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KONCEPTUÁLNÍ NÁVRH POMOCÍ SPECIFIKÁTORU "LOKÁLNÍ KONTEXT"

Conceptual Design by Specifier „Local Context"

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Abstract: The main motivation of the paper has been induced by the fact that so called classical intentions (as, e.g., quantities and propositions) are not too convenient for interpretation of artifacts in the field of Problem Solving and that these intentions very poorly form the background for the development of design and synthetic disciplines, as, e.g., conceptual design and the synthesis of natural or artificial systems. It is explained the way of the use of new intentions in Problem Solving by ReDesign technique. The work with new intention Specifiers is illustrated in the solution of the problem of dehumidifying and dehydrating of ecosystem functions.

Key words: Modeling, Specification, Problem Solving, Intentions, Small Water Cycle (SWC), violence of SWC

1. Introduction

The specifier **LOC (LOCal Context)** transforms elements of Space of States of Possible Worlds (*SSPW*) into structures of the type:

$$\langle \boldsymbol{X}, \mathbf{IND}, \aleph_{11}, \aleph_{12}, \ldots, \aleph_{1b} \rangle, \tag{1}$$

where $\boldsymbol{X}$ is a set of known solutions, **IND** is the relation of Independence and ($\aleph_{11}, \aleph_{12}, \ldots, \aleph_{1b}$) are the Bases of the matroid.
Matroid, e.g., in [Oxley, 2001] is introduced in this paper as the structure

$$\boldsymbol{M} = \langle \boldsymbol{X}, \mathbf{IND}, \{N_1, N_2, \ldots, N_n\} \rangle = \langle \boldsymbol{X}, \mathbf{IND}, \boldsymbol{\Gamma} \rangle, \tag{2}$$

where $\boldsymbol{X}$ is a set of elements, **IND** is the relation of *Independence* and $N_1, N_2, \ldots, N_n$ are independent sets. Relation **IND** is a binary relation. The independent set contains elements from $\boldsymbol{X}$ where each two are in the relation **IND**. Relation **IND** is usually constructed with help of binary *dependence* relation (**DNT**).
The specification of a novel solution $\mathbf{x_e}$ ($\mathbf{x_e}$ is formed by an external way) is done as an extension of some of matroid bases ($\aleph_{11}, \aleph_{12}, \ldots, \aleph_{1b}$). And from the opposite side - $\mathbf{x_e}$ is

accepted as a novel solution if it could extend some (at least one) of matroid bases. We express it by (3) (exceptionally using for the result of specification predicate Spec):

$$(\mathrm{Spec}(\mathbf{x_e}) = (\aleph_{ij} \cup \mathbf{x_e})) \Leftrightarrow (\mathbf{x_e} \mid \aleph_{New} = \aleph_{ij} \cup \mathbf{x_e}), \qquad (3)$$

where $\aleph_{ij} \in (\aleph_{11}, \aleph_{12}, \ldots, \aleph_{1b})$.

Note1.1: Matroid is a structure that is defined (besides the carrier) only by the set of special sub-sets. In the matroid is possible to discover the Basis (the independent set with maximal number of elements). It is easy to find, that all Bases of the matroid have the same number of elements.

The Basis of the matroid represents in our context a system with special independent solutions. A novel solution $\mathbf{x_e}$ is an element annexed to matroid as a new independent element. The novel independent elements are *not constructible* from the old Bases. It is necessary to use a special construction, e.g., in [1].

Note1.2: The work with Specifier **LOC** has a great advantage: we may work in the level of whole solutions and it is not necessary to consider their parts and atoms and to describe them in a special language. What is to do is to check the satisfaction of Independence relation and to construct the extension of some Basis.

2. The Problem of the violence of so called Short Water Cycle (SWC)

SWC represents the behavior of a local ecosystem (e.g., the Trebon region, Czech Republic) in which the volume of water that comes in the ecosystem is evaporated and falls back in this system, e.g., in [2]. In the mentioned ecosystem is the evaporated water quickly brought up in the zone in which does not condense yet and in this height zone is transported outside the ecosystem to distanced mountains where spontaneously condenses in rising air streams. (With regard to enormous volumes of brought vapor the condensation is very

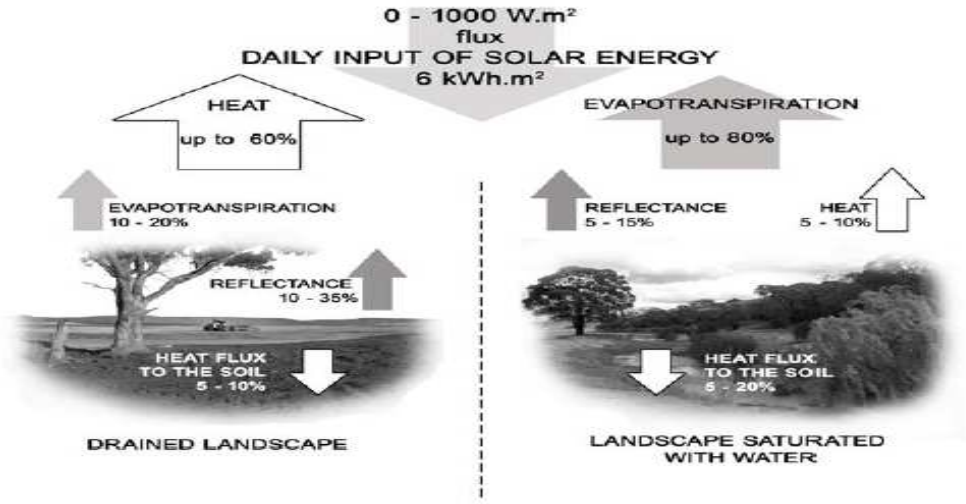


Fig.1. Two situation with SWC [2].

dynamic and the rain is sometimes of downpour form.)

Now we approach the problem solving by the ReDesign method.

- *Formulation of the problem:* Suggest the solution of the problem of the violence of Short Water Cycle (described above). The situation is illustrated in Fig.1.
- *The list of the solution requirements:*

R1) To respect knowledge contained in usual known solutions:
- X_1 = providing a maximum moisture in the soil {(x_{11} – *operations with structure of the soil,* (x_{111} = improving the soakabilty of the soil, x_{112} = increasing the concentration of soil components for conservation of moisture in surface stratum of the soil), (x_{12} – *providing supply of moisture in the soil* (x_{121} = surface water sources (brooks, wels, rivers, ponds, lakes), x_{122} = bothside penetration "surface stratum-underground water sources", x_{123} = external climatic sources of humidity (rains and fogs), (x_{13} – *providing conservation of soil moisture by external influences on moisture supply* (x_{131} = stabilizing the cover of landscape by vegetation (forests, gardens, parks)}.
- X_2 = providing a maximal humidity in the *interaction zone* (0-200 m) above the landscape surface {(x_{21} – effecting on micro-atmosphere above the surface of he landscape (x_{211} = special aerosols), x_{22} – closing of evaporation fields above the surface of the lanscape (x_{221} = artificial clouds and fogs), x_{23} – providing the return of moisture back from higher level into interaction level (x_{231} = forming the cooling zone above the surface of the landscape (20 m), x_{232} = dispersing condensation kernels)}.

R2) The novel solution will be different from solutions introduced above (including the differences in ecological disadvantages of the introduced solutions).
R3) The demands for energy consumption of the novel solution will be adequate.

We have hence the set of known and possible solutions:

$$\boldsymbol{X} = \{X_1, X_2\} = \{x_{111}, x_{112}, x_{121}, x_{122}, x_{123}, x_{131}, x_{211}, x_{221}, x_{231}, x_{232}\}. \quad (4)$$

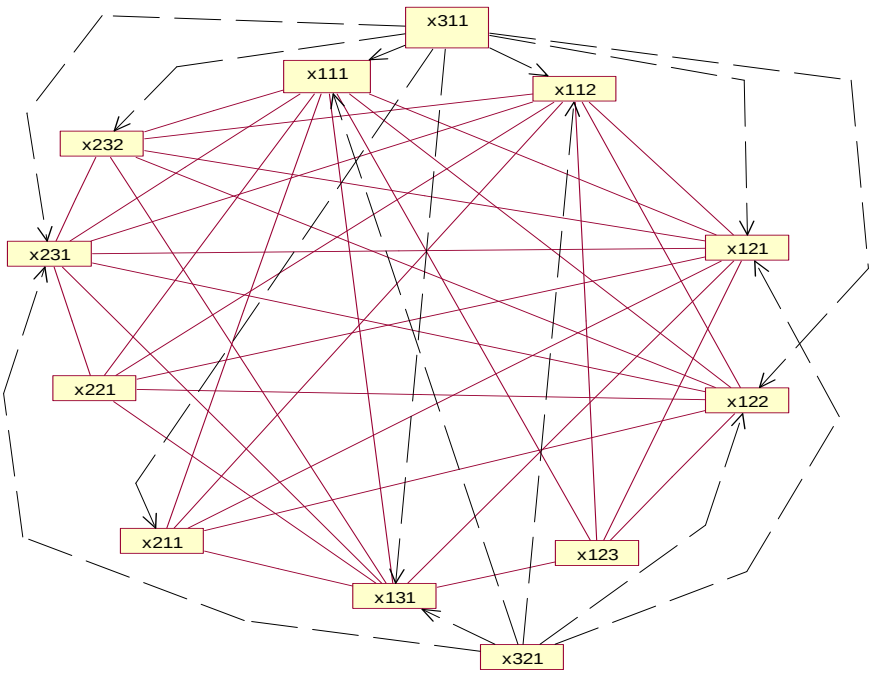
- *The search for a novel solution starts* with definition of some convenient relation of Dependence (Independence).

Definition 2.1: Solutions x_{ijk} , x_{pqr} from $\boldsymbol{X}$ are Dependent (**DNT**(x_{ijk} , x_{pqr})) if one (or two, three or four) of the following conditions holds (hold):
(i) Solutions x_{ijk} , x_{pqr} contribute to the solution of the given problem by the same or similar ways, means and principles. (Expert criterion.)
(ii) There are changes (variations) of x_{ijk} associated (in an actual time-space of solution synthesis for a given problem) with changes (variations) of x_{pqr} (or vv.).
(iii) The application of x_{ijk} in a problem solution implies the application of x_{pqr} (in this problem solution) (or vv).
(iv) Application of x_{ijk} in the problem solution excludes the application of x_{pqr} (in the problem solution) (and vv).
The only difference is now the actual semantics of the concept "the solved problem". The actual problem is "the decreasing (eliminating) the dehumification and dehydratation of the landscape".
Using *Definition 2.1* we form now the table of dependencies between individual solutions (Tab.1) and then we form the matroid $M(\boldsymbol{X})$ (as it has been introduced in sub-section 1). Matroid $M(\boldsymbol{X})$ is illustrated in Fig.2.

Very easy is found an interesting and original solution X_3:
X_3 = to form of a local climate {(x_{31} – to form a local pressure drifts (x_{311} – dissolving atmosphere bulbs, x_{312} – opening of vacuum lentils), x_{32} – initiating local precipitation (rainfall) (x_{321} – weak chemical initiation of raining)}.
This solution has been suggested by human solver and by means of the mastoid is possible to check, if the novel solution is independent on some known solutions and if a mastoid base with higher cardinality can be constructed.

Tab.1. Dependence relation

DNT	x_{111}	x_{112}	x_{121}	x_{122}	x_{123}	x_{131}	X_{21}	x_{221}	x_{231}	x_{232}	x_{311}	x_{321}	x_{233}
x_{111}	1	1	0	0	0	0	0	0	0	0	0	0	0
x_{112}		1	0	0	0	1	0	0	0	0	0	0	0
x_{121}			1	1	0	0	0	0	0	0	0	0	0
x_{122}				1	0	1	0	0	0	0	0	0	0
x_{123}					1	0	1	1	1	1	1	1	0
x_{131}						1	0	0	0	0	0	0	0
x_{211}							1	1	1	1	0	1	0
x_{221}								1	0	1	1	1	0
x_{231}									1	0	0	0	0
x_{232}										1	0	1	1
x_{311}											1	0	0
x_{321}												1	0
x_{233}												0	1



Obr.2. Mastoid *M(X)* for Table 1.

The columns for novel solutions x_{311} a x_{321} are joined to the table Tab.1. (The possible solution x_{312} is not investigated here.) The extension of the matroid ***M(X)*** by elements x_{311} and x_{321} is denoted by connection links with arrows from elements x_{311} a x_{321}.
Now we approach the search for the novel solution. The specification of a novel solution ($\mathbf{x_e}$) is according to (3):

$$(\text{Spec}(\mathbf{x_e}) = (\aleph_{ij} \cup \mathbf{x_e})) \Leftrightarrow (\mathbf{x_e} \mid \aleph_{New} = \aleph_{ij} \cup \mathbf{x_e}), \quad (5)$$

In the original matroid have been discovered 3 four element Bases:

$$\{x_{111}, x_{121}, x_{123}, x_{131}\}, \{x_{112}, x_{121}, x_{221}, x_{231}\} \text{ a } \{x_{111}, x_{121}, x_{231}, x_{232}\}. \quad (6)$$

Joining elements x_{311} and x_{312} the only one Basis with 5 elements is discovered:

$$\{x_{111}, x_{121}, x_{231}, x_{232}, x_{311}\}. \quad (7)$$

Note 2.3: Bases in the graphic form of the matroid are recognized as perfect graphs with edges representing IND relation and nodes connected each other. (It means, e.g., that nodes of four elements Basis are connected by 6 edges, nodes of five elements Basis are connected by 10 edges, etc.) ♦
The offered solution x_{311} may be accepted as a new original solution $\mathbf{x_e}$, however the solution x_{321} not. Similarly we can find further solution "x_{233} = Inducing horizontal whirls above the surface of the landscape – Fig.3., that enables to form 5 element Basis

$$\{x_{112}, x_{121}, x_{221}, x_{231}, x_{233}\} \quad (8)$$

We do not provide (in the level of the conceptual design) the technical realization of x_{233} (e.g., a system of ventilators or special thermodynamics in the interaction

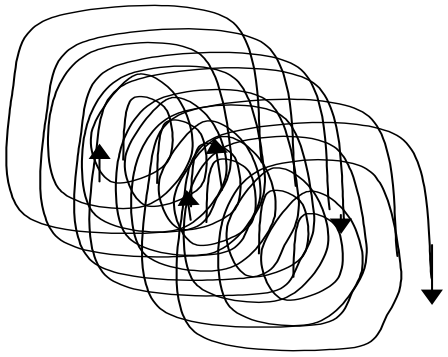


Fig.3. One image of the solution x_{233}.

stratum). This is the topic the detailed design.

3. Conclusions

Many successful inventors (known from history) confessed, that obtained a surmising or an intuition which led them to the discovery. Let us remember, e.g., the discovery of "Auer gas stocking" that lighted up (in gas lamps) our streets in nineteen century. Karl Auer, chemist from Welsbach in Austria found in 1885 that the mixture of 99% of oxide of thorium and 1% of oxide of cer shines intensively near the temperature 2100° C. We easily believe that it was not the result of a tedious "trial/fault" process. Which prompter Karl Auer used ?

The basic problem is, that such prompters were (and are) invisible and unavailable. The ways for their clarification by nowadays ontologies, e.g., in [3], are usually blind. Our proposed paper tries to explain internal way of conceptual ReDesign, investigates one variant of a visible process that mediates reasoning of human solver and as a special prompter led him to discovery.

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