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Аннотация. *В работе приведен анализ конструкций реакторов для переработки твердых органических отходов в биогаз и биоудобрение с указанием их конструкционных преимуществ и недостатков.*

Ключевые слова: ***реактор, твердофазная ферментация, биогаз, биоудобрение***

Annotation. *The analysis of reactor designs for processing solid organic waste into biogas and biofertilizer with their structural strengths and weaknesses is presented in work.*

Key words: ***reactor, solid fermentation, biogas, biofertilizer***

УДК 631.001.04

MODEL OF PARAMETRIC SYNTHESIS REHABILITATION AGRICULTURAL MACHINES

Ivan L. Rogovskii, Valentyna I. Melnyk

Annotation. *The paper gives an overview of techniques that are considered agricultural machinery as a whole – indivisible object and a complex structure of interacting units, as well as methods for determining the need for spare parts to specific technical means. The analysis of possible options for health system recovery architecture. Formation of the procedure of administrative decisions is a cyclic process of interaction and involves problem analysis and formulation phase,* *the search phase and optimization of alternative solutions, implemented with the help of information support.*

Key words: ***model, parametric, synthesis, rehabilitation, agricultural machine***

Introduction. In today's dynamic market conditions, increased competition, the complexity of the process control to the DSS meet the following requirements:

• analysis and integration of a number of external and internal sources of marketing, manufacturing and financial information;

• improving the efficiency of the analysis of the efficiency of production processes and prediction of their development;

• expanding the scope of the persons involved in the preparation and decision-making;

• automation of extraction of knowledge about the laws in the situation to make timely decisions, and others.

To implement these requirements are widely used data warehouses, operational systems and data mining.

Queueing Networks (QN) in the analysis of the characteristics of the technological processes of repair work most widely for the following reasons:

• widespread use of the principles of modularity and systematic approach when designing processes enables each stage of the procedure put in correspondence classes together are necessary for its implementation of the system resources;

• the repair and maintenance work is characterized by the stochastic nature of the flow of orders and maintenance processes;

• representation of the process of repair work can be represented as a sequence of steps resource applications maintenance system.

Analysis of recent research. Analysis of research scientists, especially Kurt Hoffman and review decisions of a number of major European and US manufacturers showed that the cost of maintaining and forming business maintenance and repair of agricultural machinery can be significantly reduced by centralizing inventory management, improve the accuracy of forecasting needs and the optimization saved nomenclature. The task of improving business processes and management techservice organizational structures in terms of stochastic settled in the papers of O. V. Sydorchuk, M. I. Chernovol, V. D. Voytyuk, V. A. Voytov, V. A. Didur and other authors [1–8].

Results of research. Using the terminology of the queuing system (QS), model analysis, in general, can be represented in the form of a closed or open queuing network with arbitrary laws revenue and service applications in the network nodes, the presence of logical conditions (locks) with different service disciplines. This model of performance analysis is given by the tuple:

$$M=(Q, El, P, L, \omega, J, \Omega), \quad (1)$$

where: Q – set of nodes in the network; El = {1, ∞} – capacity applications of sources; P = {P^l} – set of stochastic transition matrices of applications on the network; P^l = {p^l_{ij}} – applications of transition probability matrix of type *l* in the *i* node at the *j* node of the network; $l \in L$; L – many types of applications; ω: $Q \to \Theta$; Θ – the set of admissible SMO types of network nodes; J: $Q \times L \to B$, B = {$b_i(l)$, $\sigma_i^2(l)$} – a set of applications for determining the characteristics of the type l service network nodes, where $b_i(l)$, $\sigma_i^2(l)$ – average value and the variance of service time application *l* type in the *i* node; Ω = {0, 1, 2, 3, ...} – determines the presence or absence of a logical network environment – locks: 0 – no blocking; 1 – lock caused by the presence of the limited size of the buffer; 2 – lock caused by the simultaneous application of several occupation of network resources; 3 – lock caused by the restriction of the number of applications in a fragment of the network; ... – other types of locks.

Methods of analysis of this model in the framework of the QS are divided into exact, approximate, simulation, hybrid. The use of either method is determined by a random selection process used for the description and analysis of the system, its structure and type, the assumption of independence or dependence of random variables, view the distribution function.

In the most general form of model sets the relationship E = f (xi, yi), where E – the result of system operation; x_i – variables and parameters that can be controlled; y_i – variables and parameters that can not be controlled; f – functional relationship between x_i and y_i, which determines the amount of E. When forming technique based on simulation approach, the thesis adopted modeling technique including the following steps:

1. Definition of the system – the establishment of boundaries, limits and gauges the effectiveness of the system to be studied.

2. Formulation of the model – the transition from the real system to a certain logic (abstraction).

3. Data preparation – data selection, required to build the model, and present them in an appropriate form.

4. Broadcast model – description of model in some formal language.

5. Evaluation of adequacy – increase to acceptable level of granularity.

6. Strategic planning – planning of the experiment, which should give the necessary information.

7. Tactical planning – defining the method for each test series, provided the experimental plan.

8. Experimentation – the process of simulation to obtain the expected data and sensitivity analysis.

9. Interpretation – construction of entries from the data obtained by simulation.

10. Implementation – practical use of models and simulation results.

11. Documentation – registration of the implementation of the project and its results, as well as documentation of the process of creating and using models.

The procedure for implementation and a process flow diagram "Registration, accounting and control of the process (the milestones) of the order to repair components and assemblies" (Fig. 1). The main steps of the process are: the opening of the order for assembly or repair of the unit; acceptance unit or the unit for repair; Development of design and technological documentation; Dismantling and Troubleshooting; planning needs for spare parts; extract of materials and spare parts under the order; repair work; inspection and testing of STK, the transfer of goods to the warehouse and the order closing.

Responsible for the implementation of phase 1 of "Opening Order unit or repair the unit" is the production department. In step 2, it compiled a list of components and assemblies, sent for repair. In step 3, developed design and technological documentation for manufacturing parts (drawings, specifications, materials consumption rates, routings). Pass runs only when design documentation is missing. If BMR is already there, then, step 4.

At disassembly and Troubleshooting formed defect-fence bill, which includes a list of spare parts for repair or replacement, and appointed responsible (RMC). The main outcome of step "Material Requirements Planning" is to develop applications for warehouse, for the manufacture, repair of components and assemblies or applications provider for subcontract work.

Stage "Statement of materials and spare parts on order" to the production of materials and parts, issued to repair components and assemblies from a central warehouse. In the absence of the required materials or parts from the central warehouse is performed first process of goods and materials procurement. The result of the main phase of the "Repairs" are components and assemblies, renovated forces mechanical-repair shop. Then begins the stage of "testing and acceptance of STC" which determines the components and assemblies that have passed the test and acceptance of technical control services (STK), and the main technical and operational characteristics of the nodes identified by the tests. Then, the transfer of goods to the warehouse with the formation of consignment note, which is responsible for the mechanical repair shop, after the closing of the order occurs.

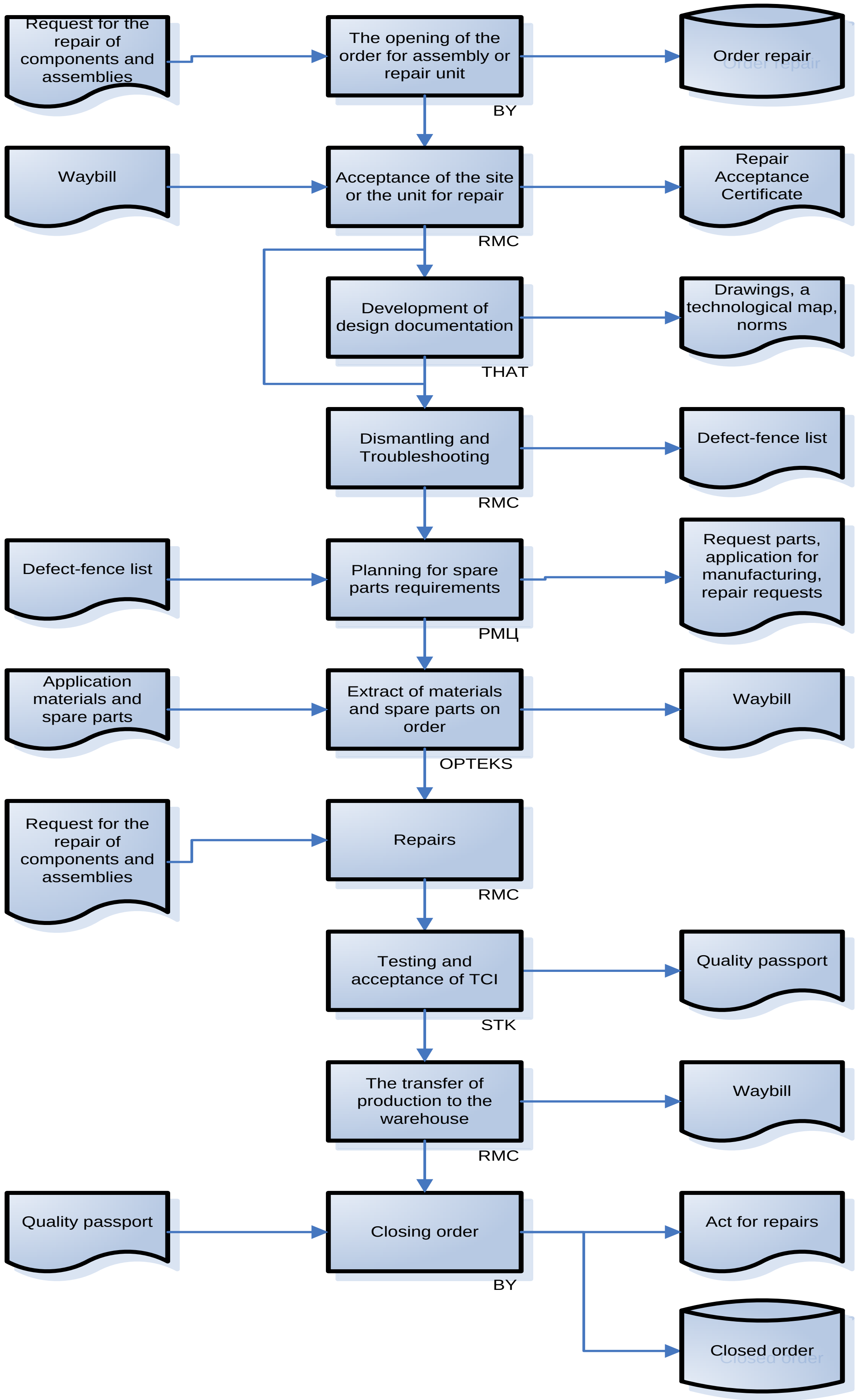
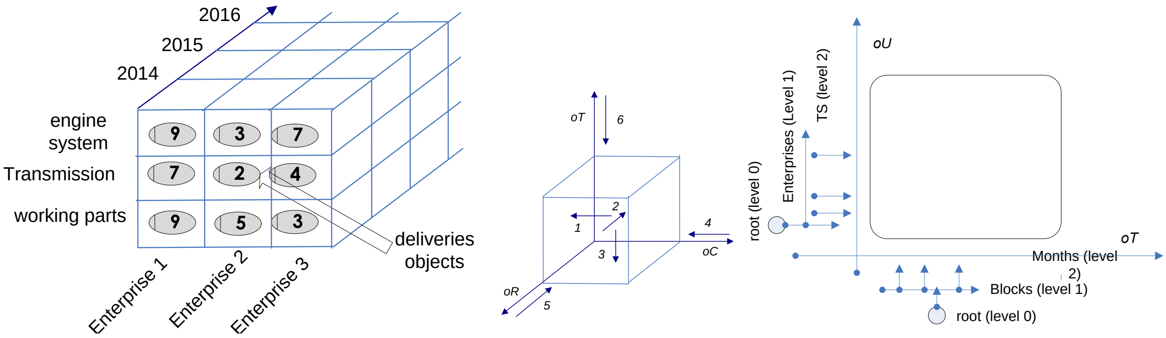


Fig. 1. Diagram of a process, registration, accounting and control of the repair order components and assemblies.

For statistical analysis applications on the data streams to the given OLAP-form with classification technology measures, dimensions, and cell sites (Fig. 2).



a) OLAP-cube b) subset of measurements c) measuring hierarchy

Fig. 2. Three-dimensional OALP-cube with simple measurements.

Indicators: *W* – volume orders (receipts) in monetary terms, *V* – the intensity of orders (receipts) – flow applications.

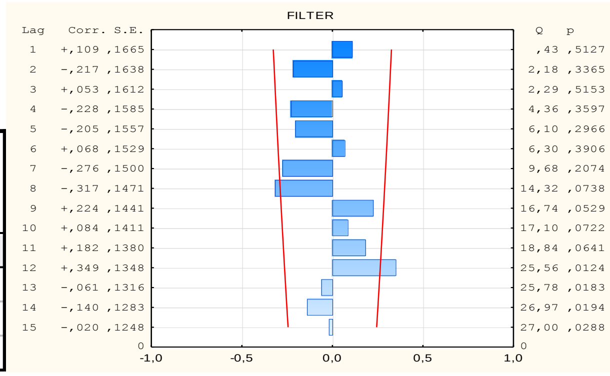
Measurements: Ntov – components, DCn – enterprise, Soft – application state, Tp – type of application, DG – Discount groups, PG – product groups, Obk – turnover code, Kpl – price list code, Modn – model, T – time.

Objects: Sost – state of application [0 – not performed; 1 – is made; 2 – dealer's refusal; 3 – is not handled; 4 – reserve; 5 – treatment, not available; 6 – processing, incomplete cancellation]; Tp – type applications [1-S – warehouse, 2-T, W – operational, 4-A – Optional, 7-G – Guarantees MMC, 5-N-new condition – 3-V]; DG (PG) – Discount groups (product groups) [D – parts, M – Mechanical, E – electrician, R, X – consumables]; Obk – turnover code [1 – Fast, 2 – Middle, 3 – Low, 4 – Slow, 5 – Top]; Kpl – code price list [1 – spare parts, 2 – original option, 3 – option unoriginal, 4 – unoriginal, 5 – tires, 6 - technical liquids]; T – time dimension (available statistics from 2010 to 2016). For timeline – days, months, quarters, years – the most commonly used in the analysis. Cell – W – direct orders, V – the intensity of orders.

For parameterization of the generated work order model, the statistical analysis of the needs for spare parts and components, which allowed to assess a number of characteristics of the query stream. Demonstrated a significant correlation in the individual groups of parts (Fig. 3,a). Further, the analysis of time series autocorrelation functions (Fig. 3,b). Based on the analysis in the thesis the task of modeling time series with the set (obtained on the basis of statistics) correlation value of estimates and autocorrelation function.

To model input is selected then the distribution of the standard families of distributions that best describes the number of source data.

	Correlations (Rez_Sol_2_Kopp.sta) Marked correlations are significant at p < ,05000 N=33 (Casewise deletion of missing data)				
Variable	Means	Std.Dev.	AIR_REF	GASKET	FILTER
AIR_REF	14213,9	5843,13	1,00000	0,95639	0,98783
GASKET	20482,3	8065,38	0,95639	1,00000	0,96574
FILTER	20334,4	8275,62	0,98783	0,96574	1,00000



a) table of correlations b) autocorrelation function

Fig. 3. Average monthly rate on main parts of queries.

The developed software environment function parameter setting allows the user to investigate the change in the characteristics of the simulated system, depending on the variation of the input properties of accidental exposure. For example, the gain or attenuation of the autocorrelation of the input data, reduction of the expectation, etc. At the entrance to the simulation model generated data sets are served with a variety of autocorrelation coefficients, the values of the expectation, etc. An algorithm for constructing the process model is shown in Fig. 4.

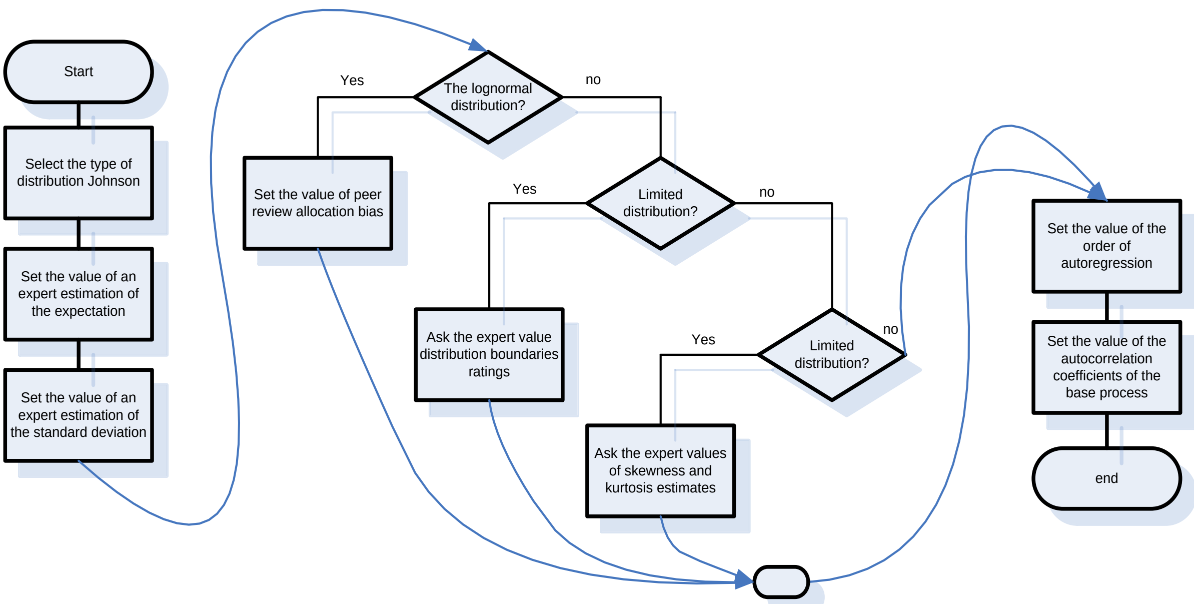


Fig. 4. Algorithm for constructing the process model.

Construction expert assessment of the process parameters for the algorithm leads to the formation of the model ARTA-process with the necessary parameters. To estimate the parameters for a given number $X_1, X_2, ..., X_n$ of known volume *n* algorithm is used, which is reduced to minimize the function:

$$S_D(\psi)=\frac{1}{(n-p)^2}\sum_{t=p+1}^{n}\frac{(n-p+1)^2(n-p+2)}{(t-p)(n+1-t)}\left(\Phi\left[V_{(t)}(\psi)\right]-\frac{t-p}{n-p+1}\right)^2, \qquad (2)$$

where: $V_{(t)}(\psi)$ – order statistics:

$$V_t(\psi)=\frac{\gamma+\delta f\left[\frac{X_t-\xi}{\lambda}\right]-\sum_{h=1}^{p}\alpha_h\left(\gamma+\delta f\left[\frac{X_{t-h}-\xi}{\lambda}\right]\right)}{\sigma_Y^2}. \qquad (3)$$

The order p autoregressive process and the type of distribution f-Johnson assumed given. The procedure involves the following steps:

1. Setting the order of autocorrelation p on the basis of the Schwarz criterion.

2. For each type of Johnson distributions are determined by:

2.1. initial values of the distribution parameters $\gamma, \delta, \lambda, \xi$.

2.2. initial values of the parameters $\alpha_1, \alpha_2, ..., \alpha_p$ as autoregression parameters on the basis of the system of equations:

$$\sum_{h=1}^{p}\alpha_h\rho_Z(h-k)=\rho_Z(k),\ k=1,2,...,p, \qquad (4)$$

where: $\rho_Z(k)$ – underlying process autocorrelation coefficient k order.

2.3. minimum value of the function $S_D(\psi)$ on $\alpha_1, \alpha_2, ..., \alpha_p$.

2.4. conditional minimization function $S_D(\psi)$ on $\gamma, \delta, \lambda, \xi$.

2.5. if the stop condition $\left|S_D(\psi_k|x)-S_D(\psi_{k-1}|x)\right|\le S_D(\psi_{k-1}|x)\times\Delta$, where - priori given relative error is not satisfied, go to 2.3, otherwise go to 2.6.

2.6. posteriori value of the autocorrelation r order.

2.7. if r=p, then go to step 3, otherwise the task order autocorrelation r and go to 2.1.

3. Evaluate the adequacy of selected processes and the selection of the closest distribution on the basis of the consent of the test criterion.

Conclusions. The results obtained in the analysis of the results showed the presence of the seasonal nature of the cross-correlations between the volumes of individual businesses streams.

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Анотація. *У статті виконано огляд методів, які розглядають сільськогосподарську техніку як єдине ціле – неподільний об'єкт і як складну структуру взаємодіючих агрегатів, а також методів визначення потреби в запасних частинах до конкретних технічних засобів. Проведено аналіз можливих варіантів архітектури системи відновлення працездатності. Формування процедури управлінських рішень є циклічний процес взаємодії і включає фази аналізу і постановки завдання, фази пошуку і оптимізації альтернативних рішень, що реалізуються за допомогою інформаційної підтримки.*

Ключові слова: ***модель, параметричність, синтез, відновлення працездатності, сільськогосподарська машина***

Аннотация. *В статье выполнен обзор методов, которые рассматривают сельскохозяйственную технику как единое целое – неделимый объект и как сложную структуру взаимодействующих агрегатов, а также методов определения потребности в запасных частях к конкретным техническим средствам. Проведен анализ возможных вариантов архитектуры системы восстановления работоспособности. Формирование процедуры управленческих решений представляет собой циклический процесс взаимодействия и включает фазы анализа и постановки задачи, фазы поиска и оптимизации альтернативных решений, реализуемых с помощью информационной поддержки.*

Ключевые слова: ***модель, параметричность, синтез, восстановление работоспособности, сельскохозяйственная машина***