Optimalization of the systemic evidence of returnable packaging transport – analytical-synthetic model

Petr Prochazka
Department of Radiology and Toxicology
Faculty of Health and Social Studies
University of South Bohemia
Ceske Budejovice, Czech Republic
Premysl Zaskodny
Department of Radiology and Toxicology
Faculty of Health and Social Studies
University of South Bohemia
Ceske Budejovice, Czech Republic
Pavol Tarabek
Didactic Institute
Bratislava, Slovak Republic

Abstract: **Analytical-synthetic modelling (ASM) is a method of cognitive structures arrangement. It is based on combination of systemic and logical approach of problem investigating. This paper focuses on modelling of process in returnable containers systemic evidence. We have chosen the systemic evidence based on combination of three software systems. The systems are described. The model includes also the optimalization part. First part of the paper is specialized on general methodology of ASM and process modelling. In the second part, the problem of systemic evidence is worked up. The model also regulates all phases of the process and gives the result of optimalization.**

I. INTRODUCTION

Analytical-synthetic modelling (ASM) of cognitive structures was developed by P. Zaskodny and P. Tarabek. They founded the "Analytical-synthetic modelling and didactic communication research group" which includes specialists from various types of science and practice. You can find more information on the web side: http://www.zsf.jcu.cz/Members/zaskodny/analytical-synthetic-modelling-and-didactic-communication-research-group/analytical-synthetic-modelling-and-didactic-communication-research-group/.

We focus on developing and improving of methodology of ASM. Also the general process model based on ASM was created.

This paper presents the structure of cognitive architecture modelled with ASM. We have chosen the structure of physics as a part of education science. We show that thinking and problem understanding can be modelled and arranged within the AS frame.

II. METHODOLOGY OF ANALYTICAL-SYNTHETIC MODELLING

In the Czech education there was a new theory developed by J.Brockmeyer, called: "Education Communication".

In the framework of the theory "Education Communication" here is the order of transformations of the knowledge from scientific into education language which is comprehensive enough to the scientist as well as students.

This order of transformations is as follows from the scheme:

<u>Transformation T1:</u> System of theories $\rightarrow$ Scientific system from the point of view of its communication

<u>Transformation T2:</u> Scientific system from the point of view of its communication $\rightarrow$ Contents of the model

<u>Transformation T3:</u> Contents of model $\rightarrow$ Legend to model

<u>Transformation T4:</u> Legend to model $\rightarrow$ Knowledge already achieved (T4 is realized through cognitive process)

<u>Final Phase of the Cognitive Communication:</u> Knowledge already achieved $\rightarrow$ Lasting component of the education and its application.

Within the framework of transformations T1, T2 and T3 it is necessary to express and communicate suitably the knowledge of science and practice. For this purpose new methods were brought up which reflected cognitive structure of concepts and

knowledge. These methods emanate from analytical-synthetic structure of knowledge (J. van Deursen, P.Zaskodny) and from hierarchically arranged levels of conceptual knowledge systems (P.Tarabek). These methods utilize models and net graphs.
General model of cognitive structure of investigated problem (without concrete conceptual knowledge contents) see both figure Fig.1 "General model of analytical-synthetic (cognitive) structure" and Legend to Fig.1.
The figure Fig.1 represents the general introduction which is needful for basic comprehension of the analytical-synthetic modeling of a cognitive structure. From this reason, Fig. 1 as well as Legend to Fig. 1 should be investigated in detail.

General model of cognitive structure of investigated problem is included in analytical-synthetic modeling of concrete investigated problem. It can be shown that this analytical-synthetic modeling is acceptable for researching of educational problems concerning different scientific branches (J.van Deursen).

III. PROCESS MODELLING

With simple reconstruction of the basic ASM method, we obtain the structure of process. This structure shows sequence of process phases and offers the concrete output and gives the possibility to observe the course of process. Process can be described in the mean of change of state objects and their parameters (Fig 2).

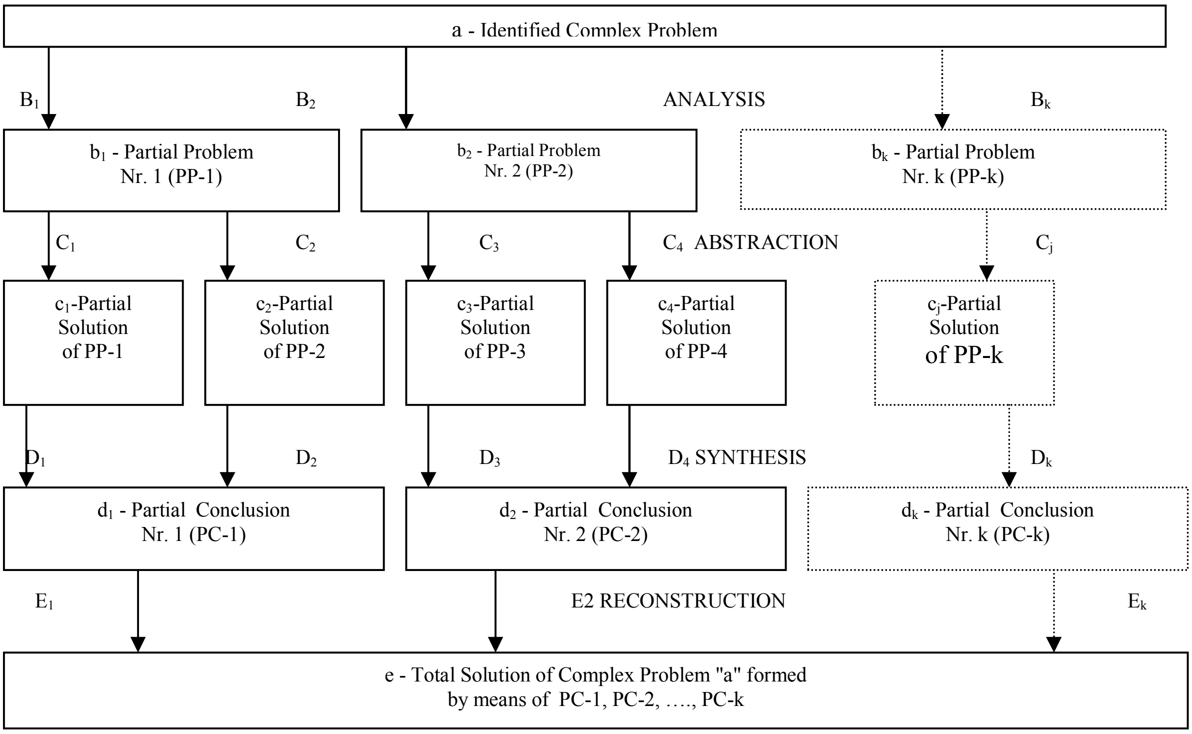

Fig 1: General model of cognitive structure: **a** - (Identified Complex Problem) - Investigated area of reality, investigated phenomenon, $\mathbf{B_k}$ - (Analysis) - Analytical lay out within the framework of corresponding knowledge level, $\mathbf{b_k}$ - (Partial Problems PP-k) - Result of analysis: essential attributes and features of investigated phenomenon, $\mathbf{C_k}$ - (Abstraction) - Qualification of abstraction essences within the framework of corresponding knowledge level, $\mathbf{c_k}$ - (Partial Solutions of PP-k) - Result of abstraction: partial concepts, partial knowledge, various relationship etc., $\mathbf{D_k}$ **-** (Synthesis) - Synthetic finding of dependences among the results of abstraction within the framework of corresponding knowledge level, $\mathbf{d_k}$ - (Partial Conclusions PC-k) - Result of synthesis: principle, law, dependence, continuity etc., $\mathbf{E_k}$ - (Intellectual Reconstruction) - Intellectual reconstruction of investigated phenomenon / investigated area of reality and **e -** (Total Solution of Complex Problem "a")- Result of intellectual reconstruction: analytical-synthetic structure of conceptual knowledge system.

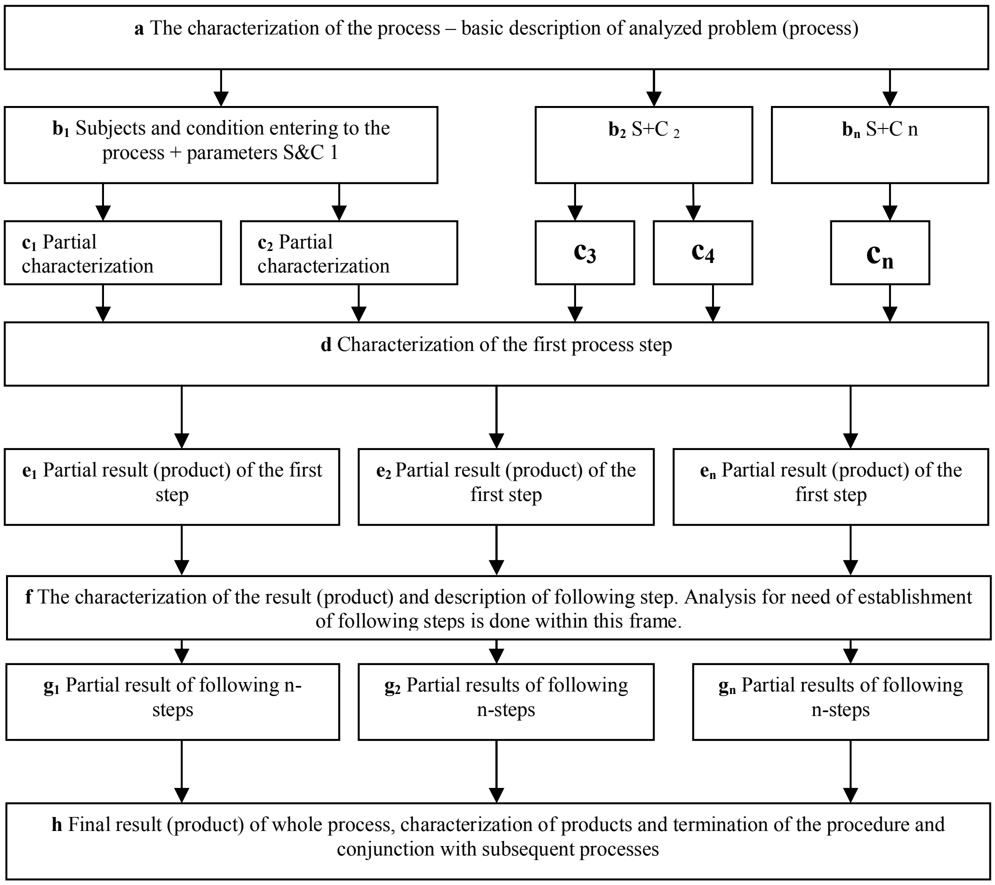

Fig 2: General process modeling based on cognitive structures principles

IV. MODELING OF COGNITIVE ARCHITECTURE

We have developed the optimization of the systemic evidence of returnable containers. The optimization is based on conjunction of the three software systems (Software system no. 1 – 3). This conjunction enables the automatic data migration without the influence of human factor. The model of conjunction is presented in Fig 4.

If we connect the software systems and allow them to communicate together we create the cognitive system which provides the systemic evidence. This cognitive system has all necessary information and data to be able to transfer the data into the software system no.1. The amount of packaging, which is to be sent to supplier, is determined according to the state of packaging in this software system.

We have built the cognitive architecture based on this type of conjunction.

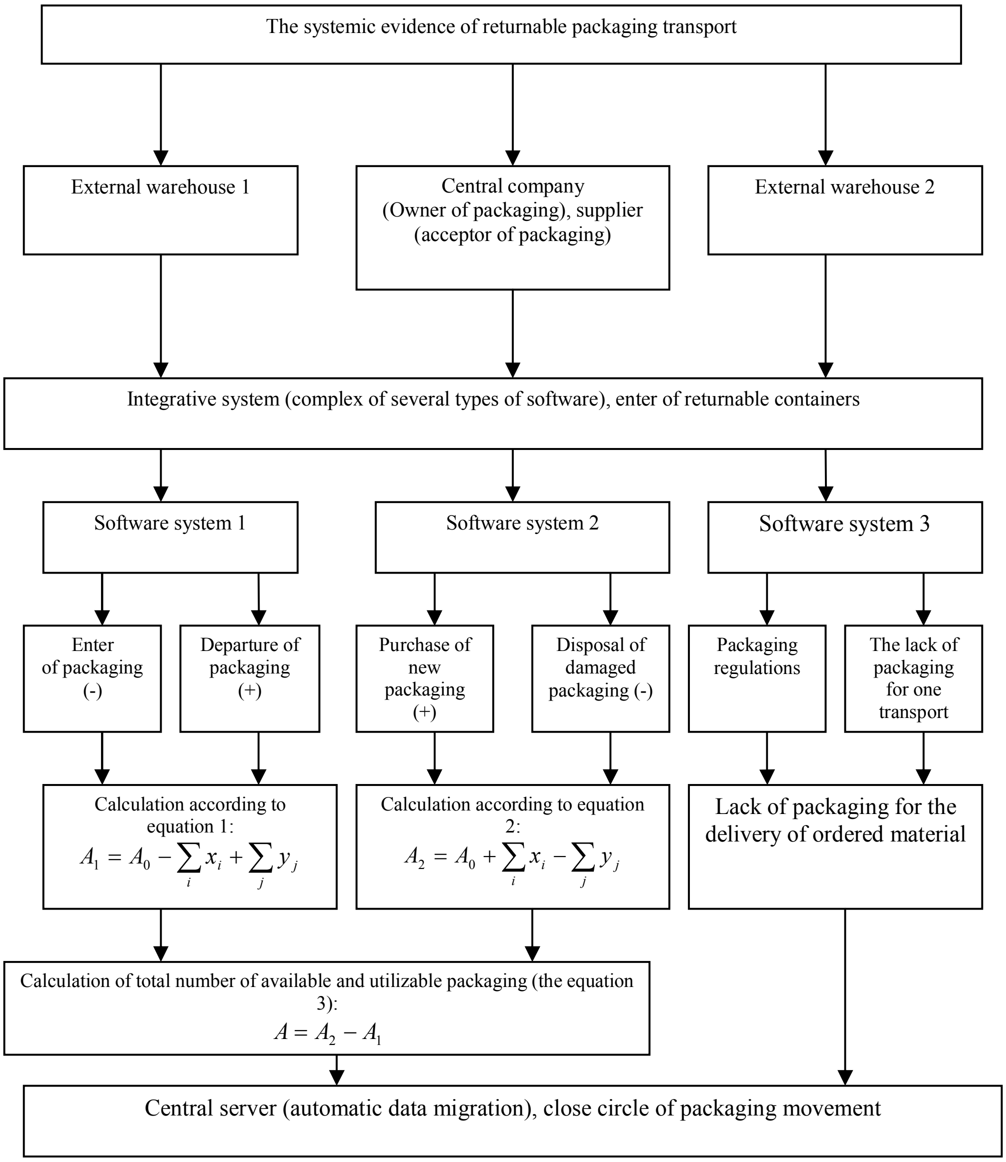

Fig 3: Model of systemic evidence using the software systems

First quantification describes the current state of the systemic evidence using the manual data entering. The data entering is done by external warehouses. This level has been tested of optimization.

Second quantification defined the three types of software which gather the data about the number of packaging and make the rules about the transport and the lack of returnable containers. Every type is used for different step within this process. This level also shows the steps and defines the particular functions of the software systems. Also the theoretical mathematical way of functioning is described. This quantification proposes and shows the way of optimization of this basic logistic process. Returnable containers enter to the close system.

The optimization is based on the horizontal connection of the first level in the second quantification (the three types of software system). The automatic data migration among these systems results from the connection. Thus the manual data entering is eliminated and by it also the error rate is lower.

Equation 1: calculates the number of packaging that is in the circle run of packaging between the supplier and the central company

A_1......................the final number of packaging which circles between the supplier and the central company

A_0..............................the starting number of packaging corresponding with the result number of previous calculation

x_i...............................the number of sent packaging

y_j...............................the number of entered packaging

i................................the number of transports (frequency) i=1,2,3,4..........n

j................................the number of transport (frequency) j=1,2,3,4...........m

Equation 2: calculates the balance of purchased and disposed packaging. The result shows how many packaging is needed to buy.

A_2 ....the final number of packaging that is in all processes

A_0 ....the starting number of packaging from previous calculation

x_i .... the number of purchased packaging

y_i ....the number of disposed packaging

i ....the number of operations (frequency) i=1,2,3,4.....n

j.......................................the number of transport (frequency) j=1,2,3,4...........m

Equation 3: calculates the number of all available and utilizable packaging for the transport

A .... final number of available and utilizable packaging

A_1 ....the result from calculation according to the equation 1

A_2 ....the result from calculation according to the equation 2

V. CONCLUSIONS

We have constructed the model of systemic evidence of returnable containers. This model is very simple and well arranged. The model conjuncts three types of software. This conjunction makes the cognitive system which can be arranged to cognitive architecture. There are three subjects entering to the architecture (two warehouses and central company). The supplier does not enter with the systemic data into the system so therefore it is not described. This system shows the simplification of the systemic evidence and can be used not only for returnable packaging evidence.

The process model shows subsequently going steps and changes of objects and parameters. This can be also used for modelling of many types of processes (e.g. in physics, chemistry, economy, technical sciences etc.).

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