Робота відноситься до області дослідження операцій, зокрема до верифікації оціночного показника, який потенційно може бути використаний в якості критерію оптимізації. Розроблено правила еквівалентного перетворення операційних процесів і метод створення попередньо ідентифікованих моделей еталонних операцій різних підкласів. Етап верифікації проходить оціночний показник, який показує несуперечливі результати на всіх класах ідентифікованих еталонних операцій

Ключові слова: локальний критерій ефективності, метод верифікації оціночних показників, критерій оптимізації

Работа относится к области исследования операций, в частности к верификации оценочного показателя, который потенциально может использоваться в качестве критерия оптимизации. Разработаны правила эквивалентного преобразования операционных процессов и метод создания предварительно идентифицированных моделей эталонных операций разных подклассов. Этап верификации проходит оценочный показатель, который показывает непротиворечивые результаты на всех классах идентифицированных эталонных операций

Ключевые слова: частный критерий эффективности, метод верификации оценочных показателей, критерий оптимизации

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DEVELOPMENT OF A VERIFICATION METHOD OF ESTIMATED INDICATORS FOR THEIR USE AS AN OPTIMIZATION CRITERION

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1. Introduction

An indicator verification issue regarding its compliance with an optimization criterion is important from the practical point of view. The optimization criterion should ensure the coordination of the owner's (super-system) goal with the results of the executive system procedural activity. Only then the control processes can be completely automated. And this is possible only if the choice of the optimization criterion is systematically substantiated.

A feature of the verification method [1] is the technology, based on the exclusion of the estimated indicator from the set of the tested ones if the results of rating estimation of the models of operations, where the verified indicator was applied, don't correspond to the rating estimates, received by using local efficiency criteria.

The indicators, that provide rating efficiency evaluation of compared operations within a certain class of reference models of operations, have been defined as the local efficiency criteria.

The verification method development is carried out in a number of directions:

– limitation of the set of verified indicators by specification of the set of formal signs of estimated indicators [2];

– expansion of the method on a class of indicators that provide an assessment of operations with the distributed parameters [2] and classes of models of reference operations.

It is obvious that the reliability of the verification method is increased at the expansion of the number of classes of operations reference models. At the same time, the expansion of the classes demands the idea development about the used cybernetic model and specification of the models of local efficiency criteria.

Thus, the extension of the classes of reference models of identified operations is an important scientific and practical task.

2. Literature review and problem statement

The verification issue of estimated indicators for their use as the operational process optimization criterion is difficult for a number of reasons. The first reason is caused by the fact that now a large number of technical and technical

and economic indicators, which developers associate with the indicator intended for use as an optimization criterion, are developed.

The technical indicators may include criteria that use the object technical parameters as a reference point for decision-making in choosing the most advantageous control.

Thus, in the work [3], an attempt to use the "critical load" value as an optimization criterion has been made. In the development [4], the authors plan to solve the issue of the operational process efficiency assessment with the use of an indicator "reliability", in [5] – by means of such indicator as "filling criterion". In [6], an optimization attempt is carried out by applying the indicator that defines an "energy of selection error", and in the work [7], for the optimization problem solution, the value of minimum deviation from the predetermined trajectory is used.

Despite the fact that the technological operation change in time leads to energy product cost change and to the equipment wear, the criterion "productivity" continues to be used in optimization problems [8].

Recently, the number of works aimed at the power efficiency issue development [9] has considerably increased.

Traditionally, there are a lot of researches, in which the optimization process is associated with cost minimization [10]. At the same time, the equipment wear [11] as the output product cost reduction function from control, is considered extremely seldom.

The second class of indicators, which are offered to be optimization criteria is based on the use of mixed estimates, received as a result of scaling of important basic indicators [12].

In the research [13], the generalized criterion that is formed by the results of processing the extremum values of integrated indicators and defined by the authors as an "efficiency criterion" is used. At the same time, the accuracy assessment of the developed indicator as the efficiency criterion hasn't been proven in the work.

Consequently, the estimated criteria have the most various internal structures that don't display the cybernetics of the studied process [14].

On the other hand, the works within the "operations research" are more directed to the illustration of the identification possibility of classical operational models with the use of various mathematical methods [15]. At the same time, the issue about the development of the adequate cybernetic concepts, the operational models and methods of their identification remains open.

For example, the mathematical modeling language Marked Petri Net is more developed by mathematicians for logical tasks solution. Thus, Petri nets are used in the work [16] to model dynamic discrete systems. However, this device is not used by cybernetists to solve optimal control problems, in particular as a tool for identifying system operations.

3. The purpose and problems of the research

The purpose of the work is the development of the verification method of estimated indicators that can potentially be used as a global optimization criterion.

For the research goal achievement, the following problems have been solved:

– definition of the rules for the operational process equivalent converting;

– definition of an additional class of global models of simple operations that have been chosen from subclasses with pre-defined rating efficiency.

4. Development of the verification method of the estimated indicator intended for use as optimization criterion

In the work [1], it is established that the simple operation cybernetic model (SOCM) can always be presented in the form of the triple (RE, TO, PE). Here RE is the integral expert evaluation of operation input products, TO is the operation time, PE is the integral expert evaluation of operation output products.

Also, the simple operation cybernetic model can be represented in the form of marked Petri net (MPN) fragment (Fig. 1).

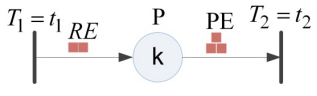

Fig. 1. A simple operation cybernetic model in the form of marked Petri net fragment

If the quantitative parameter of the transition T_1 is connected with the moment of the beginning of the operation model ($T_1=t_1$), and the quantitative T_2 parameter is connected with the operation model end moment ($T_2=t_2$), then the operation time is $TO=t_2-t_1$.

As a cybernetic task, when performing a technological operation, is the increase of value of the operation output products in relation to the value of operation input products, the transition P represents the model of the marker transformation system mechanism (k).

This means that the cybernetic mechanism k converts the input marker with the quantitative parameter RE into the output marker with the quantitative parameter PE=k·RE. So, if RE=2 units, k=1.5, then PE=3 units.

In the work [2], it is established that among the Q set of estimated indicators, the internal structure of which corresponds to the functional f (RE, TO, PE), there is a certain indicator X that is the E sample of the set Q displaying the resource efficiency of the simple operation model $(X \in Q) \wedge [\exists X \to E]$.

The essence of the E indicator identification method consists in the fact that in case of imposing certain limitations on the parameters of cybernetic models of simple operations, it is possible to create classes of models of simple operations (K1, K2, K3,..., Kj). In this case, each simple operation cybernetic model within a certain class can be identified with respect to its rating efficiency.

For a possibility of such identification, for each operation class or subclass, the indicator that can be used as a local efficiency criterion (LEC) has been defined.

Due to the identification of SOCM by using certain LEC, the verification possibility of an indicator of the Q class on the SOCM set of the corresponding class appears. At the same time, the indicator value allows ranging models of operations concerning the rating of their efficiency. However, the identification of operations by LEC doesn't give the answer to the question of how much SOCM with a higher rating is more effective than SOCM with a lower rating.

Let's determine the objects of MPN (Fig. 2) as SOCM of the subclass A of the class K_1 by the three (RE_A, TO_A, PE_A, (($PE_A=k_A \cdot RE_A$) ($k_A>1$)). Then, SOCM of the subclass B of the class K_1 can be determined through the SOCM parameters of the A subclass ($RE_B=RE_A$, $TO_B=2 \cdot TO_A$, ($PE_B=2 \cdot (PE_A-RE_A)=2 \cdot (k \cdot RE_A-RE-_A)=2 \cdot RE_A(k_A-1)$), $k_B=PE_B/RE_B$).

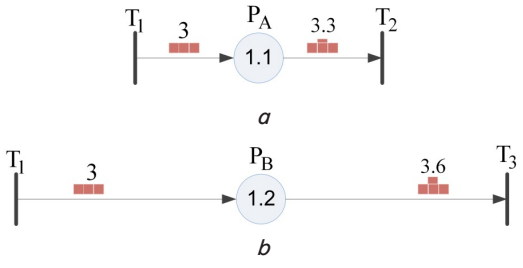

Fig. 2. An example of defining the class K_1 of models of simple operation: *a* – A subclass model; *b* – B subclass model

At the same time, if the MPN cybernetic model (Fig. 3) is adequate, i. e. it is possible to accept that $RE_{A2}=PE_{A1}$, $PE_{A2}=k_A \cdot RE_{A2}=k_A^2 \cdot RE_{A1}$, then for comparison of the operations A and B it is possible to apply the results of LEC comparison of type $AE_{(A1,2)}=k_A^2$ and $AE_{(B)}=k_B$. If ($AE_{(A1,2)}>AE_{(B)}$), the operation A is more effective and vice versa.

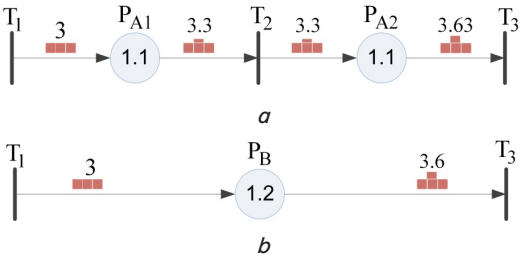

Fig. 3. An illustration of the method of direct comparison of the results of marker transformation of identical initial investments with the use of: *a* – the consecutive two-operational transformation; *b* – one-operational transformation

The proof is based on the assumption that the MPN model adequately displays the cybernetics of the converting process. That is, the marker weight of the A_1 operation output is transferred to the A_2 operation input.

We will determine the operational process of consecutive marker transformation (Fig. 3, *a*) by the concept "developing operational process".

For the operation B, which has a long duration, the added value of AE_B at t_3 time is defined from the expression $AE_B=PE_B-RE_B=RE_B(k_B-1)=RE_{A1}(k_B-1)$.

For an operational process, based on the operations of the subclass A, the $AE_{A1,2}$ value at the t_3 time is determined from the expression $AE_{A1,2}=(PE_{A1}-RE_{A1})+(PE_{A2}-RE_{A2})=RE_{A1}(k_A-1)+RE_{A1}(k^2-k)=RE_{A1}(k_A^2-1)$.

As the ratio of $RE_{A1}(k_A^2-1)$ and $RE_{A1}(k_B-1)$ models is determined by the $AE_{(A1,2)}=k_A^2$ and $AE_{(B)}=k_B$ relation, these indicators are LEC allowing to identify operations of the A and B subclasses of the K_1 class.

As (($k_A^2=1.21$)>($k_B=1.2$)), the A operation is more efficient than the B operation (Fig. 2).

Creation of operation model classes that have been identified by local efficiency criteria (LEC) provides the verification possibility of the estimated indicator, which can potentially be used as the optimization criterion. Such verification allows defining the consistency of processing results of the identified operation data triple with the estimated indicator use, in relation to the results of the operation rating assessment with the LEC use.

So, the indicator

$$EL=\frac{(PE-RE)^2 T_1^2}{PE \cdot RE \cdot TO^2}\ [17],$$

in relation to the operations A and B (Fig. 2), gives the following estimates: $EL_A=0.0022$; $EL_B=0.002$.

The rating assessment of the A and B operations, received with the use of EL indicator, doesn't contradict the rating assessment with the use of LEC.

The proposed verification method with identified SOCM classes is based on the exclusion of the indicators in the case of conflicting estimates. Therefore, the more classes of the identified SOCM with the use of LEC, the more reliable the verification results.

Estimation consistency, at the same time, is a necessary but not sufficient condition for final decision-making.

Reliability of the verification process could be increased significantly if there was a possibility of creation of the equally effective models of operations, which belong to different subclasses.

For example, if the MPN model (Fig. 3, *a*) is adequate, then it is possible to state a hypothesis concerning the fact that models of the operations A and B, which have $k_A^2=k_B$, are equally effective.

This follows from the fact that the operational process based on the operations of the A subclass of the K2 class at the t_3 time, leads to the equal result (Fig. 4).

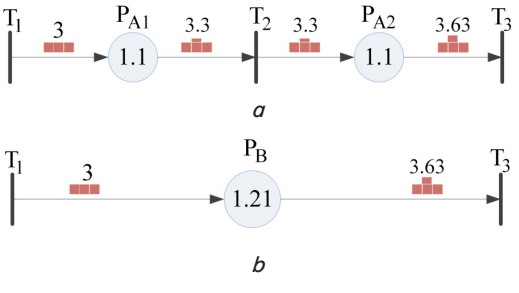

Fig. 4. An example of fragments of Marked Petri Nets, the operational processes of which are synchronized in time: *a* – two-operational process; *b* – one-operational process

On the other hand, the EL indicator, which still was verified for consistency [1], has shown that the operation B ($EL_B=0.002278$) is more effective than the operation A ($EL_A=0.002273$).

Therefore, if the MPN model is correct, then:

– the EL indicator isn't an efficiency indicator;

– the A and B operation models can be used as a standard for equally effective operations.

If the MPN model isn't correct and the operation B is more effective than the operation A, then:

– using the proof of inadequacy of models of the A and B operations, it is possible to develop a constructing method of a new class of models with the predetermined identification;

– the EL indicator has shown consistent estimation results of the new class of identified operations;

– it is necessary to redefine (to specify) the $AE_{(A1,2)}$ and $AE_{(B)}$ private criteria determination model for adequate assessment of the operation subclasses of the class K_1.

Like any other mathematical model, MPN displays objects and processes of the real world simply. At the same time, the MPN, developed for the solution of problems of one class without a certain complication and specification can't be used for solving the problems of another class. Respectively, without the development of a conceptual framework and marker transformation model classes, the MPN can't complexly solve problems in the theory of optimal control.

For example, modeling of control processes, in fact, is based on a number of postulates:

P. 1. The start moment of any operation, as well as its finish moment, can be defined.

P. 2. Each position defines the logic of the converting process simple mechanism.

Corollary of P. 2. All MPN models of operations are models of simple operations, but not of operations with the distributed parameters.

P. 3. Movement of markers (products) between operations takes zero time.

P. 4. The marker movement process doesn't demand resources.

Limitations, formulated in the form of postulates, make it possible to significantly simplify the solution of problems of a certain class. However, the need of the system task solution demands interaction of models, each of which solves the problem of its own class.

So, the principle of marker transformation

$$PE = k \cdot RE,$$

in fact, is axiomatic when determining the process cybernetics.

Axiom 1. Any operation is carried out for the purpose of increasing the value of output products in relation to the value of input products.

The second rule, imposing a restriction on the principles of display of arches as elements of the cybernetic PN, is their interrelation with the operation time.

Such interrelation externally can be shown differently, but its need is also caused by the cybernetics features of real processes.

Let's assume that operations of different duration provide the input marker formation (product weighing 2 units) in the output marker (product weighing 4 units). From a position of the cybernetic approach, such SOCM are different. This is connected with the fact that the efficiency of the operational processes based on such operations is also different.

P. 5. For correct display of the cybernetics of the modeled processes, the transitions of MPN have to be identified relative to each other taking into account the time factor.

The identifier of transition can either display a binding to a certain timepoint, or the temporary sequence of transitions in relation to the beginning moment of the operational process.

The model in the form of MPN (Fig. 3) visually displays the fact that the operational P_A process consists of two operations (Fig. 3, *a*). The operational process (A_1, A_2) has the same duration in time, as well as the operation B (Fig. 3, *b*).

However, the operational process (A_1, A_2) includes the hidden transfer operation of the A_1 operation output product on the input of the A_2 operation. Therefore, the creation of a cybernetic model with the use of the classical idea of MPN model restrictions can't be used when the process cybernetics are investigated.

In this case, a part of the value of an output product of the operation A_1 will be used for the realization of the product transfer from A_1 to A_2.

This fact can be displayed, for example, in the form of transition losses (Fig. 5).

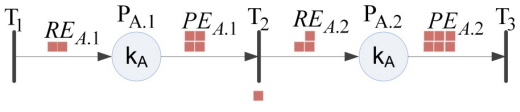

Fig. 5. A representation of the marked Petri net fragment with a possibility of display of the marker transition losses

Thus, on the operation B input, the RE_{A2} product with a smaller value, in relation to the expert assessment of the previous operation output product PE_{A1} will be created. That is, if the model is constructed correctly, then the equality $RE_{A2}=PE_{A1}$ can be established only in the presence of additional investment of the process (A_1, A_2) at the time t_2 (Fig. 6).

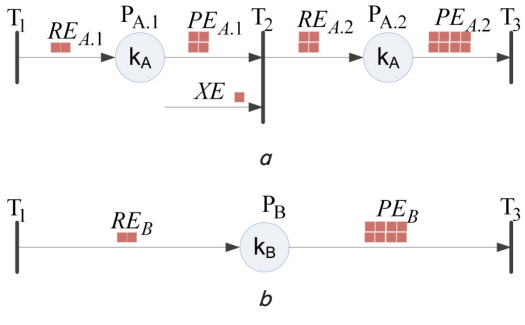

Fig. 6. An illustration of the principle of equivalent transformation of synchronized operational processes with the use of the office of the marked Petri nets: *a* — two-operational process of marker transformation with compensation of losses of transition; *b* — equivalent representation of two-operational process with compensation of losses of transition

This means that in the description of the process cybernetics, it is necessary to consider the resource consumption value that is necessary for ensuring interoperational interaction.

P. 6. The transfer process of the investment marker from the previous cybernetic operation to the subsequent one demands nonzero investments of overcoming the marker transition.

P. 7. The lack of the marker transition investments reduces the weight of the transferred marker by the value of losses of transition investments.

Thus, the models that describe the cybernetics of processes using the PN should take into account the marker weight loss when passing the marker transition.

The conducted researches allow formulating the rule of the SOCM transformation:

Any SOCM of the form

$$P(A) \rightarrow \left[\left(RE_A, TO_A, PE_A \wedge PE_A = k_A \cdot RE_A \right) \right]$$

can be converted into the operational process

$$P(B_1, B_2) \to \left[\left(RE_{B1}, TO_{B1}, PE_{B1} \wedge RE_{B1} = RE_A \wedge TO_{B1} = (TO_A / 2) \wedge \right.\right.$$
$$\left.\left. \wedge PE_{B1} = \sqrt{k_B} \cdot RE_{B1} \right) \right] \wedge \left[\left(RE_{B2}, TO_{B2}, PE_{B2} \wedge RE_{B2} = \left(\sqrt{k_B} RE_{B1} - XE \right) \wedge \right.\right.$$
$$\left.\left. \wedge TO_{B2} = (TO_A / 2) \wedge PE_{B2} = \sqrt{k_B} \cdot RE_{B2} \right) \right]$$

and vice versa.

Let's state a hypothesis concerning the fact that if the system mechanism of the operational process P_1 displays the marker converting process cybernetics in the following form:

$$PE = k \cdot RE,$$

and the system mechanism of the operational process P_2 displays the cybernetics of the marker converting process $PE = k^2 \cdot RE$, then the operation model of the type (Fig. 3, *a*) is less effective than the operation models of the type (Fig. 3, *b*).

Theorem 1. Let XE be the losses of overcoming the marker transition T_2. Then any operation in the form of:

$$A \to \left(RE_A, TO_A, PE_A = k \cdot RE_A \right)$$

is less effective in relation to the operation of the type:

$$B \to \left(RE_B = RE_A, TO_A = 2 \cdot TO_A, PE_A = k^2 RE_B \right).$$

Proof. As a result of the marker transformation at the output of the operation A_1, the cybernetic product is formed as follows:

$$PE_{A1} = k \cdot RE_{A1}.$$

As a result of the loss of the marker transition, at the input of the operation A_2, the conversion process will look like:

$$PE_{A2} = k \cdot \left(k \cdot RE_A - XE \right).$$

On the other hand, as

$$RE_A = RE_B, \quad k_B = k_A^2,$$

at the output of the operation B_1 at the time t_3, the cybernetic product is formed:

$$PE_B = k_B \cdot RE_B = k_A^2 \cdot RE_{A1}.$$

Because:

$$PE_B(t_3) - PE_{A2}(t_3) =$$
$$= k_A^2 RE_{A1} - k_A \left(k_A \cdot RE_A - XE \right) = k_A \cdot XE,$$

the operation B is more effective than the operation A.

Theorem 1 is proved.

Consequently, the A and B models of operations cannot be used as standards for equally effective operations of different classes.

On the other hand, the fact that the operations of A and B subclasses when using a certain technology of their design are not equally efficient allows the creation of a new class of SOCM. Operation subclasses of this class don't demand a definition of LEC for identification of their rating efficiency. That is, the rating identification of their efficiency is predetermined.

Let's consider a class formation method of the operation models, which are previously identified concerning their rating efficiency in terms of the MPN:

1. The initial marker value of investments of the modeled operations $RE_A = RE_B$ is defined in a random way;

2. Within the restrictions $F > k > 1$, the coefficient of marker transformation, where F is the external environment restrictions, is defined;

3. Within $T_{min} > TO_A > T_{max}$, the operation duration with a smaller value of the rating efficiency identifier is defined;

4. From the expression $PE_A = k \cdot RE_A$, the operation output marker value with a smaller rating efficiency identifier value is defined;

5. From the expression $PE_B = k^2 \cdot RE_B$, the value of the operation output marker with a larger value of the rating efficiency identifier is defined;

6. The operation duration with a larger rating efficiency identifier value $TO_B = 2 \cdot TO_A$ is defined.

The development of the idea about the cybernetics of the developing operational process shows that the expression of the local criterion of AE requires specification.

So, to state a judgment about the relative efficiency of the A_1 and B operations (Fig. 3) with the use of the direct method, it is necessary to consider the loss of the marker weight on the step of marker transition passing. Of course, the marker transition passing rule change is necessary only for those MPN models, which describe the cybernetics of the converting process.

If we assume that the original efficiency indicator (E) is determined, the value of the marker transition loss can be determined from the operation balance equation of different subclasses of the following form:

$$E_A \left(RE_A, TO_A, \left[k \cdot RE_A + XE \right] \right) =$$
$$= E_B \left(RE_A, \left[TO_B = 2 \cdot TO_A \right], \left[k^2 RE_A \right] \right),$$

having solved it relatively XE or with the use of numerical methods.

For the verified indicator, the value XE determines not the value of marker transition losses, but the value of a restriction on the comparison possibility of operations of different duration.

The expression of balance with the EL indicator use will have an appearance:

$$\frac{\left(k \cdot RE - RE + XE \right)^2}{\left(k \cdot RE + XE \right) \cdot RE} = \frac{\left(k^2 - 1 \right)^2}{2 \cdot k^2}. \qquad (3)$$

From (3) we cannot obtain an explicit expression for XE. But

$$XE = f(RE, k).$$

The fact that the time factor doesn't influence the XE value is explainable as, according to the comparison condition of the A and B operations, the transition time (T_p) is equal to a difference of operational processes:

$$T_P = TO_B - 2TO_A = 2TO_A - 2TO_A = 0.$$

For example, for the EL indicator, the dependence of XE (k) at RE=3 units will have an appearance (Fig. 7).

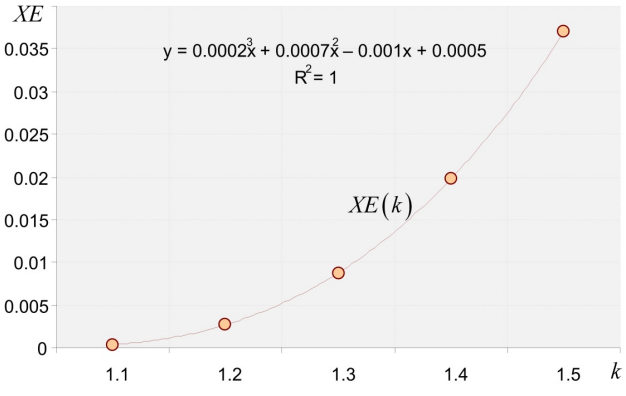

Fig. 7. Change of transition losses from the transformation coefficient value (k) for RE=3 units

The conducted researches allow defining an indispensable condition, which needs to be considered at the realization of the verification method of the class of estimated indicators, within which the identification of the original efficiency indicator or optimization criterion is carried out.

So, for example, the comparison of the A and B models of operations, in which $RE_A=RE_B$ and $2TO_A=TO_B$, with the direct comparison methods use is possible only if the value of transition losses of the operation with the smaller duration is considered.

In the work [1], the AE absolute predictive assessment measure of operational processes has been developed. It defines the rating efficiency value of the A and D operations, where

$$RE_A=RE_D\ TO_D=2TO_A,$$

with the use of private criteria

$$AE_S = k_S^2 RE_S \text{ and } AE_L = k_L RE_L.$$

Here AE_S and AE_L are local assessment criteria for operations of multiple duration. At the same time, the AE_S criterion estimates the operations (S) of a smaller duration, and the AE_L criterion estimates operations (L) of a bigger duration.

For the model taking into account interoperational losses, the expression for AE_S and AE_L will have the appearance:

$$AE_S^{'} = k_S^2 \cdot RE - k_S \cdot XE, \quad AE_L^{'} = k_L RE_L.$$

The results of the indicator EL verification on operations models (Fig. 2) are given in Table 1.

Table 1

The results of the EL indicator verification taking into account the specified LEC model of $AE_{(A1,2)}$ and $AE_{(B)}$

Operation	RE	TO	PE	k	AE	EL	XE	AE'
A_1	3	2	3.3	1.1	3.63	0.00227	0.0005	3.629
B	3	4	3.6	1.2	3.6	0.00208	0	3.6

The researches have shown that the AE_S criterion model specification hasn't changed the rating of estimated operations, therefore, the EL estimated indicator has been verified on this class of operations.

5. Research results connected with the verification of the estimated indicators

As a result of the conducted researches, it has been established that the mathematical model, which displays the cybernetics of the operational process has to consider the losses of interoperational interaction.

Creation of the specified model has allowed expanding a set of classes of the identified operation models concerning their rating efficiency. Moreover, the method of creating a new class of operation models provides their predetermined identification. That is, this method doesn't demand determination of private efficiency criteria.

Also, the creation of the specified model has allowed developing the rule of equivalent transformation of equally efficient operational processes.

The data on changes in the interoperational transition losses, depending on the Petri net marker conversion strengthening coefficient value has been received. As an efficiency indicator, the evaluation indicator was used, which had undergone all stages of verification for the possibility of using it as an optimization criterion.

The amendment to the formulas of local criteria, which estimate the rating efficiency of the operations that have different duration has been introduced.

6. Discussion of the research results connected with the development of the verification method of estimated indicators

As shown by the results received in the work, it wasn't succeeded to create reference models of the equally efficient operations belonging to different classes within this research. That is, it was failed to create the equally efficient operation reference models. Their successful assessment would allow indicating immediately that the verified estimated indicator is an original efficiency indicator.

Therefore, the received results expand the possibilities of the verification method of estimated indicators based on applying indirect signs.

Nevertheless, the cybernetics research of synchronized operational processes with the use of the expanded device MPN, on the one hand, has shown that the rule of creation of network models depends on a type of the studied process. And this, in turn, has allowed developing the rule of converting the MPN fragments into the equivalent structures.

Also, depending on whether the physics and cybernetics of the converting process or control processes are investigated, the type of the MPN model will change.

Definition of the rules of equivalent transformation of processes with the use of operations of different classes opens the prospects of creation of new methods of structural optimization of models in the form of MPN.

Besides, the possibility of representation of processes of different classes in the form of MPN opens the prospects of complete description of the models of operated systems as cybernetic objects of interactive interaction.

7. Conclusions

1. Rules of the equivalent operational process converting in the form of MPN of one class into the model of the operational process in the form of MPN of another class, which considers the cybernetics of the converting process have been defined.

The possibility of the expression specification for determination of the efficiency rating of operations of different duration is an important consequence of definition of transformation rules of operational process models.

The definition method of a restriction on the possibility of rating estimation of operation models with different duration has been developed.

2. The conducted researches have allowed developing the rules of creation of the class of simple global operation models, the identification of which doesn't require determination of private efficiency criteria.

The verification method of estimated indicators, which can potentially be used as the optimization criterion, has been developed. The task is solved by definition of the class of simple global models of operations of different subclasses with the predetermined rating efficiency.

Expansion of the set of identified classes of reference models of simple operations allows increasing significantly the reliability of the verification method of estimated indicators, which can potentially be used as the optimization criterion.

At the same time, the positive effect of the expansion of the opportunities of the verification method has been shown not so much in the increased probability of excluding the inadequate estimated indicator, but in the introduction of a restriction on the creation rules of classes of reference models of operations. Introduction of such a restriction prevents the possibility of excluding the adequate estimated indicator from consideration.

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