СЕКЦІЯ 4. ВПРОВАДЖЕННЯ ПЕРЕДОВИХ ТЕХНОЛОГІЙ У СІЛЬСЬКОГОСПОДАРСЬКОМУ ВИРОБНИЦТВІ

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IMPROVING THE MAINTENANCE STRATEGY OF THE AGRICULTURAL MACHINERY IN THE CONDITIONS OF THE REPUBLIC OF MOLDOVA

Marian T., PhD drd State
director Agrotechservice Enterprise SRL «Basadoro Agroteh»,
e-mail: marian@ussm.md
Agrarian University of Moldova, Moldova

The great diversification of agricultural technology as both the resource that is used and a constructive performance requires new approaches to technical services provided to farmers in the agricultural sector.

If the problems related to marketing of tractors and agricultural equipment in the Republic of Moldova are quite well organized, then the maintenance function has been ignored or is at its infancy stage. Thus, the current issue is to establish certain maintenance strategies used in the field, which requires a detailed analysis of the factors that influence it.

Based on the findings, the research problem is structured, which consists of identifying the best solutions to organize agricultural equipment maintenance under the current development conditions of the Republic of Moldova. The maintenance systems used in engineering served as an object of research.

Analysis of the current research. It has become a reality that the centralized maintenance system, used when agriculture was based on collective ownership (kolkhozes and sovkhozes) has been destroyed, and another one, based on technical-scientific principles, is not created or is at its infancy stage.

At present, maintenance activities for agricultural equipment are usually carried out by means of two methods. The first one is based on systemic maintenance performed at intervals or fixed resources established in advance. The second one is realized with the help of unplanned or poorly planned activities [1].

In the first case, maintenance activities take place according to a pre-arranged timetable and are called upon to prevent possible refusals.

In the second case, maintenance activities are performed when a refusal occurs. This type of maintenance is usually observed in companies that do not have a strategy for predicting refusals and is much more expensive due to the fact that agricultural works have to be interrupted and due to the advanced degree of the defect situation.

Maintenance costs are increased in both cases and the reliability of the repaired equipment does not often meet expectations [2].

Obviously, local scientific research and good practices as well as the ones from developed countries, along with older traditions in this field play an important role in this context.

We consider that under the current development conditions of Moldovan agriculture efficient technical services for agriculture can be achieved through the creation of regional centers of technical services that will be firm- or dealer-based and established in developing regions of the country. These statements also coincide with the opinion of several researchers, for example, [3-6].

The experience in the field of dealer services shows that there have been structured three types of dealer services at present: the company services system, the dealer system and the dealer system of company services [4].

The company services are performed by companies that are on the balance sheet of the agricultural machinery manufacturer.

The services in the dealer system are carried out by intermediaries whom the manufacturer empowers to perform technical services of the equipment produced by the corresponding companies.

The dealer system of company services is characterized by the fact that the manufacturer empowers the dealer to perform technical services and rigidly controls the quality of provided services.

Regardless of the accepted maintenance dealer system, the services themselves can be performed directly in maintenance centers or at the place agricultural machinery is located. It is the beneficiary of agricultural machinery who chooses; the relationship between quality and price must serve as decision-making arguments.

The aim of this work is to create an overview of the situation in the field of equipment maintenance, highlighting possible ways of improving the maintenance strategy by evaluating practices to maintain the existing agricultural machinery currently both in Moldova and worldwide.

Results and discussions. In 2020 a case study was conducted by means of the comparative analysis of five maintenance strategies used in engineering.

At the first stage there were selected the key maintenance performance indicators (MKPI), which characterize the performance of the studied strategies.

Various indicators were used as MKPIs to estimate the level of reliability of the equipment that was undergoing certain maintenance interventions.

Indicators to assess maintenance costs were selected as recommended in the specialty literature [7] and grouped according to the cost of spare parts, labor and travel costs needed to get to the place of maintenance activities.

The assessment of MKPI was performed by experts in the fields related to maintenance activities, such as: two people from the academic environment (Faculty of Agricultural Engineering, SAUM; two representatives of the Mecagro Institute of Agricultural Technology; two specialists from technical maintenance workshops; two dealers of agricultural equipment producers and two beneficiaries of agricultural equipment (directors of agricultural enterprises).

MKPIs were divided into two categories: directly and indirectly proportional. The maximum score was attributed for the maximum value of MKPI in case of directly proportional indicators; as to the indirectly proportional indicators - the maximum score was attributed for the minimum value of that indicator.

Assessment was carried out for five basic maintenance strategies: preventive maintenance (PM); reactive maintenance (RM), predictive maintenance (PdM), proactive maintenance (PAM) and reliability-centered maintenance (RCM). The description of maintenance strategies used in the study can be found in our paper (8).

At the second stage there was selected the perspective strategy suitable for the conditions of the Republic of Moldova based on the MKPI assessment.

The following table shows the ranking of maintenance strategies according to the importance attributed to each MKPI by experts.

Hierarchy of products					
Parameters:	Score accumulated				
	PM	RM	PdM	PAM	RCM
- directly proportional					
Availability of MSE	10	1	8	8	9
Availability of AM	4	2	10	10	10
Probability of AM good operation	10	5	9	9	10
Average resource until the appearance of the limit state	10	3	9	10	10
Probability of AM treatment	9	2	9	10	10
- indirectly proportional					
Average time of treatment	2	7	8	9	10
Costs of spare parts	2	7	9	9	10
Labour costs of maintenance activities	3	6	9	9	8
Transportation costs to the place of maintenance activities	7	8	7	8	10
Total score	57	41	78	82	87
Hierarchy of the occupied place	4	5	3	2	1

PM - preventive maintenance; RM – reactive maintenance; PdM – predictive maintenance; PAM- proactive maintenance; RCM - reliability-centered maintenance; MSE – maintenance-specialized equipment; AM – agricultural machinery.

The paper presents the results of a comparative analysis of maintenance strategies for agricultural machinery suitable to be used in dealer technical services under the conditions of the Republic of Moldova. The analysis was carried out by means of expertise with the participation of specialists from the academic environment, research and production sectors as well as maintenance of agricultural machinery. Key maintenance performance indicators were used for assessment; they were divided into two categories: directly and indirectly proportional.

The results showed that most experts prioritized maintenance systems based on the predicted occurrence of refusals. The highest score was attributed to the reliability-based maintenance system (87 out of 100 points), which requires a systemic approach to maintenance activities by setting minimum maintenance levels able to ensure safe operation of machinery.

The lowest score was attributed to the reactive maintenance system (41 out of 100 points), a strategy that involves carrying out maintenance activities when refusals occur.

Reference:

1. Marian Gr. Consideraţii privind revitalizarea sistemului de mentenanţă a tehnicii agricole în Republica Moldova. Ştiinţa agricolă. Vol. 1,2007, pg. 61-63.

2. Khodabakhshian, R. A review of maintenance management of tractors and agricultural machinery: preventive maintenance systems. Agric Eng Int: CIGR Journal. 2013, Vol. 4, 15, pg. 147-159.

3. Чеботарёв , М.И. and Савин, И.Г. Проблемы и перспективы развития технического сервиса АПК. Научный журнал КубГАУ. 2014, Vol. 97, 3, p. 10.

4. Кушнарев, Л.И. К концепции организации фирменного технического сервиса машин и оборудования. Вестник БГТУ им. В.Г. Шухова. 2019, Vol. 2, pg. 144-148.

5. Мяло, О.В., Лучинович, А.А. and Баймухамбетов, С.Р. Оценка требований к дилерским центрам по обслуживанию сельскохозяйственной техники на территории Западной Сибири. Электронный научно-методический журнал Омского ГАУ. 2017, Vol. 1, 8, pg. 1-6.

6. Субаева, А.К. Зарубежный опыт воспроизводства техники в агропромышленном комплексе. Вестник волгоградского института бизнеса,. 2015, pg. 138-142.

7. Афоничев, Д.Н, Кондрашова, Е.В and Аксенов, И. И. Совершенствование организации технического сервиса в сельском хозяйстве. Лесотехнический журнал. 2014, Vol. 3.

8. Marian T. Îmbunătățirea performanțelor mentenanței tehnicii agricole în întreprinderile de tip sevice. Studiu bibliografic de specialitate. Știința Agricolă. UASM, 2019, Vol. 2, pg. 85-94.

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ПРОГНОЗУВАННЯ СТАНУ ТЕХНІЧНИХ ОБ'ЄКТІВ НА ОСНОВІ АПАРАТУ КАНОНІЧНИХ РОЗКЛАДІВ

Атаманюк І.П., д-р техн. наук, професор
Миколаївський національний аграрний університет, Україна

Одним з підходів для вирішення задачі прогнозування параметрів складних систем ймовірнісної природи є представлення процесу зміни значень досліджуваних параметрів в дискретні моменти часу $t_i, i=\overline{1,I}$ у вигляді деякої випадкової послідовності $X(i)=x(i),\ i=\overline{1,I}$, і застосування до даної послідовності алгоритму прогнозу. Припустимо, що послідовність повністю задана дискретизованими моментними функціями: $M\left[X(\nu)X(i)\right], \nu, i=\overline{1,I}$. Необхідно отримати значення послідовності в майбутні моменти часу $t_i, i=\overline{k+1,I}$