System Capability Estimation Example

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***Abstract*—We consider a new mathematical formalism application example and discuss results. The formalism, families of stochastic alternative networks, is described on application example and computational results obtained. This formalism allowed us to model alternative functioning cases due to changing system environment conditions and the environment's impacts. Researchers can now create analytical models to research dynamic capability organizational capability, sustainable development, information technology capability. Numerical results obtained were analyzed with statistical software language R and illustrated with R 3D graphics plots. Numerical data analysis results can be further used for system capability indicators prediction based on capabilities data patterns illustrated.**

I. INTRODUCTION

There is a gap between the need to decide a variety of problems, such as infonomics [1], information technology (IT) governance, process mining [2] problems, on the one hand, and theoretical models and methods available for such problems decision as related mathematical problems - on the other hand. We suggest system capability analytical research methods and models [3], to fill this gap. Among such models and methods, families of alternative stochastic action networks are suggested.

System capability is a system's ability to achieve changing goals as a reaction to changing environments. We consider complex technical systems (CTS), which are such systems that include interrelated elements of a different nature, i.e., mechanical, organizational, human, and technological components. For such CTS system capability is required to react correctly on CTS environment changes and impacts [4], particularly - to respond to environment attacks, to respond on goals changes so - to interact properly with the environment and with parts of the system which is under environment impacts. Information operations are needed [5] to create such capability and to provide interaction under changed conditions.

The system capability is used to estimate information technologies performance indicators, dynamic capabilities indicators, organizational capabilities indicators, system dependability indicators. Further, indicators of this property are used to solve various practical problems as appropriate mathematical problems of indicators estimation and the CTS elements, capabilities, information operations synthesis based on indicators, estimated as a function of possible CTS characteristics. For estimation of such property complex of models is necessary. It shall reflect the interacting system, its environments of a different kind, and information operations. Information operations are required to check the system and its environment functioning states to measure their correspondence. Then information operations are used to alternate the CTS functioning to achieve a possibly changed goal set by changing the environment and with changing impact on the CTS.

Models of information operations use as a reaction to modeled environment changes were considered in previous publications [6], [7]. This publication concentrates on families of alternative action networks, example computations details, and obtained numerical data analysis and visualization.

Presented alternated networks models as a result of environment impact are required [8], but not yet described in sufficient details in known literature. This article illustrates our previous results of system capability evaluation [9], [10] for different purposes with example. Initial, intermediate, and final data structures discussed, in particular.

II. THE ENVIRONMENT MODEL EXAMPLE

For the simple environment model (1) let us suppose that each state of the environment $c_i^e(T)$ at the given moment determined by environment action a_i^e performed at this moment. This state actualized at the beginning of the environment's action and changed to the next state to start a new action immediately after ending previous one.

The simple environment model is based on the assumption that the environment performs one and only one action at any given moment. Considering other assumptions, it means once one action of the environment is finished and the time horizon for planning has not yet reached next action of the environment in sequence shall start immediately. s_0^e- the start

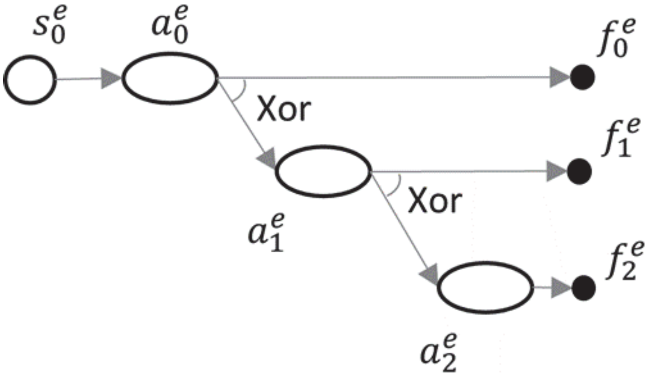

Fig. 1. Simple environment model

state of environment functioning, changed at the moment of environment actions start at T_0 (singular action before the start of model time);

a^e_0- the basic action of the environment functioning - action, which used for the creation of the base plan of functioning starting T_0;

a^e_1, a^e_2- possible future actions of the environment;

f^e_0, f^e_1, f^e_2- possible final states of the environment, associated with actions of the environment, performed at the moment of planning time horizon finish T^H (singular actions after T^H);

c^e_0, c^e_1, c^e_2- possible states of the environment on the time frame $[T_0 = 0, T^H]$;

$P^a(c^e_i)(T) = P^c_i(T)P^{ne}_i(T), P^c_i = \prod_{p=\overline{1,i}}(F^{eb}_p(T)), P^c_i$-”cumulative” conditional probability of the chain of actions start in the environment till the moment T;

$F^{eb}_i(T_p)$-probability of the action a^e_i and state c^e_i start at the moment T_p.

$P^{ne}_i = 1 - F^{ee}_i(T_p), F^{ee}_i(T_p)$- probabilities of action (and corresponding state) not ending and ending respectively.

Actions states at any time interval are calculated under the condition that a sequence of preceded actions (and states) of the environment has been implemented before each consecutive environment action (and so, state) starts.

Actions and correspondent states of the environment sequences C^e_n form the vector (multidimensional array) $\mathbf{C}^e, |\mathbf{C}| = N$ of possible sequences of actions of the environment. The objective of the model $\mathbf{M^e}$ of the environment functioning is to construct array $\mathbf{C}^e$ and to calculate its characteristics, required for model $\mathbf{M^s}$ of system functioning in changing conditions.

The example of **C** structure shown at the Table III.

The beginning, the end of the alternative actions, and states possible sequences occurred in a random time and are set by probabilities distributions. We used a sufficient discrete number of possible time frame sequences to represent the state sequence's random time. Thus, each C^e_n consists of sequences of states $c^e_i(T_j), j \in J$ corresponding to probably same actions a^e_i of the environment but at different moments $T_j \in \mathbf{T}$, where $|\mathbf{T}| = J, T_J = T^H$ and T^H- horizon of modelling and planning.

Only one possible sequence C^e_n of alternative states $c^e_i(T)$ of environment functioning used for the creation of the model of the system functioning and alteration of the functioning of the system under the given environment conditions $\mathbf{M^s}(C^e_n)$.

We assume that the characteristics of the probability distribution $F^{eb}_i(T)$ of the stochastic moment $\hat{T}^{eb}_i$ (where $\hat{X}$ means X is stochastic value) of the action a^e_i beginning and $F^{ee}_i(T)$ of the action a^e_i end in the environment can be calculated based on two parameters Beta probability distribution. This distribution is the distribution of the actions a^e_i duration $\hat{t}^{ea}$ distributions $F^{ea}_i(t)$. Parameters of $F^{ea}(t)_i$ of this distribution are the left and right boundary of the duration distribution.

TABLE I. THE CHARACTERISTICS OF THE ENVIRONMENT STATE

$P_{i,i'}(T_j)$	P^a_{nj}	T_j	T_{j+1}	$s^d_1(T_m)$	...	$s^d_k(T_m)$	...

As a result, moments of the a^e_i beginning are stochastic values $\hat{T}^b_i$ (with parameters T^{eb}_a, T^{eb}_b respectively), moments of the a^e_i ending are stochastic values $\hat{T}^e_i$ (with parameters T^{ee}_{ai}, T^{ee}_{bi} respectively). Mean value M_i and variance σ_i parameters calculated based on formulas, suggested at [11]:

$$M_i = (3T^e_{ai} + 2T^e_{bi})/5, \sigma^2_i = 0.004(T^e_{bi} - T^e_{ai})^2$$

. $P^a_{i,i+1}(T_j)-$probabilities of possible environment changes events $\hat{E}_{i,i+1}(T_j)$ from the state (c^e_i to the state c^e_{i+1} at the moment T_j due to actions in the environment;

$$P^a_{i,i+1}\left(T_j, T_{j+1}\right) = p^l_{i(i+1)k}\ P^b_{i+1}\left(T_{j+1}\right),$$

where $p^l_{i(i+1)k} = f^l_i\left(T_j - T_{j-k}\right)$ - the probability that to the beginning of the interval $[T_j, T_{j+1}]$ considered there was state c^e_i under condition, that this state have began at moment T_{j-k} and than (under same condition) at interval $[T_j, T_{j+1}]$ this state changed to the (next possible) state c^e_{i+1}.

In the example assumed, $f^l_i\left(t\right) = F\left(t^l, t^r, t\right)-$cumulative B-distribution function of time required to fulfill operation a^e_i with left and right bounds of possible time $[t^l, t^r]$ and at the variable time t.

Here, probability $P^b_{i+1}\left(T_{j+1}\right)$ is the probability that to the end of $[T_j, T_{j+1}]$ interval state c^e_{i+1} not finished.

$$P^b_{i+1}\left(T_{j+1}\right) = P^{cb}_{i+1}\left(T_{j+1}\right)\left(1 - F^e_{i+1}\left(T_{j+1}\right)\right);$$

$P^{cb}_{i+1}\left(T_{j+1}\right)-$cumulative conditional probability of the $i+1-$th state beginning at the moment T_{j+1} :

$$P^{cb}_{i+1}\left(T_{j+1}\right) = \prod_{k=\overline{0,i+1}} F^b_k\left(T_{j+1}\right).$$

$P^a_{nj}-$probabilities of states actualization at T_j due to the actions in the environment realized according alternative sequence C^e_n;

$s^d_k(T_m)-$states, demanded by the environment at the border with the system. The states demanded at future (relative to the state of the environment) moments T_m.

A. *Environmental Demands to the System Functioning Results*

Let us designate $s^d_1\left(T_m\right), \ldots, s^d_k\left(T_m\right)-$caused by the actualized goals of the environment demanded states of the system at future moments $T_m \geq T_j$ (as a rule, $T_m \neq T_{j+k} \in \mathbf{T}$).

In the example, moments T_m are non-probabilistic and the number of moments is given as natural number.

Values mentioned set as a dimension of the matrix of the variable dimension.

One dimension of the matrix is sequenced C^e_n. The other dimension consists of moments in **T**, and the other - of the characteristics of requirements to the system functioning at some future moments T_m.

B. Role of information operations in System Functioning Alternation

Demands to the system functioning are formed based on actualized goals and technology description by information operations Ti^{sbe}.

For example, demand s_k^d is the sub network g_k of system functioning whose actions should be successfully implemented up to the given moment T_m, and total cost C^d to perform technological operations shall not be larger than allowed.

Each line in the Table I corresponds to the demanded sequences of states required by the environment to the specified moments.

Each line is characterized by the estimated probabilities of the sequences C_n^e and cells c_{nk}^e being implemented.

Each cell c_{nk}^e corresponds to the estimated probability of the state actualization at the cell time frame, provided that the given state sequence C_n^e realized.

Each sequence contains states - $< c_0^e, \dots c_i^e\ , \dots, c_{i+1}^e \cdots c_p^e, \dots c_m^e >$ of alteration (transitions).

These alternations are implemented according to the information operation Ti^{sbe} of the alteration of the system's functioning. Ti^{sbe} implements the following actions:

Determining the states c_n^s of the system (as states of sets of possible system actions, i.e., complex states) at possible moments and calculating probabilities of such states.

Identify the actions that are needed for the auxiliary actions of alteration. For example, they can be presented as a vector of recovery actions with specified characteristics. Identify other possible auxiliary actions (for example, information operations before and after recovery).

Determine new operations after auxiliary actions are done. They can be presented as a new network of actions allowed by performed auxiliary actions.

The definition of actions networks to achieve next goal based on states of the environment and states of the functioning (to achieve previous goal) is implemented as function of TI^{sbe} defined for each environment description array cell (tables III and I) and for each possible system state at the moment of functioning alternation. Thus, information operation realize mapping:

$$TI^{sbe} : (\mathbf{M^e}, \mathbf{M^s}) \to \mathbf{M^s}*,$$

where $\mathbf{M^s}*-$ model of alternated functioning due to changed environment (according model $\mathbf{M^e}$). Information operations are elements of activity whose objectives are to obtain and operate information, not exchange matter and energy used to represent this information. Information operations are implemented by personnel per specific information technology. The regularities of the formation of activity effects due to the use of information operations have not been studied in sufficient detail to predict the effects of activity with predictive mathematical models, at the design stage, depending on the selected characteristics of the information operations used. They were not studied because there are no suitable models and methods for analytically describing the effects of information operations and the operational properties under conditions of change and interactions. Such models' absence, in turn, is related to the lack of a universally accepted concept of the manifestation of the effects of information operations under conditions of change and interactions. Particularly for non-information (material) results obtained by non-information (material) operations, which depend on the study's information operations (as the cause and effects of change). The non-information effects of such actions vary with the implementation of the dependencies between environmental changes, further information, and, subsequently, non-information activities.

Since information operations lead to changes in non-information ones but do not directly lead to non-information effects, it is urgent to develop the concept of information and non-information action dependencies and, further, the concept of information and "material" effects conversion. The mathematical models developed of the formation of usage effects of information operations, including non-information (material) effects that changed due to the information effects, are designed to analytically evaluate the operational properties of the use of information operations.

The need to perform informational and then transitional operations is caused by a changing environment. It is typical for the complex technical and socio-technical system, considered an example, and for other systems, which regularly interact and are altered by environmental actions. Such need is genuine for digitalization in various industries, described by such popular terms as digital production, digital medicine, digital economy, and digital state [12]. As evidenced by the analysis of digitalization [13], its research based on the dynamic capabilities, organizational capabilities of the system use and the ability of the system and its operating personnel to change functions so that it better meets changing conditions, improves, and achieves changing operation goals [4] [14] [15].

The new property of the system capability proposed is an operational property that characterizes the system's ability to achieve the changing (i.e., actual and possible) goals during operation (in a changing environment). Such property depends on the characteristics of the "target" and "transition" functions of the CTS, including the informational actions performed to check the state of the CTS and the environment, develop prescriptions for performing technological operations, and bring the orders to the executors. This property's indicator is evaluated depending on the composition and characteristics of different types of possible actions. They form a set of choices in the problems solved.

The system's capability is represented by the characteristics (e.g., expectations, distribution boundaries, modes) of a corresponding random variable describing the system states' compliance measures with requirements or attributes that describe such measures of compliance (e.g., random vectors, graphs).

To estimate indicators of IT performance or digitalization effects indicators under conditions of change and interaction, we proposed to use the difference between system capability indicators values for new (for example, digital) IT technology use and primary (for example, traditional) IT technology use. Thus, IT I_a indicator $\Phi(I_a, I_0)$ compared to primary IT I_0 can be estimated as difference:

$$\begin{aligned} \Phi_1(I_a, I_0) &:= \psi_1(I_a) - \psi_1(I_0), \text{ or,} \\ \Phi_2(I_a, I_0) &:= \psi_2(I_a) - \psi_2(I_0). \end{aligned} \tag{1}$$

where $\psi_i(I_j)-$ scalar indicator i of system' capability under condition IT j used.

III. INITIAL DATA STRUCTURES EXAMPLES

The actions names and actions modes names and parameters table example shown in the Table III. All actions of networks are united into one table. The correspondence of networks vertices ID's and actions ID's is given by the Table III. Structures shown allows to create possible sequences of environment states changes. Each of such sequences cause sequence of networks to be performed in the response to the environment changes. Example of such sequences in tabular form shown at the Table III. The network alternations are described with the corresponding network cut ID's. The cut is the set of vertices that serve as the one network's borderline to its alternation. Corresponding alternative sequences of the environment changes and network cuts in the sequences are shown in Table IV.

TABLE II. THE ACTIONS AND ACTION MODES DATA

a_i	a_mi	t_a	t_b	$\ldots$	$Name$
1	1	3	5	$\ldots$	Conn. of the P921A to IA
2	1	8	30	$\ldots$	Conn. of the P27AB to IA
...	...	...	...	$\ldots$	...
n	1	12	55	$\ldots$	Fueling of the P921A
...	...	...	...	$\ldots$	...

TABLE III. ALTERNATIVE SEQUENCES OF ENVIRONMENT STATES IN TIME

№	$< c_i^e > /T_z$	T_0	T_1	T_2	...	T_j	...
1	$< c_0^e >$	c_0^e	c_0^e	c_0^e		c_0^e	
2	$< c_0^e, c_1^e >$	c_0^e	c_0^e	c_0^e		c_1^e	
...	...	c_0^e	c_0^e	c_1^e	...	c_1^e	...
n	$< c_0^e, c_1^e, c_2^e >$	c_0^e	c_1^e	c_1^e		c_2^e	
...	...	c_0^e	c_1^e	c_2^e	...	c_2^e	...

TABLE IV. ALTERNATIVE SEQUENCES OF THE ENVIRONMENT CHANGES AND CORRESPONDING NETWORK CUTS

SID	CID	$ChangeID$	$ProbA$
23527897	321	432	$0,0000125$
23527898	322	432	$0,0000117$
23527899	323	432	$0,0000119$

Each SID corresponds to different sequences of cuts referred by CID. $ChangeID$ is environment change ID, and $ProbA$ is the probability of sequence actualization. Between each pair of cuts, two networks inserted - i.e., remedial network from one goal to another and next, network to achieve a new goal. Each sequence of networks cuts and corresponding networks between cuts then translated into sequences of ordered operations in the lexicographic order. Such order determines acceptable structures for serial computations in multidimensional arrays created. Intermediate structure used to determine sequence of functions computation shown in the Table III.

TABLE V. THE CORRESPONDENCE OF POSSIBLE NETWORKS STRUCTURES AND ACTIONS ID'S DATA

V_i	N_3	N_4	N_5	N_6	N_7
1	1	1	26	1	1
2	2	2	27	2	2
3	3	25	25	25	3
4	4	4	4	4	4
5	5	5	28	5	5
...	...	...	...	...	...
33	$NULL$	$NULL$	$NULL$	37	37

TABLE VI. CORRESPONDENCE OF ALTERNATION MOMENTS, ENVIRONMENTAL STATES CHANGES AND DEMANDS ID'S TO THE SYSTEM FUNCTIONING

T_z	C_p, C_q	G_n, G_m	$Dem1$	$Dem2$	$Dem3$
1	$C1, C2$	$G1, G2$	1	38	75
2	$C1, C2$	$G1, G2$	2	39	76
3	$C1, C2$	$G1, G2$	3	40	77
...	...	...	...	...	...
37	$C1, C2$	$G1, G2$	37	74	111

Information operations provide functions that map the environment and other conditions to possible alternations of networks. Example of the table that provides functional dependencies of the environment's state changes at the given moments and changes the demands to the system's functioning shown in Table III.

IV. INTERMEDIATE DATA STRUCTURES EXAMPLES

Data tables constructed allows computing functional models dependencies [10], [16] between network vertices and next, between vertices and cuts.

The lexicographic order of network vertices was used according to Table IV. In this order, computation of network actions characteristics made sequentially by the order given by the lexicographic order of cells, according to cell types, defined by the network local structures. Thus, computations flow becomes linear. This simplifies computations in case of large amounts of networked data. Results of computation

TABLE VII. CORRESPONDENCE OF NETWORKS, LEXICOGRAPHIC ORDERED NETWORKS ACTIONS ID'S AND TYPES OF VERTICES STRUCTURES

$NumV$	$Net3$	$Lex3$	$Prev$	$Next$	$Type$
V_i	N_k	V_il	V_ip	V_in	v_t
1	1	1	$NULL$	$2, 3$	s, f
2	2	3	s	4	ser
3	3	2	s	5	ser
...	...	...	...	...	ser
33	$NULL$	33	32	$NULL$	f

according to the Table IV allows to compute series of networks cuts sequences as shown in the Table IV. For each cut ID in a row i.e. CID probabilities $P(\hat{A}_{CID})$ computed according functional models provided in [10], [17], [18], [16] and next, for each sequence ID in a row defined by this SID compositions of actualization and than, measure of demands and results correspondence probabilities evaluated.

As a result, the multidimensional matrix structure of probabilities sequences depending sequences of environment conditions formed. An example of such structure is:

$[35, ”01”, 0.001043672574109, ..., 0.0001575290810923]$, where first two numbers are ID of system functioning and ID of environment functioning and further real numbers are probabilities. This structure elements used to built reports with use of R statistical language. It allows to analyze computed probabilistic data with use of established probabilistic routines. The code:

```
zz1 <- as.matrix(m2z01)
persp(iXY01$x,iXY01$y, zz1,
ylim = range(iXY01$y)*0.12,
xlim = range(iXY01$x)*0.5,
xlab = ”Actualization␣probability”,
ylab = ’W’,
zlab = ”Total␣possibility”, col = ”black”)
```

Produce the Figure 2 from two CSV files with output data for sequences of the system functioning which corresponds to environment changes of the length one.

Axes are sequences of functioning actualization’s, compliance and total probabilities.

The surface obtained is quite dense excluding series of points in upper part of the figure, i.e. realisations of functioning with highest actualisation possibility and highest compliance are rare (shown as black areas) events, while regular compliance - actualisation’s pairs form regular structure (shown as grey area). This gives the possibility to represent such surfaces analytically, without actual networks computation.

The code:

```
zz2 <- as.matrix(m2z012)
persp(iXY012$x,iXY012$y, zz2,
ylim = range(iXY012$y)*0.95,
xlim = range(iXY01$x)*0.001,
xlab = ”Actualization␣probability”,
ylab = ’W’,
zlab = ”Total␣possibility”, col = ”black”,
theta = 0, phi = 15, r = sqrt(3), d = 1,
      scale = TRUE, expand = 1,
      border = NULL, ltheta = -135,
      lphi = 0, shade = NA, box = TRUE,
      axes = TRUE, nticks = 5,
      ticktype = ”simple”)
```

Produce the Figure 3 from two CSV files with corresponding output data but for the sequences of the system functioning which corresponds to environment changes sequences of the length of two events (in the environment). The surface obtained for two events in the sequence is quite sparse excluding series of points in upper left part of the figure, i.e. realisations of functioning with relatively high actualisation possibility and high compliance are regular (shown as black areas) events and form linear structure, while disturbances (shown in black) are rare. This, like in previous case, gives the possibility to represent such surfaces analytically, without actual networks computation.

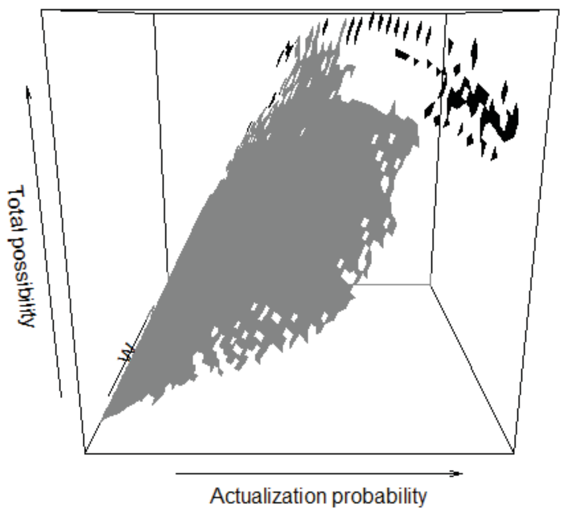

Fig. 2. The possibilities of transitions and correspondence in the sequences of the length one

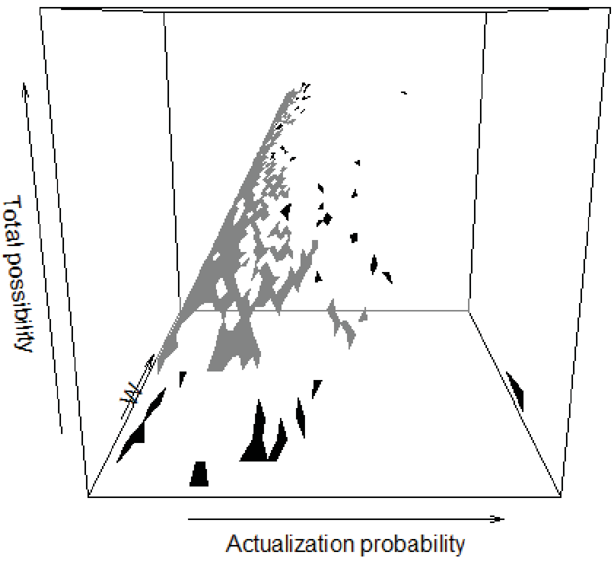

Fig. 3. The possibilities for transitions of the length of two events

Models suggested allows us to estimate the multidimensional probabilistic measure $\hat{\Omega}(T_u)$, presented in previous articles [19], [10]:

$$\begin{gathered}\hat{\Omega}(T_u) = \{(P(\hat{A}_u), P(\hat{E}_u),\\ P(\hat{B}_{ui}), I_u^{er*} = \overline{1,|U|}, T_u = \overline{1,|U|}\},\end{gathered} \tag{2}$$

where the indexes run through all possible T_u, $pi_u^e \in \Pi_u^e$ and all possible u in $\hat{A}_{ui}$ i.e., through all possible dimensions of the complex index U which corresponds to probabilistic measure changes.

$S_i^e(i_i, pi_u^e)/\hat{E}_i-$ the realization of the environment state at moment T_i as a result of an alternative fulfillment $i_i \in I_i$ (result of event $\hat{E}_{ui}$);

$\hat{B}_{ui}(i_i, pi_u^s, \pi_u^e)/\hat{A}_i)-$ the event that due to an alternative fulfillment $i_i \in I_i$ state $S_i^s(i_i, pi_u^s, \pi_u^e)/\hat{A}_i$ will correspond to state $S_i^e(i_i, pi_u^e)$;

$\hat{A}_i$ according to description $\mathcal{R}$ of correspondence, given by the probabilistic correspondence predicate $p(S_i^s, S_i^e, i_i; \mathcal{R})$ (a twice vague probabilistic predicate):

$$P(\hat{B}_{ui}(i_i, \pi_u^s, \pi_u^e)/\hat{A}_{ui})) = Poss(p(S_i^s, S_i^e, i_i; \mathcal{R})); \tag{3}$$

As a result, scalar indicator of dynamic capability can be estimated:

$$\psi(O, C, S, M) := \sum_{i=1,u}^{i=I_u,u} \prod_{i=1}^{i=|I_u|} P(\hat{E}_{ui}) P(\hat{A}_{ui}) P(\hat{B}_{ui}), \tag{4}$$

which is the system's scalar capability indicator, a probabilistic measure value in $[0, 1]$. Examples of various cuts of multidimensional measure $\hat{\Omega}(T_u)$ presented in the Figures 4, 5, 6.

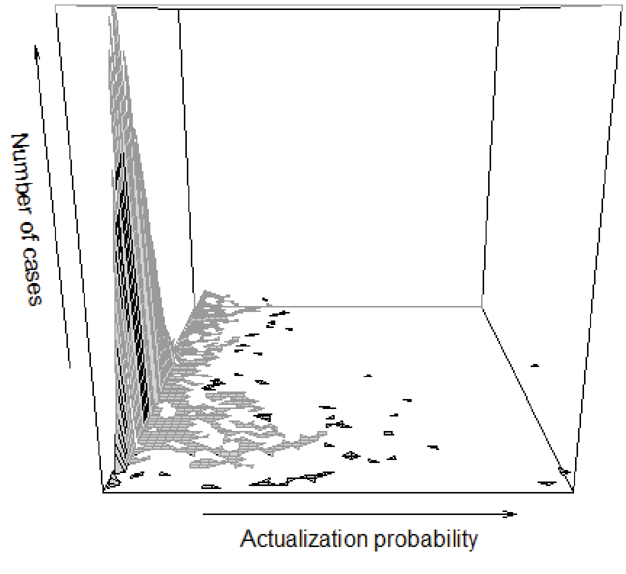

Fig. 4. Projection by sequence length over alternatives in lexicographic order

In Fig 4 the number of cases for probability numbers illustrated. There is the peak of such number realization.

In Fig. 5 wire framed surface is the projection on actualization axe. As one can see, the form of figure is quite close to quadratic or mix of two quadratic.

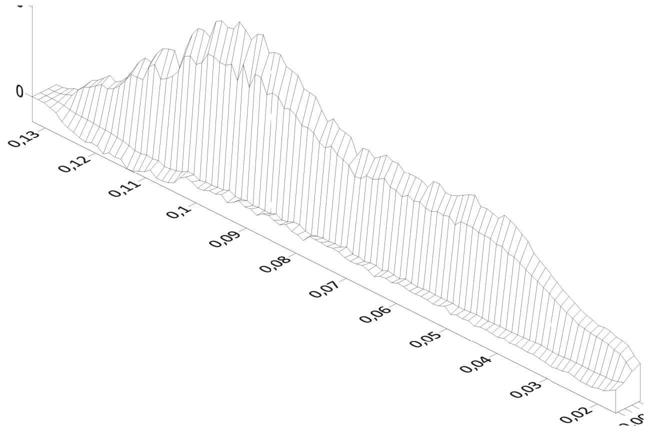

Fig. 5. Projection of the surface to the axe of the possibility of alternation

In Fig. 6 the sequence of alternative project modernization decisions ordered from less perfect to most perfect in complex probabilities axes (capability addends, total capability) axes.

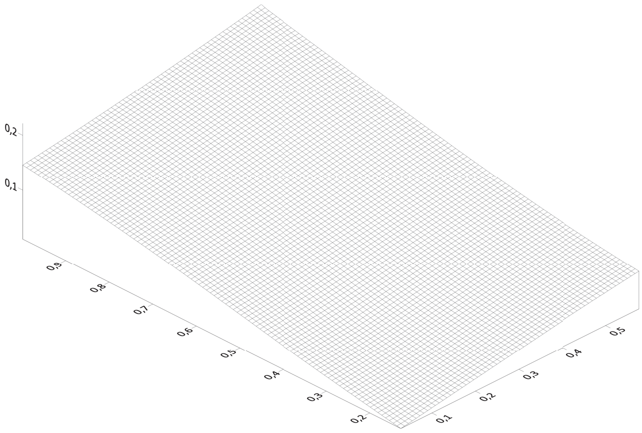

Fig. 6. Capabilities addends for lexicographic order of cases perfection

The results obtained allow us to produce some assumptions about the structure of the $\hat{\Omega}(T_u)$ multidimensional matrix and about its formation:

Most influence on capability indicators is from frequent structures. Such frequent structures are determined by system environment actions and system functioning network structures. Research of such structures and capability indicators dependencies for such structures shall be done in the future.

Possibilities (probabilities, depending on their statistical or expert nature) associated with the structure and frequencies of events associated are mostly determined by the structure and by the data specific to the environment actions (for example, in our case, one event chains are most frequent) and by demands to network structure (in our case - by the terminal character of the demands to the networks of actions);

Rare events do not affect capability indicators dramatically and can be taken into account when accessing risks, not capability;

By the same threshold to the previous change, sequential change of system parameters characteristics cause an almost linear change in capability indicators.

V. CONCLUSION

As a result of the suggested models and algorithms, the quantitative estimation of system capability and other operational properties concerning changing environment becomes possible depending on the problems' parameters and variables to be solved.

The possible features to estimate are dynamic capability, organizational capability, information technology use performance, and digitalization performance.

Suggested models can be used to research alternating networks models for information operations research to alternate system functioning. Results obtained can be further used for system capability indicators prediction based on structural features of probabilities dependencies presented in the article.

Such a method could estimate the capability indicators in strategic planning applications without knowing all actions and their characteristics but knowing their structures only.

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