

INCREASING AND JUSTIFICATION OF DEMAND FOR THE MODERNIZATION OF AGRICULTURAL MACHINERY

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Abstract: The paper presents a technical and economic background to the need for modernization of modern tractors and combines. The presented method allows forecasting the demand for modernization of equipment. It allows to develop the program of action to improve the quality of machines, assess their real potential, develop of strategic and operational planning for the development of modernization, organize activities of the technical service. This article proposes a method for determining the demand for modernization of agricultural machinery in technical, repair and technical enterprises, based on the analysis of statistical and expert data characterizing their influence on the demand for research. It is justified that repair company must confidently organize an active advertising campaign to promote modernized machines to the market.

KEY WORDS: MEANS OF MECHANIZATION, ANALYTICAL METHOD, COSTS, OPTIMUM, TECHNOLOGY, YIELD.

1. Introduction

One of the most important ways of preserving and increasing the machine-tractor park of Ukraine today is its modernization at the machine-building enterprises. This implies a series of works to improve the quality and economy of machines by replacing individual components to more reliable.

The enterprises of the technical service are widespread re-equipment of tractors of type KhTZ-170, combine harvesters DON-1500B, forage harvesters of German manufacture by engines of brands SMD, YAMZ. The hydraulic system, electric equipment, transmission is being improved, on tractors of type KhTZ-170 the modernization of not only the engine but also the cabs is carried out.

As a result of modernization of technology, its technical level is significantly increased. For the tractors KhTZ-170 provides improved comfort conditions, and the average mean time to failure increases in three-times. The estimated payback period is 2 years. The results of raising the technical level of modernized tractors KhTZ-170 are shown in the table 1.

2. Preconditions and means for resolving the problem

Modernization of tractors KhTZ-170 provides (according to the results of tests on farms) reduction of the cost of fuel consumption – by 10...18%, and an increase in average mean time to failure from 24 to 30 hours.

One of the main advantages of upgraded equipment that was in service is its lower price compared with the new machine and better than the repaired by the usual way and more higher quality characteristics. However, each of the repair companies willing to implement this service faces real demand for it.

Table 1. Comparative indicators of the technical level of the modernized tractor KhTZ-170

Indexes	Indicators value	
	basic (BF6M1013E, DEUTZ AG)	upgraded (SMD-62/63)
Engine power, hp / kW	186/139	175/128
Specific fuel consumption, g / kW	209	238
Average work time for refusal, h.:		
– internal combustion	810	750
– flywheel drive	110	120
– chassis transmission	510	600
– rubber products	130	150

Noise level in the cab, dB	85	75
Weight, kg	770	910
Price, USD	9500	3200
Average work time for l, h.	24	30

Like every new activity, modernization requires marketing research that determines the position of the repair enterprise in the market, the characteristics of buyers and sellers, the potential and actual volumes of work, without which knowledge it is impossible to carry out the relevant work. However, in many enterprises of the technical service of marketing work only begin to develop and have not received the necessary distribution. Many still work in olden times. This leads to frequent breakdowns of work plans, disturbed rhythm and balance of production, falling profits, slowing down wage growth, the production scale can not be forecasted, etc.

This article proposes a method for determining the demand for modernization of agricultural machinery in technical, repair and technical enterprises, based on the analysis of statistical and expert data characterizing their influence on the demand for research. The work was done using the Statistika program developed for the regression analysis of ordered, dependent and independent variables. It allows numerically to determine the influence of various factors on the resultant parameter - the demand for the modernization of complex agricultural machinery that was or is in operation. This approach provides for the purposeful management of the mentioned effective parameter, that is, the demand for modernization.

3. Results and discussion

To obtain a universal regression equation for any agricultural tractor, combine harvester and forage harvester, etc. The complex equipment all the raw data were presented in the form of comparative characteristics of modernized machines with refurbished on the farm. For example, the price was accepted as $W = W_m/W_k$, where W_m – price of a modernized machine, and W_k – the price of repair in enterprise, the level of recovery of the resource was determined by the ratio $q = q_m/q_k$ etc. This condition is due to the fact that the main alternative solution today against the modernization of the machine at the enterprise technical service is its repair on the farm.

In recent years, our secondary market has begun to develop a technique for the purchase and sale of old cars. In this regard, the enterprises of the technical service has a new possibility of business organization on the basis of modernization of the write-offs or cars bought at the farms. The written-off technique is bought up by repair companies at residual value, is modernized at restoration and then put on sale.

Such a path of modernization requires a special diligence in the study of demand, as it is associated with the acceptance of repairing

the company of all risks associated not only with the costs of recovering write-off equipment, but also with the subsequent implementation of it in the secondary market.

However, the nature of the decision to purchase a modernized machine and the modernization of equipment operated in the farm, in many respects, is similar and differs not in qualitative factors influencing it, but in their quantitative values, which was taken into account when formulating and solving the problem.

The expediency of sending a machine to a repair enterprise, or purchases in the secondary market at the consumer arises when the total costs for upgrading and subsequent costs of maintenance of the equipment will be less than when repairing the farm. When the conditions of modernization will be more comfortable for the consumer than he can do it himself. Finally, when the consumer will have full confidence in the quality of modernization.

It was from these points of view that market research was conducted based on the study of demand statistics, as well as questioning of specialists of farms and enterprises of technical service, who had experience of this work. The demand for modernization S was measured on a ten-point system, from 0 to 10.

As the function arguments, the influence of the following factors was studied:

- 1) raising the price of modernization – $W = W_m/W_k$;
- 2) reduction of downtime in repair in conditions of repair enterprise – $t_p = t_{pk}/t_{pm}$;
- 3) increase of work up to the next capital repair – $q = q_m/q_k$;
- 4) increase in reliability – $t_o = t_{om}/t_{ok}$;
- 5) reduction of specific fuel consumption – $\rho = \rho_k/\rho_m$;
- 6) reducing noise in the workplace and improving other working conditions – $Y = Y_k/Y_m$;
- 7) reduction of maintenance and repair costs – $C_{tor} = C_{tor_k}/C_{tor_m}$;
- 8) service life of machine for modernization – T_s ;
- 9) participation in the repair of specialists in the enterprise – k_u ;
- 10) one-time prepayment – k_{pred} ;
- 11) distance to repair enterprise – D .

The resulting regression equation for the demand for modernization has the form:

$$S = 3.372 - 1.107W + 0.004t_p + 2.685q + 1.491t_o - 2.799\rho - 0.684Y + 2.479C_{tor} - 0.192T_s + 0.348k_u - 0.006k_{pred} + 0.005D.$$

The correlation coefficient of the found dependence is equal to 0.914. Preemptive values S : minimal – 1.3101, maximal – 8.5615, average – 5.7576, standard deviation – 1.65961. The obtained coefficients characterizing the variation of parameters indicate a high degree of correspondence between the chosen straightforward regression model and the initial data. Checking the results by substituting the average values of the parameters found showed almost complete convergence of results. With substitution, the average demand was $S = 5.7206$.

The economic assessment of the factors influencing demand is determined by the coefficients of elasticity, which characterize the percentage of the average increase in the value of the effective indicator – the demand for a change in factor ratio by 1%. To do this, use the formula:

$$E_{ki} = X_i \frac{X_{spi}}{S},$$

where X_{spi} – the average value of the corresponding factor indicator; S – the average value of demand; X_i – regression coefficient with the corresponding factor parameter.

The results of calculating the total increase in demand are given in the table 2.

The analysis of the table showed that positive impact on the demand for modernization of equipment makes increasing in post-repair resource and reliability, the negative – the high price and long

life of machine to modernization.

The latter factor affects the decline in demand for modernized technology, primarily in the secondary market. There is also some distrust of the indicators, which are declared by repair enterprises on quality.

Table 2. Private coefficients of elasticity of the regression model of demand for modernization of agricultural machinery

Factor	Symbolic designation	Average value of indicator, X_{spi}	Regression coefficient, X_i	Elasticity factor, E_{ki}
Demand for modernization	S	5.7576		
Increasing the price of modernization	W	2.1052	-1.107	-0.40476
Lowering downtime in repairs in a repair enterprise	t_p	40.3788	0.004	0.02805
Increase of work up to the next capital repair	q	1.7939	2.685	0.083657
Improve reliability	t_o	1.5409	1.491	0.39903
Reduce specific fuel consumption	ρ	1.1758	-2.799	-0.57160
Improvement of working conditions	Y	1.1727	-0.684	-0.13932
Reduced maintenance and repair costs	C_{tor}	1.1861	2.479	0.51069
Service life of the machine for upgrading	T_s	9.7576	-0.192	-0.32539
Participation in the repair of specialists of the enterprise	k_u	0.4242	0.348	0.02564
One-time prepayment, %	k_{pred}	45.1515	-0.006	-0.04705
Distance to repair enterprise	D	110.6061	0.005	0.096052

In fig. 1 presents the results of calculating the demand for tractors XT3-170, restored after the depreciation period and write-off, for sale in the secondary market.

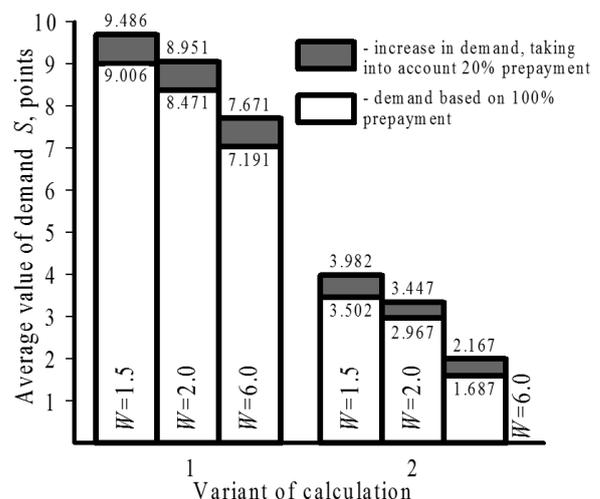


Fig. 1. – Dynamics of demand for machine modernization on secondary market at level of resource recovery: 1 – $q_m = 0.85$; 2 – $q_m = 0.60$

Positive factors include fuel economy, improved working conditions, and reduced maintenance downtime. The factors that increase the demand also include the participation of specialists in modernization of equipment, including in order to control the quality of modernization, partial instead of full prepayment for the work performed. Increasing demand while reducing the distance to the object of modernization may be interpreted not only by the

limited radius of service of machine-building enterprises, for example, SBK «Druzhba» of the Melitopol district of Zaporizhzhya region, but also the necessity in certain cases of modernization of equipment in the conditions of the farm, which in reality is used by some enterprises.

From the graph shows that an increase in the quality tractors that comprehensively characterized coefficient of recovery resources 0.85, and setting prices modernized machine that does not exceed 50% of the price of new (1 version of the calculation), the demand for modernized tractor HTZ-170 ranged from 7.0 to 9.5 points. With decreasing quality ($q_m = 0.6$), demand drops to 1.7...4.0 points (2 variants of calculation).

The 1st version of the calculation characterizes the quality indicators of the modernized tractor, established according to the State Standard of Ukraine. The 2nd version of the calculation may correspond to the actual performance of the modernized tractors, or the estimated estimates of consumers of these indicators, based on the experience of major repairs of tractors at the repair enterprise.

If the quality of the upgraded machines does not correspond to the one declared, the repair company should be extremely careful with it on the market, because the identified flaws can have a significant impact on the reduction of demand and loss of image. In case of compliance of the quality indicators with the requirements of the State Standard of Ukraine, the repair company must confidently organize an active advertising campaign to promote these machines to the market.

4. Conclusions

Thus, the presented methodology allows predicting the demand for modernization of equipment, which is necessary for the development of a program of actions of enterprises for improving the quality of machines, assessing their real capabilities, developing strategic and operational plans for modernization, organization of activities in the technical service market.

The application of the described methodology for increasing demand for equipment modernization will significantly increase it, which will undoubtedly affect both the efficiency of the use of machine and tractor unit of consumers, and the increase of economic effect of the machine-building enterprises of the region.

Research of demand problems in modernization of machines in our opinion needs more advertising influences on this issue. Agricultural producers have not even heard about this, and this direction is being seriously promoted in the SBK «Druzhba». The idea of modernizing agricultural machinery is also one of the methods to restore the shortage of technology in the countryside, as well as resource saving.

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