machines is ensuring their rehabilitation. It is known that the maintainability of agricultural machinery, as well as other properties of reliability lays in the design, therefore, in the specification of the product are established objective criteria and methods that allow us to quantitatively and qualitatively evaluate the machines that are designed. The analysis of the literature on this problem showed that over the last decade in the industry of agricultural machinery is still not enough attention is paid to the repair of technological structures combine harvesters and their maintainability. The question of maintainability is particularly acute for harvesters because the harvest is important to reduce the length of downtime for maintenance and troubleshooting.

Keywords: ***distribution law, complexity, reliability, operation, combine harvester***

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ANALYSIS OF MODEL OF RECOVERY OF AGRICULTURAL MACHINES AND INTERPRETATION OF RESULTS OF NUMERICAL EXPERIMENT

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Abstract. *Maintenance is an important complex production processes as an integral element of the process of providing services, ensuring the functioning of agribusiness. Despite the fact that human error, not technology failures pose the greatest potential risk, little in the literature discusses aspects of the human factor associated with the risk factors of the working environment in which employees realize that.*

Conditions of the working environment (working conditions) while conducting production processes have a significant impact on the implementation of the professional characteristics of personnel. In addition to the impact of hazards physical factors of production environment on the quality of the production maintenance processes affect the professional competence and industrial discipline of the personnel in the field of industrial safety in accordance with job requirements and the production hierarchy.

Due to the fact that IT consists of production processes of high complexity with high requirements to quality of work, strict compliance with the regulations, require a special methodological support,algorithms, methods and models for decision support managers of

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service enterprises in the organization of production processes, focused on achieving the lowest level of employee exposure hazards inherent in the working environment.

Key words: ***analytic, spatial requirement, maintenance, agricultural machine***

Formulation of problem. If the weights be chosen with condition for the normalization, the criterion function will fulfill the role of the rating at the appropriate level of the system hierarchy.

It seems appropriate then to identify the concept of rating and trust assessments.

The main idea of the rating approach is to create conditions for the development of proposals for changes in the actual level of hazard factors of industrial environment, the activation of the "safe-oriented" activities of all services and units involved in maintenance of agricultural machines and increasing their motivation to work according to the rules of industrial safety.

Analysis of recent research results. For generality we call each estimated position indicator (rating) [1]. For each indicator we determine the level (from a standard based on 3-levels with a possible division into sub-levels to include in the general scheme of rating approach the method of assessment of workplaces by labor conditions) and the weighting factor (or coefficient of importance) of this indicator in this group of indicators [2, 3].

Thus it is necessary to distinguish between the required level (for each index, not necessarily the highest) achievable level (in the specific conditions of interaction between the system and external environment) [4]. Mandatory level should be known to all stakeholders. At this mandatory level should be set, where possible, by far, in the form of not allowing discrepancies [5]. Mandatory level guarantees a satisfactory rating, a higher level increases the rating.

Purpose of research is an analytical research of model of recovery of agricultural machines and interpretation of results of numerical experiment.

Results of research. Note that the value of the rating approach is based on it built a complete system of rating the management of implementation risk factors of production environment of the production process maintenance of aircraft, including the rating monitoring process in General. In order to process rating control to have maximum impact, it needs to be involved in the performance of all factors. This condition automatically occurs when the rating on each level of the hierarchy coincides with the target function. Two-dimensional convolution on two indicators best meets the proposed matrix representation and diatomea tree. The feature of this structure is the aggregation (integration) at each node of the schema tree structure, only two assessments.

Integrated the rating should reflect the priorities of the indicators. The formation of these priorities, and hence the formation of rating should be should be performed by experts based on the opinions of decision makers.

People can effectively measure (proportion) only a limited number of indicators and best of all, if at each step of the assessment is necessary to compare more than two or three indicators. Such a comparison in the case of two indicators is convenient to carry out, with the presentation of the results of comparison in a two-dimensional matrix, or a simple table.

At each step the previous convolution is seen in a pair of one new indicator. To do this, in the context of multivariate analysis is carried out level-based distribution of considered parameters.

Dichotomous view can be described structural arrangement in the form of predarea with the root vertex corresponding to the integrated assessment, and the hanging vertices corresponding local indicators". Each intermediate vertex corresponds *K* the aggregate evaluation of f_k, the resulting convolution of the two estimates of the respective nodes of the lower level (Fig. 1).

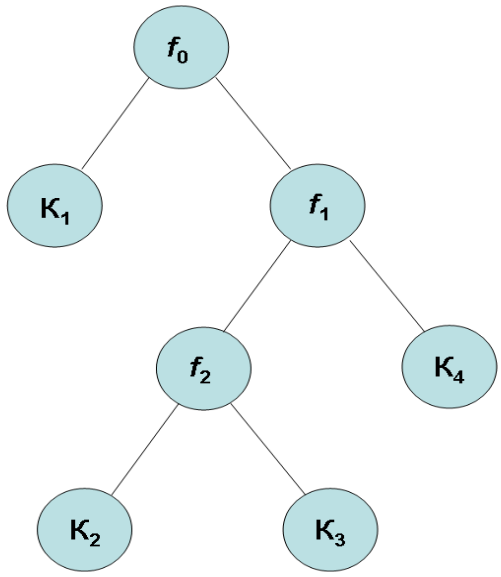

Fig. 1. Scheme of the convolution of the estimated 4 indicators in the form of a dichotomous tree with the root vertex and the hanging vertices, where K and f are the original and complex (aggregated) evaluation (in our case the indicators of risk factors of production environment).

The block diagram shown in Fig. 1 will deliver into compliance dichotomie representation of the integrated assessment, representing the analytical model of complex non-linear multi-level convolution to be written in the form of the following formula:

$$f_0=F(K)=\varphi_1[k_1\,(\varphi_2\,(k_2,\varphi_3\,(k_3,k_4))], \qquad (1)$$

where: φ1, φ2, φ3 – weights.

Dichotomie representation allows to solve the problem of generalization of the evaluation n criteria by sequentially solving a number of problems with the two. For expansion of opportunities and some generalizations of the method, dichotomie modify the view so that each level could be considered not just one, but two pairs. Each time a choice continues to be placed one of two, but each level can be considered 2 to 4 indicators.

Management process implementation of risk implies purpose: change (reduction) in the number and intensity of realization of the risk factors of the working environment when undertaking production processes maintenance. It should be noted that similar risks of production (technological) processes exist on other dangerous industrial objects. With further increase of the parameter p, the zero fixed point is unstable. This means that even at small initial values of the variable (indicator of one of the factors), over time the value of the variable will increase until, until it reaches the second fixed point. This behavior is variable (Fig. 2) is observed at all values of the parameter in the interval $1<p<2$. The diagram illustrates the presence of the parameters p = 1.5 and q = 1 non-zero stable fixed point. Fig. 2 – Fig. 5 on the y-axis is the value of CP 1, and x_{n+1} is x_n. That is, the dependence of the subsequent state of the system from its previous state.

As noted, the feedback parameter q does not affect the stability of dynamic regimes, however, this parameter, or rather from the ratio of the parameters depends on the deviation of fixed points from 1.

When dalsem increasing the parameter p the fluctuations of the values of the variable will have not two, but four possible States, achieved alternately (Fig. 4). The diagram in Fig. 3 illustrates the presence of the parameters p = 2,4, q = 1,6 stable cycle of period 4, which appears at p >~2,236.

Then the 4-cycle turns into a cycle of period 8, 16, etc. When it exceeds a certain critical parameter value there is a transition system into a chaotic regime. To determine the critical value analytically is not possible. The numerical experiment showed the presence of the cycles of other periods (3, 5, 6, 7, etc.), and the increase of the cycle period in this case cannot be associated with the growth parameters. For example, a cycle of period 3 (Fig. 5) is observed immediately before the transition to the chaotic behavior of the variable. The diagram in Fig. 5 illustrates the presence of the parameters p = 2.5, and q = 2 stable cycle of period 3.

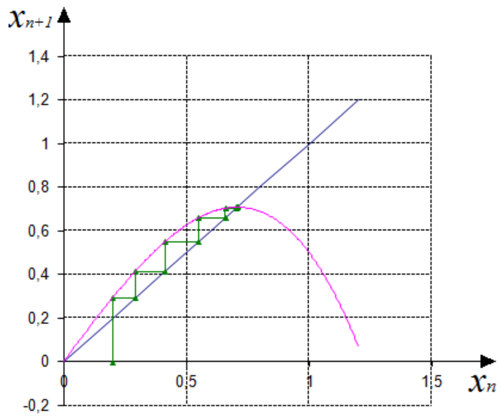

Fig. 2. Iterative mapping graph representing the dependence of each of the following normalized state variable x_n 1 from the previous x_n for values of parameters p = 1.5 and q = 1 and initial conditions x_0 = 0,2.

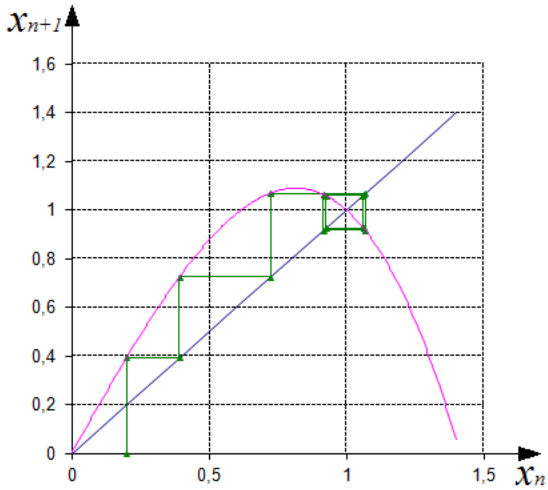

Fig. 3. Iteration diagram of mapping representing dependence of each of following normalized state variable xn 1, xn for previous parameter values p = 2.1, and q = 1 and initial conditions x_0 = 0,2.

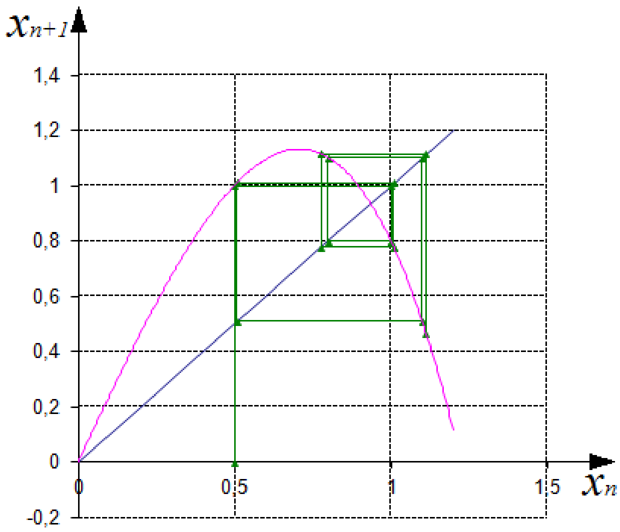

Fig. 4. Iteration diagram of mapping (1) representing dependence of each following normalized state variable x_{n1} from the previous xn for the values of parameters p = 2,4, q = 1.6 and initial conditions x_0 = 0,5.

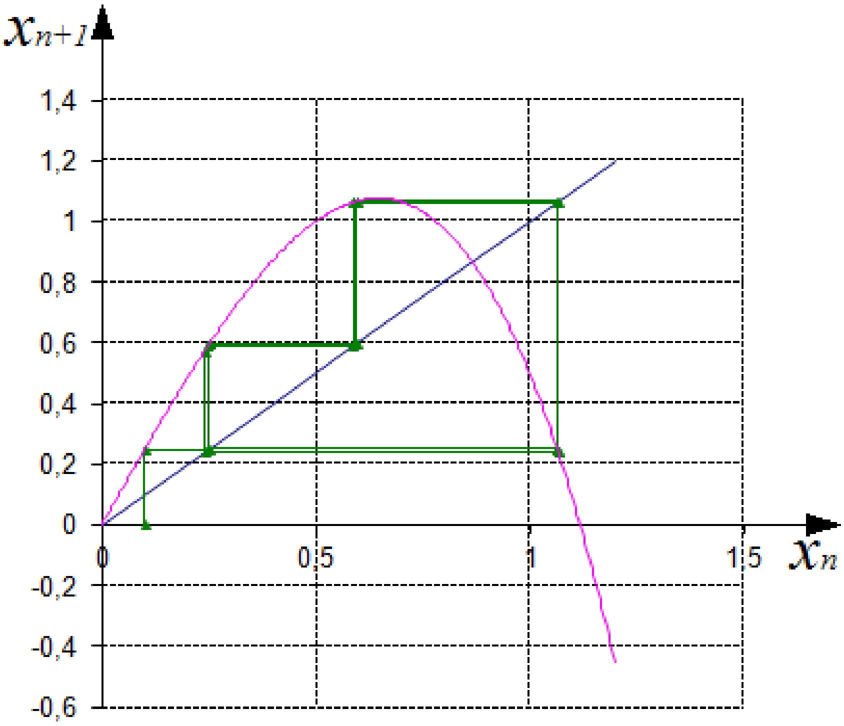

Fig. 5. Iterative mapping graph (1) representing the dependence of each of the following normalized state variable x_{n1}, x_n for the previous parameter values p = 2.5, and q = 2 and initial conditions x_0 = 0,1.

Conclusions

To sum up the results. There are parameter values under which:

– a small deviation from the equilibrium state will lead to uncontrolled growth danger factor of the respective production environment, i.e., the probability and intensity of exposure to this risk will increase many times, exceed permissible values;

– a small deviation from the equilibrium state will transfer the system to another equilibrium state, and this transition at the same values of parameters and initial conditions occurs in the direction of increasing indicators of the hazards, and the other in the direction of decline that is of most practical interest;

– perhaps the ambiguous behavior of a system in which the number of accepted her conditions, two or more;

– with further increase of the parameter the behavior of the system becomes unpredictable – chaotic, what we should fear most.

References

1. *Rogovskii, I. L., Melnyk, V. I.* (2016). Model of parametric synthesis rehabilitation agricultural machines. Scientific Bulletin of National University of Life and Environmental Sciences of Ukraine. Series: Machinery and Energetics AIC. K., Vyp. 241, 387–395.

2. *Rohovs'kyy, I. L.* (2015). Methodologist of operation restore management health agricultural machinery at the on-merzenich resources. Scientific Bulletin of National

University of Life and Environmental Sciences of Ukraine. Series: Machinery and Energetics AIC. K., Vyp. 212, ch. 1, 314–322.
3. *Rogovskii, I. L.* (2016). Entropy algorithm performance quality recovery efficiency of agricultural machinery. Zbirnyk tez dopovidey III Mizhnarodnoyi naukovo-tekhnichnoyi konferentsiyi «Kramarovs'ki chytannya» (17-18 lyutoho 2016 roku) / Natsional'nyy universytet bioresursiv i pryrodokorystuvannya Ukrayiny. K., 20–23.
4. *Rogovskii, Ivan*. (2014). Stochastic models ensure the efficiency of agricultural machines. Motrol : Motorization and power industry in agriculture. Tom 16, 3, 296–302.
5. https://cims.nyu.edu/~kiryl/Calculus/Section_9.3-Polar_Coordinates/Polar_Coordinates.pdf.

АНАЛІЗ МОДЕЛІ ВІДНОВЛЕННЯ ПРАЦЕЗДАТНОСТІ СІЛЬСЬКОГОСПОДАРСЬКИХ МАШИН ТА ІНТЕРПРЕТАЦІЯ РЕЗУЛЬТАТІВ ЧИСЕЛЬНОГО ЕКСПЕРИМЕНТУ

І. Л. Роговський

Анотація. *Технічне обслуговування – найважливіший комплекс виробничих процесів, що є складовим елементом процесу надання сервісної послуги, забезпечує функціонування АПК. Незважаючи на те, що саме помилки людини, а не відмови техніки представляють найбільшу потенційну небезпеку, в літературі мало розглядаються аспекти людського фактора, пов'язані з небезпекою факторів виробничого середовища, в якій працівники здійснюють технічне обслуговування.*

Умови виробничого середовища (умови праці) при проведенні виробничих процесів чинять значний вплив на реалізацію професійних характеристик персоналу, що здійснює технічного обслуговування. Крім впливу небезпек фізичних факторів виробничого середовища на якість виробничих процесів технічного обслуговування впливають професійна компетентність і виробнича дисципліна персоналу в сфері виробничої безпеки у відповідності з посадовими обов'язками і виробничої ієрархією.

У зв'язку з тим, що технічне обслуговування складається з виробничих процесів підвищеної складності з високими вимогами до якості виконуваних робіт, до суворого дотримання вимог регламентів, потрібне спеціальне методичне забезпечення, алгоритми, методи і моделі для систем підтримки прийняття рішень керівників сервісних підприємств при організації виробничих процесів технічного обслуговування, орієнтованих на забезпечення найменшого рівня впливу на працівників небезпеки факторів виробничого середовища.

Ключові слова: ***аналітичність, просторова вимога, технічне обслуговування, сільськогосподарська машина***

АНАЛИЗ МОДЕЛИ ВОССТАНОВЛЕНИЯ РАБОТОСПОСОБНОСТИ СЕЛЬСКОХОЗЯЙСТВЕННЫХ МАШИН И ИНТЕРПРЕТАЦИЯ РЕЗУЛЬТАТОВ ЧИСЛЕННОГО ЭКСПЕРИМЕНТА

И. Л. Роговский

Аннотация. *Техническое обслуживание – важный комплекс производственных процессов, являющийся составным элементом процесса оказания сервисной услуги, обеспечивающий функционирование АПК. Несмотря на то, что именно ошибки человека, а не отказы техники представляют наибольшую потенциальную опасность, в литературе мало рассматриваются аспекты человеческого фактора, связанные с опасностью факторов производственной среды, в которой работники осуществляют техническое обслуживание.*

Условия производственной среды (условия труда) при проведении производственных процессов оказывают значительное влияние на реализацию профессиональных характеристик персонала, осуществляющего технического обслуживание. Помимо влияния опасностей физических факторов производственной среды на качество производственных процессов технического обслуживания влияют профессиональная компетентность и производственная дисциплина персонала в сфере производственной безопасности в соответствии с должностными обязанностями и производственной иерархией.

В связи с тем, что техническое обслуживание состоит из производственных процессов повышенной сложности с высокими требованиями к качеству выполняемых работ, к строгому соблюдению требований регламентов, требуется специальное методическое обеспечение, алгоритмы, методы и модели для систем поддержки принятия решений руководителей сервисных предприятий при организации производственных процессов технического обслуживания, ориентированных на обеспечение наименьшего уровня воздействия на работников опасностей факторов производственной среды.

Ключевые слова: ***аналитичность, пространственное требование, техническое обслуживание, сельскохозяйственная машина***