shoulders of a giant", i.e. in our case – physical and mathematical analysis.

Having singled out and discussed the main professional techniques of engineering creativity, we can now build the general structure of the professional engineering activity.

Structure of Engineering Design: subject, object, statuses, procedures and system of connections

Fig. 1 shows the Engineering Design structure [8] developed in accordance with the views described above. An engineer is the subject of activities (not shown at the figure). We understand the ED process as a set of purposeful procedures (P1-P8), transferring the object of ED from one status into another (S1-S6). A status is a combination of the designer's systematic notions conditioned by the aims of the given ED procedure. Before ED beginning (status S1) the "tree of needs" is to be conceptually understood.

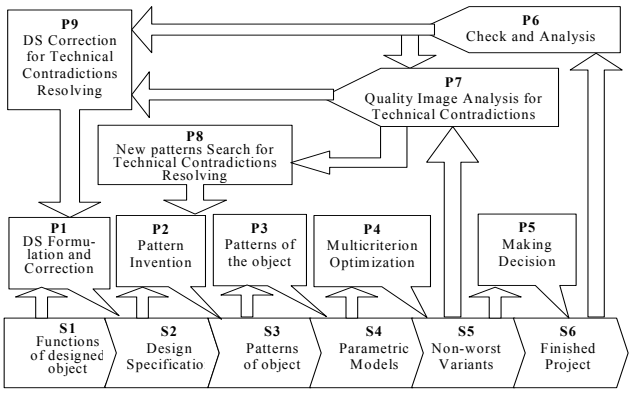

Fig. 1. The Engineering Design Structure

Statuses of ED object and ED procedures. To obtain a quantitative comparison of the TS variants it is necessary

to convert conceptual requirements to the object into a quantitative form - to formulate a Design Specification (DS): status S2. Experienced designers insist that a good DS predetermines 60% of success. An engineer's intention to create a competitive ED object is to be reflected first of all in the DS. One must make use of QQs because they play the primary role. It is QQs that make the core of the ED problem: to create an object fulfilling the functions in the best possible way with the minimum negative consequences and the least possible expenditures. Of particular importance is the fact that every ED object requires many QQs to be taken into consideration. Reduction of the QQs number and the conversion of some of them into restrictions is a forced measure – for the simplification of the models and facilitation of the optimization procedure. Therefore, the choice of the set of QQs is one of the most important conceptual tasks.

The next particular aim of ED is creative in its essence. This is invention (generation) of the maximum number of patterns: ideas, schemes, kinds of constructions (S3). To make powerful mathematical apparatus work, one has to describe all patterns by models (S4). The designation of the models is to connect constructive (inner) parameters of an object with QQs and other parameters of DS. Statuses S3 and S4 are the most capacious object statuses. In the choice of their capacities lies one of the ED contradictions: between a probability of finding the solution of the desired level of quality and the materials necessary for the search, labour and time resources.

The aim at the next stage is to reduce sharply the search region. It can be simply achieved by eliminating all superfluous things; the so-called “worst solutions” - both the worst patterns and the worst combinations of parameters. In status S5 some set of “incomparable” patterns is retained, and each of them is represented by a set of non-worst combinations of parameters.

ED procedures and ED strategies. The achievement of particular design aims, that is the conversion of an object from one status into another, can be realized by purposeful ”technological” actions, which we call ED procedures. ED strategies make up the consequence of procedures. So-called “direct” procedures (P1-P5) form a linear strategy of the direct solution of the ED problem. But this is, as a rule, the worst strategy. The best and least time-consuming results can be obtained by means of cyclic iterative and branched strategies including “reverse” procedures (P6-P9).

Formulation of DS (P1) is a responsible stage of the design. The principal “tool” at the disposal of an engineer in this procedure is his or her conceptual thinking. Procedure P2 is heuristic and inventive. The principal “tools” in it are engineer's ability to invent, his or her vision and intuition. Procedure P3 - the description of patterns in terms of models - is the most formalize done. Both analytical and conceptual thinking is necessary at this stage: for selecting the style of description, important factors and processes, for the substantiation of the possibilities of the simplification of a model. The aim of procedures P4 is a sharp reduction of a set of variants – in ideal to one. But, unfortunately, the world is not as simple as that! If the number of QQs in S2 is more than one, one can choose the non-worst set S5 only by means of multicriterion optimization. In complicated problems the search for non-worst solutions demands the heuristic methods and the choice of the directions of the search.

Decision making. The final procedure P5 consists in choosing one or several solutions S6 from non-worst solutions S5. The peculiarity of the procedure lies in the impossibility of using formally the DS requirements (all of them have already been made use of in P4!). Here the main “tool” is the human ability to take decisions. As a person taking a decision, a designer takes into account aesthetic, ecology and security aspects, the values of the user, and many other factors. In short, the engineer's technical and general culture, understanding of the meaning of life and modus of existence, are the factors, which count at S6.

It should be noted that the form of the region of non-worst solutions gives unbiased information about the expediency of making one type of article or a number of types of articles [7]. But it is a human who must take a decision, and be responsible for it, even in the case when a computer is being used. Iterative strategies with a return by way of “reverse” procedures serve for the verification and improvement of the results for the change of direction of the search and making it more accurate. They are more efficient than direct ones, but more complicated.

If the result could not stand the test in P6, the process comes back to P4 (when there is some hope for improving the result with the help of one pattern out of the set S3) or to P2 (when new patterns are desired) or even to P9 (with the aim of DS correction). The improvement of the quality of TS solutions in ED is almost always accompanied by the situation in which attempts to improve this or that QQ of TS cause the worsening of other QQs or are blocked by the necessity to fulfil DS conditions and DS restrictions of the assignment. Namely such a situation is a technical contradiction (TC). Quantitatively, the set of TCs of an object is characterized by the form of the region of non-worst solutions in QO space.

A TC can be weak or strong, removable (by accepting a compromise) and irremovable. The character of the TCs is a “portrait” of the design situation. It is most important for an engineer that TCs, as a rule, are specified by the pattern of the object. Changing the patterns, one can purposefully affect the character of a TC and in this way find ways of advancing. This is one of the key laws of the developments of ED objects. Procedures P7 and P8 are the key ones in the technology of improving the object to be designed; they are of primary importance at the stage of pre-designing research.

Scientific and technological knowledge

Good illustration (and even confirmation of efficiency) matrix of interactions of Table 1 is the technological education, actively developing in many countries. In England the technological education is based on a paradigm of training named “A Method of the Projects”. A sight on knowledge is considered below, on which this approach is based.

“Declarative knowledge” and “remedial knowledge”. Divide “declarative knowledge” (I know, that it – X) and “remedial knowledge” (I know how to do (make) У) [9]. The second one can be, and can and not to be ex-

pressed by words, it can be conscious and not realized, it can mean actions or simply reflections. At lessons of Design and the Technologies (they are obligatory at all schools of England for all children from 5 till 16 years) speak and do for development "of "abilities" much. It is the term means an opportunity something to ***do***, to be ***active*** in designing and manufacturing of products, ability ***to investigate, to analyze, to reflect, to accept the decisions and to carry out the accepted decisions***.

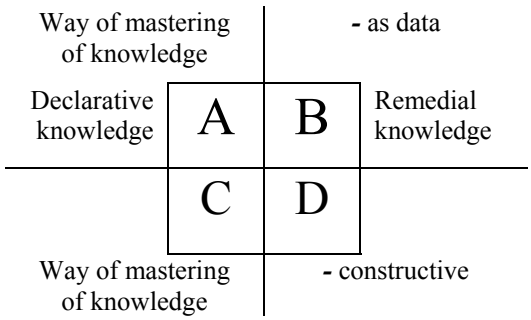

Fig. 2. Structure of space of knowledge on [9]

Scientific knowledge and technological knowledge. The majority of the authors assert that it is impossible to consider technological knowledge only as applied scientific knowledge. Technological knowledge or praxis (from greek. praxis: the combination of reflection and action) - has the right to independent existence, and it is much wider, than applied sciences.

The relations between a science and technology. Among the people engaged TE in England, the interactive sight is most distributed, when a science and technology consider in dialectic interaction. Advantage of an interactive sight - that it rejects the superiority "«academic" above "«practical" (or on the contrary), and also in a recognition of that fact, that we, people, so homo faber (man making), as far as and homo sapiens (man conceiving).

Mastering of knowledge. The experts engaged in education in England, speak about the "«constructive" approach to training children. It can oppose such approach, when during the education or training we deal "with "data". In British TE to the deductive approach prefer inductive. Children carry out the creative training tasks. They together reflect that they have made also to that have learned. There try to avoid lectures on the theory, of which then it is necessary to make practical conclusions, because in result the schoolboys become passive, and, besides such approach hardly results in the present understanding.

Training through the technological projects. TE, based on a Method of the Projects, takes place, basically, in a square D (see fig. 2). The accent is made on active training, when children study to project and to make things necessary to real life. The teacher simply uses the Method of the Projects as a means to achieve the purpose - to develop each schoolboy and to transform it into the creative and initiative man capable to work in the single and in a team, man flexible and capable to study all life.

"Continuum" as not expressed by words or intuitive knowledge. The professor Harrison, one of the TE founders recently has written book [10]. In it he traces, as engineering thinking and the technological abilities develop at the child from the moment of birth. He asserts, that technical development is a universal experience of all people: the ability to engineering and technical designing depends on creative use as scientific (expressed by words) of knowledge, and intuitive (not expressed by words). The general education today owes to operate both forms of knowledge and understanding.

Engineering design (ED) – social technology of transformations of methodology to the design information

Separate question - about sources of social technologies in engineering and in engineering education. In their basis - many-years experience on system training of the engineers for productive design activity [11, 12]. The analysis of this experience, and also description of concrete mechanisms of introduction ST in educational process and their influences on development of education leave for frameworks of the present work.

The world of the Man and World of Engineering today are divided (shared). And it - is bad, of what we are constantly convinced. The various ideas of their association, integration are put forward. It seems, the real opportunity of progress consists in a desirable direction in process "transfusing". We put in it sense evolutionary, active rapprochement, when the mutual understanding will be formed during interaction "transfusants" compelled to decide of a task on a joint of these cultures. Figuratively speaking, object ST, on our sight, just also should become processes "transfusing" of two worlds in their interaction, at different levels, in different categories, in different kinds of activity etc.

Social technologies in space of sciences and practices. Creators always aspired to comprehension and development of communication between Science and Practice. Many from them in the businesses and the life comprehended this communication. Today there is a real opportunity "to socialize" this communication, to make by its more realized, accessible much for a stage of EDUCATION. Let's consider a set of models for space "Science - Practice" in their methodological development. Their system was born during discussion on General meeting IHEAS [13].

1) The most simple model is described by words: "A Science - direct productive force ".

2) Second - too simplified, but considerably more constructive. In it a part connecting a science and practice, is the Engineering Designing (**ED**). The essence **ED** is, that before something to make in practice, the man creates the Project - ideal (and, whenever possible, scientific) description of the future object or future activity. To confirm efficiency of this model, we shall note: namely on the basis of these ideas Great Britain has constructed the national program of development of technological education. **ED** methodology and developed on its basis the activity concept of engineering education have with the British approach much in common.

3) The following level of understanding of a problem has come in an operating time in the IHEAS above the concept of innovative education. It became clear: to develop innovative ability of a nation it is impossible, while

into the base of the thesaurus of educational system will not be entered not only **ED**, but also still lot of structures of activity. Similar, these key elements are the following triad: Research+Design+Management. The chain of these kinds of activity is one more model.

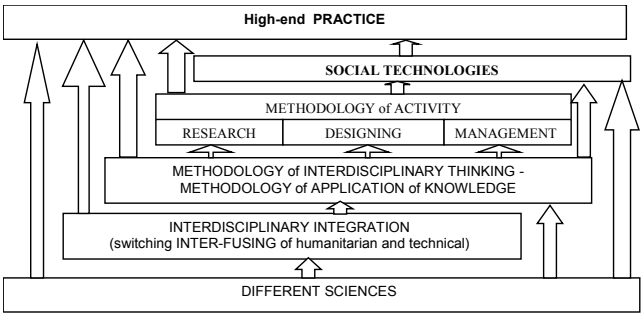

Fig. 3. Structure of LEARNING-ACTIVITY space

4) Introduction ST - qualitatively new and important step in development of model. In the report "Social technologies - resource of development of engineering education" ([13], page 154) and in the subsequent discussion on the section «Methodology and social technologies of innovative education» a number of the descriptions ST through their place in the structure are received, in each of which the centre of structure and main subject of action is the Man. Most typical of them we draw in a Fig. 3, where the graphic model of LEARNING-ACTIVITY space is submitted.

Conclusions

We admit bewilderment of many dear readers and we apologize for possible incorrectness in the text of our paper. But all written above was born by life and creative search of many and many people organized in different structures. We would like here again to express them gratitude and deep sincere gratitude for cooperation and interaction.

We want to emphasize: the described above global applicability ST will execute only in that case, when they will be used not for unification or standardization of activity, but for giving to it of the maximal variety. ST should be formed and accustom for creation of additional opportunities for the personal development.

The described ST and ED structures, based on the professional techniques, offers an engineer freedom of creative self-realization in practically every procedure. Thus, the multicriterion statement naturally integrates invention with a system approach, with physical analysis and mathematical optimization. The result of this integration can be rightly called engineering creativity. The described properties of the ED methodology can be used in a basis of methodology of innovative education.

The kinds of activity, discussed in the work, cardinally differ. This variety together with opportunities of realization of various sets of methods and means, and also different sequences of performance of procedures is opened by ample opportunities for construction ST, which can help development of creative abilities of the Man.

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A scientific-technological education (STE), as the training for innovative activity, requires new organization of work with the information, knowledge and technologies - new "social technologies" (ST) as sets of ways and methods of intellectual activity. Paper represents the structure of ST kinds in space "Knowledge-Information-Activity". The most important for STE kind of activity – engineering design (ED) is considered more detailed. Three key elements of ED methodology are: "dual" (parametric and pattern) description of technical solutions, multicriterion statement and truncation, analysis of technical and physical contradictions. The ED process as a set of purposeful procedures, transferring the object of ED from one state into another, is described. Ill. 3, bibl. 13 (in English; summaries in English, Russian and Lithuanian).

В. Взятышев. Социальные технологии работы с информацией, используемые в инженерной и учебной деятельности // Электроника и электротехника. – Каунас: Технология, 2007. – № 3(75). – С. 5–12.

Научно-технологическое образование (НТО) как подготовка к инновационной деятельности требует новой организации работы с информацией, знаниями и технологиями, то есть новых «социальных технологий» (СТ) как совокупностей способов и методов интеллектуальной деятельности. В статье предложена структура множества СТ различных видов деятельности в пространстве «Знания–Информация–Деятельность». Детальнее рассмотрен наиболее важный для НТО вид деятельности – инженерное проектирование (ИП). Три ключевых элемента методологии ИП: «дуальное» (параметрическое и обликовое) описание технических решений, многокритериальная постановка и усечение, анализ системы технических и физических противоречий. Описана структура процесса ИП как совокупность процедур, изменяющих состояния объекта ИП. Ил. 3, библ. 13 (на английском языке; рефераты на английском, русском и литовском яз.).

V. Vzyatyshev. Socialinės darbo su žiniomis ir informacija technologijos, taikomos inžinerinėje ir mokymo veikloje // Elektronika ir elektrotechnika. – Kaunas: Technologija, 2007. – Nr. 3(75). – P. 5–12.

Mokslinis-technologinis išsilavinimas (MTI), kaip pasirengimas inovacinei veiklai, reikalauja naujo darbo su informacija, žiniomis ir technologijomis organizavimo, t. y. reikalingos naujos „socialinės technologijos" (ST), kurias būtų galima laikyti intelektinės veiklos būdų ir metodų rinkiniu. Straipsnyje siūloma ST aibės struktūra, vaizduojama erdvėje „žinios–informacija–veikla". Pati svarbiausia MTI veiklos rūšis – inžinerinis projektavimas (IP) – nagrinėjama detaliau. Skiriami trys pagrindiniai IP metodologijos elementai: „dualinis" (parametrinis ir struktūrinis) techninių sprendimų aprašymas, daugiakriteris aprašymas ir apribojimas, techninių ir fizinių prieštaringumų analizė. IP procesas aprašomas kaip tikslingų procedūrų, perkeliančių IP objektą iš vienos būsenos į kitą, rinkiniu. Il. 3, bibl. 13 (anglų kalba; santraukos anglų, rusų ir lietuvių k.).