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GENERALIZED NET MODEL OF DECISION MAKING PROCESSES IN THE MANAGEMENT'S SYSTEMS WITH USE OF INTUITIONISTIC FUZZY SETS

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Abstract: *The paper represent one realization of Generalized Net (GN) for formal description of the Decision Making Process (DMP) in the Management's systems, in according to Decision Making Theory. This Generalized model of Decision Making Process includes estimates of some aggravated circumstances: DMP in state of risk, DMP in state of two types non-determination – accident and fuzzy.*

Introduction

In according to Decision Making Theory (DMT), the Task of Decision Making includes one set of alternative actions and the person making decision, must choose the best alternative in respect of concrete goal or aggregate of goals [5]. After decision making the person must check for the efficiency of the results. The main elements of the Decision making task are: goal, restriction, states of the environment (outside and inside), alternatives, results and rules for choice. The decision making process is associated with estimate's process on the current state of the management system, goal's state(s) of the system and actuate the system in the defined goal's state. This is performed by means of: analysis of the inside and outside system conditions; generalizing to alternatives decisions and choice of one decision and its realization. If the results of decision don't satisfy assigned goals, then decision making person chooses new alternative or it generalizes new decision making process (by backup connection).

Description of Decision Making Process's model by means of Generalized Net

In according to DMT [4], The Decision making task in the management's systems is connected to following subtasks:

- Analysis of system's parameters about the object (system), which has been managed, in its current state;
- Analysis of system's parameters about the object (system), which has been managed, in his goal's state;
- Management to transaction between the current's state and the goal's state of object (system), which has been managed.

The described process is called Decision Making Process, which include:

- estimation of object's (system's) states;
- estimation of inside and outside system's factors;
- generation of alternatives; choice of decision;
- performing the decision;
- control of the results.

The Generalized Nets [1], [3] are putting into practice very often for description about the complex processes, allowing considerable parallelism, as the GN-models gave opportunity for great flexibility and clearness of presentation.

Therefore, in this paper, is done one attempt for description of the decision making process of person by means creation of general model, based on the GN-application.

The scheme of the decision making's model, realized by means of generalized net, is presented in figure 1. The description of the GN-model is following:

$E=\{Z_1, Z_2, Z_3, Z_4\}$, where

Z_1 – comparative evaluation of the parameter's values in the management's object (system) with the values of the goal's parameters in the same management's object (system)

Z_2 – generating of alternatives of decisions

Z_3 – choice of decision

Z_4 – performing of the decision

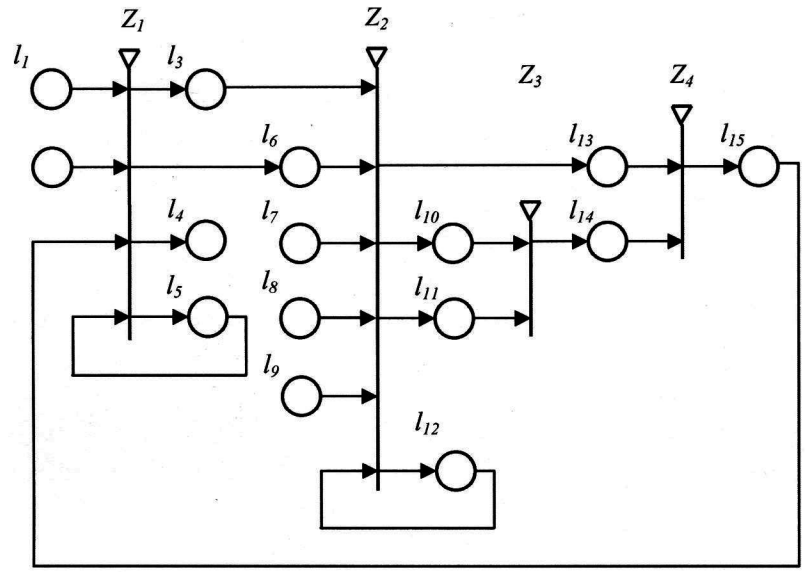

Fig.1 Basic GN-model of the Decision making process in management's systems

Tokens, using in Generalized Net E, are:

α – the object (system), which has been managed, with following characteristics:

$X_\alpha(e^\alpha_{p1}, e^\alpha_{p2}, \ldots, e^\alpha_{pi}, \ldots, e^\alpha_{pk})$, where e^α_{pi} is the estimate on i- parameters from k ($i \le k$) defined (essentials) estimation's parameters;

β – resources (subproducts, production powers, personal), with following characteristics:

$X_\beta(e^\beta_{r1}, e^\beta_{r2}, \ldots, ^\beta_{ri}, \ldots, e^\beta_{rs})$, where e^β_{ri} ($i \le s$) is the estimate on i- resources from s necessary resources;

γ – goal's states of object (systems)), with following characteristics:

$X_\gamma(e^\gamma_{p1}, e^\gamma_{p2}, \ldots, e^\gamma_{pi}, \ldots, e^\gamma_{pq})$, where e^γ_{pi} is the estimate on i- parameters from q ($i \le q$) defined (essentials) estimation's parameters;

ι – information (data base and knowledge base about the object array, about the decision making processes and oth.), with following characteristics:

$X\iota(e^\iota_{f1}, e^\iota_{f2}, \ldots e^\iota_{fi}, \ldots, e^\iota_{fn})$, where e^ι_{fi} perhaps to be estimation of the risk, estimation of the probability or estimation on the apriority information, about given process n ($i \le n$).

δ – this is estimation of the environment, with following characteristics:

$X_\delta(e^\delta_{w1}, e^\delta_{w2}, \ldots e^\delta_{wi}, \ldots, e^\delta_{wn})$, where e^δ_{wi} is estimation on i-environment's factor from h ($i \le h$), which influence to the management's object (system).

φ – alternatives, with the following characteristics:

$X_\varphi(e^\varphi_{g1}, e^\varphi_{g2}, \ldots e^\varphi_{gi}, \ldots, e^\varphi_{gn})$, where e^φ_{gi} is estimation on i-decision from d ($i \le d$) alternatives decisions, about the object (system), which has been managed.

$\mathbf{e^\alpha_p}$, $\mathbf{e^\beta_r}$, $\mathbf{e^\gamma_p}$, $\mathbf{e^\iota_f}$, $\mathbf{^\delta_w}$ and $\mathbf{e^\varphi_g}$ are functions in the GN, where they includes values in intervals: {0,1} – for common case; [0,1] – for normal fuzzy, or [0,1], [0,1] – for intuitionistic fuzzy and non-determination a both type (fuzzy and fortuity).

For flexibility estimation of the different parameters is prefer to use intuitionistic fuzzy estimations. Therefore, everywhere in the represented GN-model, the estimations $\mathbf{e_k}^{\{\alpha, \beta, \gamma, \iota, \delta, \varphi\}}$ looks like:

$\mathbf{e_j}^{\{\alpha, \beta, \gamma, \iota, \delta, \varphi\}} = \{<\mu_j, \nu_j> (\mu_j, \nu_j \in R \ \& \ \mu_j \ge 0 \ \& \ \nu_j \ge 0 \ \& \ \mu_j + \nu_j \le 1)\}$, for j=1,...k, where:

μ_j – the rate of sure about particular parameter (alternative)

ν_j – the rate of unsure particular parameter (alternative)

$\pi_j = 1 - \mu_j - \nu_j$ – the rate of indetermination (potential array to non-standard making decisions)

The description of the transactions is following:

$Z_1=<\{l_1, l_2, l_5, l_{15}\}, \{l_3, l_4, l_5, l_6\}, t^1_1, t^1_2, r_1, M_1, (l_1 \wedge l_2, \vee l_{15},)>$, where

l_1 – initial place – here go into the object (system), which has been manage, with characteristic $X_\alpha(e^\alpha_{p1}, e^\alpha_{p2}, \ldots, e^\alpha_{pi}, \ldots, e^\alpha_{pk})$

l_2 – place of γ-tokens, where are defined goal's parameters on the object (system), which has been manage

l_3 – place of goal's state where go into α-tokens (after correction of their parameters)

l_4 – can't to execute correction of the parameters or the parameters don't satisfy goal's values

l_5 – process of parameter's estimation of the object (system)

l_6 – state where the parameters of the object /α-token/ are different, in relation with goal's parameters

l_{15} – state of object's parameters after execution to take decision

$t^1_1 = T_0$ (start of process)

$t^1_2 = t_0$ (elementary step)

$r_1 =$

	l_3	l_4	l_5	l_6
l_1	$W_{1,3}$	F	$W_{1,5}$	$W_{1,6}$
l_2	F	F	$W_{2,5}$	F
l_5	F	F	T	$W_{5,6}$
l_{15}	$W_{15,3}$	$W_{15,4}$	$W_{15,5}$	$W_{15,6}$

$W_{1,3}$ – the state of the object (system) is in accordance with normal

$W_{1,5}$ – necessities are estimation's parameters in l_2

$W_{2,5}$ – necessity is object (system) for estimation in l_1

$W_{1,6}$ – the state of the object (system) don't in accordance with normal and it must to be corrected

$W_{5,6}$ – transaction, where the estimation is made

$W_{15,3}$ – where the decision is successful

$W_{15,4}$ – where decision absence (after check-up to alternatives)

$W_{15,5}$ – where's estimate the current alternative

$W_{15,6}$ – where current alternative is failure

	l_3	l_4	l_5	l_6
l_1	$m_{1,3}$	$m_{1,4}$	$m_{1,5}$	$m_{1,6}$
l_2	$m_{2,3}$	$m_{2,4}$	$m_{2,5}$	$m_{2,6}$
l_5	$m_{5,3}$	$m_{5,4}$	$m_{5,5}$	$m_{5,6}$
l_{15}	$m_{15,3}$	$m_{15,4}$	$m_{15,5}$	$m_{15,6}$

$M_1 =$

$m_{1,3}=m_{1,4}=m_{1,6}=m_{2,3}=m_{2,4}=m_{2,6}=m_{5,3}=m_{5,3}=m_{5,4}=m_{5,6}=m_{15,3}=m_{15,4}=m_{15,6}$ – the maximum permissible number of objects (systems) to be managed.

$m_{1,5}=m_{2,5}=m_{5,5}=m_{15,5}$ – the maximum permissible number of objects (systems) for parallel estimation

$Z_2=<\{l_3, l_6, l_7, l_8, l_9, l_{12}\},\{l_{13}, l_{10}, l_{12}, l_{12}\}, t^2_1, t^2_2, r_2, M_2, \wedge(l_6, l_7, l_8, l_9)>$, where

l_3 and l_6 – as it is in transaction Z_1

l_7 – requires information (tokens ι)

l_8 – state of the environment (tokens δ)

l_9 – necessary resources (tokens β)

l_{10} – alternatives generation (tokens φ)

l_{11} – rules for choice

l_{12} – generation process

	l_{10}	l_{11}	l_{12}	l_{13}
l_3	F	F	$W_{3,12}$	F
l_6	F	F	$W_{6,12}$	$W_{6,13}$
l_7	$W_{7,10}$	$W_{7,11}$	$W_{7,12}$	F
l_8	$W_{8,10}$	F	$W_{8,12}$	F
l_9	$W_{9,10}$	F	$W_{9,12}$	F
l_{12}	$W_{12,10}$	F	F	F

$r_2 =$

$W_{3,12}$ – requires data of previous results

$W_{6,12}, W_{7,12}, W_{8,12}, W_{9,12}, W_{7,12}$ – necessary is procedures for generation alternatives process

$W_{7,10}, W_{8,10}, W_{9,10}, W_{12,10}$ – requires data for decision generation

$Z_3=<\{l_{10}, l_{11}\},\{l_{14}\}, t^3_1, t^3_2, r_3, M_3,(l_{10} \wedge l_{11},)>$, where

l_{10} – as it is in transaction Z_3

l_{11} – as it is in transaction Z_3

l_{14} – initial place, in which comes token φ (choose decision /alternative/), with characteristics X_φ

	l_{14}
l_{10}	$W_{10,14}$
l_{11}	$W_{11,14}$

$r_3 =$

$W_{10,14}$ – rule for choosing of alternative decision exist

$W_{11,14}$ – at least one decision is generated

	l_{14}
l_{10}	$m_{10,14}$
l_{11}	$m_{11,14}$

$M_3 =$

$m_{10,14}$ – when maximum number of generated alternative decisions is given

$m_{11,14}$ – when number of active rules is given

$Z_4=<\{l_{13}, l_{14}\},\{l_{15}\}, t^4_1, t^4_2, r_4, M_4,(l_{13} \wedge l_{14})>$, where

l_{13} – incoming place for the object (token α), which has been managed, with characteristics X_α

l_{14} – as it is in Z_4

l_{15} – outgoing place of the object (token α), which has been managed, with changed (corrected) characteristics X_α

	l_{15}
l_{13}	$W_{13,15}$
l_{14}	$W_{14,15}$

$r_4 =$

$W_{13,15}$ – chosen decision is executable over the parameters of the object, which has been managed

$W_{14,15}$ – the object, which has been managed, could be monitored using the chosen decision

	l_{15}
l_{13}	$m_{13,14}$
l_{14}	$m_{14,15}$

$M_4 =$

$m_{13,14}$ =1 (chosen object /α-token/)

$m_{14,15}$ =1 (chosen alternative decision /φ-token/)

Conclusion

The finding of enough efficient and grounded decisions is very complex process, because DMP is working with a large set of data, a big part of which are with fuzzy, non-precise and casual character. The person often makes decisions in limited conditions – time, resources, risk, under the influence of unfavourables factors and oth. The GN-model of the Decision making process, represented in this paper, is one attempt to emphasize of the big advantage of GN(s) for modelling to processes in different arrays of science. Generalized nets are flexibility, simple and quiet effective formalism for description of complex processes, such as the process of thinking and making of decision by the person.

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