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LEVELS OF KNOWLEDGE, CREATIVITY, HEURISTICS AND LOGISTICS

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Abstract:
The highlight of human activity is a creativity, ability to create new values, products, methods, principles, etc. One of the basic creativity methods is heuristics, based on the transformation of human intelligence to the procedures, models, programs realized by computers, modelling human activities by solution of complex tasks. The important field of heuristics application is logistics, namely in the field of modelling of control activities, such as forecasting, planning, production scheduling.

Key words:
knowledge, creativity, heuristics, logistics

INTRODUCTION

Before we will consider with the term heuristics, it is needed to say that heuristics is closely associated with the process of creativity, human characteristics, as one of the option for design – creation of something else [1]. Creativity (from lat. creo = create, invenio = find, discover), is the property, ability to create, invent something new, original work, process, method, methodology. [2] Creativity of human is conditional on the level of knowledge, ability to process its information from the environment and use them on different qualitative levels [3] where the highest level its use is to use creativity for new solutions (Fig. 1). Heuristics (from the Greek words heureka = I got it, I discovered) is one of the methodologies of creativity, methodology of problems solving by unconventional way, based on modelling of human activities by solution of complex tasks on the base of analogy and subsequent induction [3,5,7]. This approach is called technical-information [7], in contrast to biological-physiological, which is based on the modelling of internal processes of the human brain by problems solution. The following part of the paper describes technical-informational approach, which is actually used for modelling and designing of complex and difficult logistics problems [3].

1 LEVELS OF KNOWLEDGE AND CREATIVITY

The level of knowledge, i.e. the quantity and value of the memory of the stored information, procedures, methods, methodologies, solution…, level of ability to analyse them, look for analogy, generalize – induce the conclusions from them, to rules, principles, procedures, methods, methodology, discoveries, etc., this is a necessary, but not sufficient condition for creativity. The qualitative levels of information processing and their knowledge are presented by the Fig. 1.

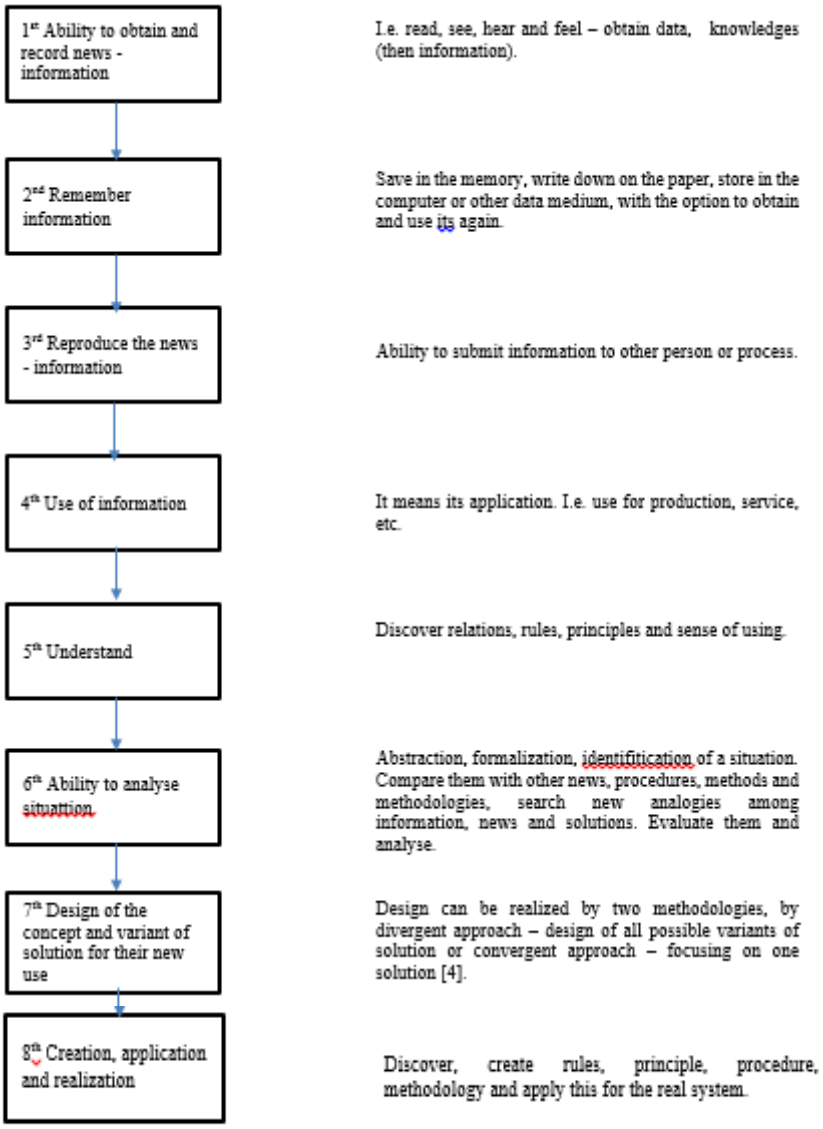

Fig. 1 *Qualitative levels of information processing*

Creative person needs to know:

a.Define the problem – goals, tasks, that must be able to identify, formalize, define their nature in the current environment. The ability to identify a problem is often the base for new solution.

b.Has to a repletion of information, knowledge and skills in the specific field, because only by this way it is possible to review what is new, what kind of solutions were applied by the previous experiments, solutions.

c.Inductive way of thinking on the base of analogy.

d.Apply own rules, experiences, practice as heuristics.

e.Not afraid to generate (induce solutions – without restrictions) by divergent way of creativity, because the environment will evaluate them as the reaction to the design of solution.

f.Do not search always by all means optimal solution, take also with good – better solution, because often, what is optimal we do not know. [5]

The creative process has always these characters:

-Cyclicality – iterative character, because also a small improvement can move the solution to the level "from which we can see moreover", that inspires to new cycle of solution.

-Cognitive character – newness. Creativity is always connected to the newness – originality. Newness can be understood not only in terms of discoveries, inventions, but also as approach that from known elements we create a new system – structure, application of other method to known information, newness in the term of new elements, rules, structures, functions, processes, methods and methodology.

-Evolutional – revolutionary character development. Each creative design should move the quality of solution to the higher level and by this way to assure the development.

These ideas are closely linked to one of the first models of the process of creativity of Graham Wallas, who divided the process of creativity into four phases [6]:

a.Preparation – definition of the problem, i.e. deviation from the state of procedure which the system should have, or we want to improve its state and functioning. Collection of information, abstraction, formalization, definition of the goals and tasks.

b.Incubation – aging, searching, generation of possible solutions, searching of analogies with solutions of the similar problems in the past, analogies of problems versus analogies of solutions, in the database – memory of the creator or in the database of colleagues, friends, in the books, projects, Internet, etc. It is created a chaos of solutions – approach which must mature. It participates the intuition, experience, feelings, subconscious, but it works on the basis of analogy, memory, comparison, induction (or abduction) [7]

c.Illumination – enlightened, it proves by brainwaves, ideas, especially under pressure from the term of ending of solution, brainstorming and communication with experts in the specific field. This moment is named as "AHA" relic.

d.Verification – found, designed solutions meets the definition of the problem, goals of the solution, if it is practically realizable and if it will bring positive effects.

2 HEURISTICS AND ITS NATURE

There are a number of problems and tasks that are difficult and impossible to describe and solve by mathematical models, such as task of capacity production planning, when the production is realized in tens of or hundreds of workplaces and devices. The assortment of product are serial hundreds of articles, on which we have in the planning period hundreds of orders and we must regard the following criteria, limitations and requirements:

-Length of the period of planning,
-Optimal production charge of the products,
-Optimal or uniform use of the capacity of devices,
-Time of products delivery,
-Priorities of customers,
-Connection to the supply chain management, (1)
-Prices of products and margins,
-Salary discipline of the customers,
-Optimal sequence of products in terms of devices displacement, maintenance, continuous change of parameters of the products, etc.

For these types of tasks if is to dozens of criteria, restrictions and rules that must be taken into account by the models creation. None of the known analytical methods, for example linear programming, dynamic programming, etc., i.e. analytical models cannot make provision for these requirements. It is not effective to simplify the problem and adapt it to a known mathematical model and the results are not use for the real practice.

Because it is not possible to consider these problems to the system of bulk service, using the simulation approach for the solution is also unrealistic.

But the enterprises operate, produce and fulfil the orders to satisfaction of customers on the base of forecasts, plans of production, capacity production plans, production schedules, etc. which are prepared by men and it is not once, but routine every day, week, month many years. What procedures are used by these successful people and experts that they can take into account all these requirements and limitations (1)?

They created their own procedures and methods by which they can prepare plans and decisions for controlling of trade, production, etc., so complex logistics activities and processes in the enterprises.

But the thinking of man, perception of the situation, assess of the number of variants and solutions also has its limitations. For example, if we have determine the optimal sequence 4 or 5 products in the production, it is possible to imagine this in our mind, we can combine and count – determine the optimal position, but if we have more than hundreds of products and we have 100 variants of position! This fact cannot be image in our mind, but there are information technologies with their programmes implementing analytical methods (combinatorics), and they can evaluate thousands of variants by the known algorithm for a few seconds.

There is a connection of human strengths from its formalization, abstraction, thinking and creativity, i.e. from natural intelligence with the strengths of computers and their equipment on the base of known and verified methods of mathematics, statistics, combinatorics and simulation, so artificial intelligence (Fig. 2). This gives the chance to create by this connection a methodology for modelling of human by solution of difficult tasks, for example logistics, i.e. external manifestations of human coded to the rules, principles and procedures and their transformation to the models and algorithms where it is possible to use performance and strengths of computers. By this way we will obtain a tool and methodology for real application for solution of complex tasks. This methodology is called heuristics, or heuristics modelling – heuristics algorithms.

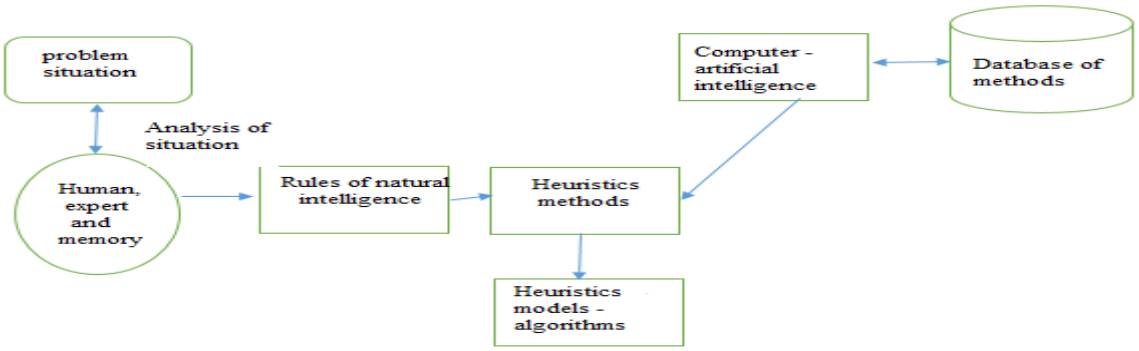

Fig. 2 *Heuristics models – connection of natural and artificial intelligence*

The second option is to describe psycho-physiological processes of brain function by problems solution. This is based on the fact that a child under the age of seven and eight years begins to exhibit signs of creativity. This way of modelling of human creativity is a way for psychologists, biologists and physicists. Technicians apply modelling of external expressions of human by solution of difficult tasks. What is the importance of this approach?

a.Abstraction, formalization and identification of the objects, events and processes to the systems.

b.Definition of properties of the abstracted systems segregating them from the other systems, relations among them and relations to others.

c.In generalization of situations, definition of specifics of the situations, finding of analogy – etalon – solution to the situation.

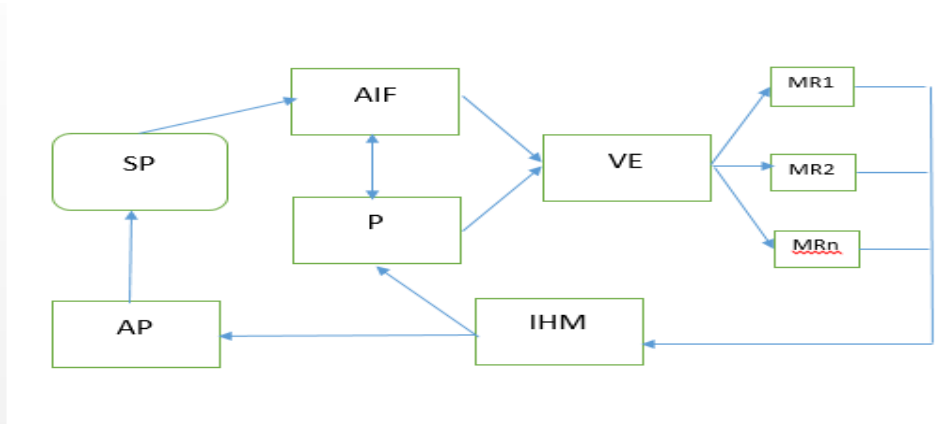

Fig. 3 *Process of elementary heuristics decision making*

where: SP – situation, process and problem.

AIF – abstraction, identification and formalization to the abstracted system.

P – memory (human, computer, book), models of solution from the previous experiments of solution.

VE – selection of the etalon – solution on the base of analogy to the abstracted system.

MRi – selected models of solution of elementary situations.

IHM – creation of the integrated heuristics models from MRi.

AP – application of solution to the SP.

Design of the IHM model – it is often consisting of many elementary models of MRi, which must be defined and obtained on the base of AIF and P. From these elementary rules of MRi is needed to create IHM, namely by determination of the sequence of application of elementary models - MRi. This is the second important problem of the heuristics models.

3 HEURISTICS AND LOGISTICS

Logistics is defined as the part of cybernetics. The objects of management in logistics are logistics flows in the chains and networks. The basic management activities for the basic of logistics chain (purchase – supply – production – sale – distribution), are planning, capacity planning, scheduling, coordination and deviation control. Models of these management activities are important model which must include a large number of criteria, rules and restrictions. The most common approach for creation of these difficult models is the heuristics modelling.

4 CONCLUSIONS

The paper has a theoretical – philosophical character. It explains the relation of heuristics, theory of knowledge and creativity. It aims to explain of the principles of heuristics decision making and modelling. It is based on the technical-information approuche of modelling a human activities, i.e. procedures, principles and rules, which by solution of difficult problems are used by man and their transformation to the algorithms and programs for creation of heuristic models. The connection of natural and artificial intelligence gives a tool and methodology how to model and thus automate the complex processes of logistics, such as allocation, layout, forecasting and planning of production, sale and distribution, capacity planning and scheduling of production and distribution, i.e. the most complex activities in logistics.

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