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OPERATING COSTS OF A TIMBERJACK 1010 FORWARDER IN A SELECTED ADMINISTRATIVE UNIT OF THE STATE FORESTS

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Abstract. Costs are the most important indicators of profitability in any business activity. The forest logistics chain consists of wood, the supplier, the buyer and the producer. Costs arising from the use and operation of forest machines such as forwarders and harvesters should not be forgotten here. The aim of this study was to define and describe all elements of costs. In such an analysis conducted for the most popular machines, costs were assessed in terms of fixed and variable costs. The purpose was to estimate the degree to which the total cost structure is influenced by servicing costs and spare parts costs. Innovation of this study is connected with the collection of actual accounting data.

Key words: forwarder, operating costs, extraction efficiency, unit extraction costs

INTRODUCTION

The approaching second wave of the economic crisis in Europe has caused considerable changes in the manner we perceive operation of machinery and equipment, both by maintenance services, as well as individuals responsible for technology in Polish enterprises. The previous economic crisis experienced three years earlier caused intensive attempts to increase process efficiency and to find cost-reducing solutions. In order to survive these difficult times it is necessary to thoroughly analyse incurred costs. Operating costs of the machine pool at any enterprise may constitute a source of considerable savings.

Operating costs are classified as logistics costs. Operating costs in case of technical equipment reflect physical and economic consumption of facilities, energy, materials and information, services and working time of employees expressed in pecuniary terms,

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used in order to realise operation tasks and maintenance of this equipment to keep its functional and operational usability under specific conditions and time [Niziński and Żółtowski 2002].

A comparison of costs of consumed fuel, electric energy, costs of servicing or purchase and remuneration for the operator does not reflect all most significant benefits for the user. It is the costs of the operator that constitute the biggest portion of all costs within several years of usage. It needs to be remembered that the more efficient a forest machine is, the faster work is performed within a unit of time.

Another approach to cost analysis is practiced by German entrepreneurs. In their companies an increasing amount of attention is focused on aspects other than the purchase price of a machine. This price may not be the most important factor in the decision to buy fixed assets, including forest machines. More and more managers responsible for the machine pool consider operation of technical vehicles in view of their operating costs throughout the entire operation life, i.e. as total cost of ownership (TCO). Another term used in this respect is total cost of operations [Dorsch 2011]. From the accounting point of view the total cost of ownership comprises total operating cost. The acronym TCO originates from the IT and telecommunications sector. Presented for the first time in the 1990's at Gardner Group (USA) it is strictly speaking a calculator of costs used in a rapid analysis of costs connected with a given investment.

Operation management reflects awareness and understanding of the essence of operation of a given machine or piece of equipment. What is important, every user of a machine or equipment directly influences all components of its operation [Legutko 2007].

In the course of operation of a machine we may distinguish three stages of its use: I – running-in, II – normal work, III – intensive wear (wear-out failure).

The running-in period is the time of grinding in of all surfaces on both moving and stationary working elements. During that period the machine should not work under continuous and nominal load. The second period is the longest period in the life of a machine or piece of equipment. During that time it works under nominal load at the maximum utilisation of its efficiency. The third period is the time of wear-out. From the point of view of maintenance it is a very difficult period due to the unpredictability of failure or damage in individual subassemblies [Pietrzak and Dróżdż 1979].

MATERIAL AND METHODS

This study concerned a forest machine, a Timberjack 1010 forwarder. The machine was purchased brand new in 1996 by the Bardo Śląskie Forest Division and since then has been used in that unit to the present. From the first day to the book-keeping data collection date the machine worked for 23 288 mth.

All the required data were collected in a specially designed questionnaire, containing information from the following sections:

- general information
- specification
- servicing-related costs
- Costs related with spare parts
- Operating conditions.

When analysing available studies and materials on the costing of use and operation of forest machines it may be stated that although some literature sources concern this

problem, their results are not completely confirmed in practice. The analysis of operating costs for agricultural machines and tractors is much more advanced.

Machine operating costs as costs expressed in terms of Q value (PLN), i.e. total costs (K_c), are divided into fixed stałe (K_s) and variable costs (K_z) [Ammann 2006].

$$K_c = K_S + K_Z$$

A Swiss organisation involved e.g. in the technical evaluation of agricultural machines created a list of operating costs of those machines, particularly farming tractors. Annual utilisation level of machines plays a decisive role in the determination of the volume of individual costs. Annual costs, both variable and fixed, refer to the period and such units as hour, hectare, ton, m³, etc. Then we receive a measure of their volumes in the form of unit costs [Ammann 2006].

Variable costs include:

$$K_Z = K_{\text{pso}} + K_{\text{pł}} + K_{\text{ez}} + K_{\text{nt}}$$

where:

K_{pso} – cost of fuel, lubricant, oil,
$K_{\text{pł}}$ – operator labour cost and related burdens,
K_{ez} – cost of elements of wearing parts,
K_{nt} – cost of repairs, inspections, servicing.

Variable costs are directly dependent on the degree of machine use. Fixed costs are independent of the volume and number of jobs a machine has performed in a given period of time.

Fixed costs are:

$$K_S = K_a + K_{\text{ub}} + K_{\text{prz}} + K_{\text{kr}}$$

where:

K_a – depreciation cost
K_{ub} – insurance cost
K_{prz} – cost of machine storage
K_{kr} – cost of bank loan.

As it was reported by Ammann [2006], only such a detailed cost analysis makes it possible for decision-makers to take decisions whether it is more cost-effective to purchase or lease machines, or whether maybe it would be better to use it jointly with other partner(-s). We need to take into consideration whether it will be used in 1, 2 or 3 shifts. When purchasing a machine it is necessary to decide whether it is more rational to invest in a bigger, more expensive and more powerful machine and to consider the length of time over which it will be used.

Most of these questions, thanks to such an analysis of needs and costs, may be answered by practically any potential buyer and user, taking into consideration the economic aspect, i.e. profitability of an action.

A decision concerning purchase of a modern cereal combine harvester should be preceded with a thorough analysis of the environment and planning. The operation period for agricultural machines ranges from 12 to 20 years [Izdebski 2002]. Thus an analysis of future effects brought by the newly purchased machine seems to be a crucial element in the decision-making process. In case of agriculture an optimal selection of

a machine for a farm is difficult as a result of problems in the identification of the amount of work in individual years of its operation. As it was stated by Izdebski [2002], selection of agricultural machines made only on the basis of the volume of their operating costs is not rational. Apart from these costs, other expenses are also involved connected with weather conditions or organisational aspects, which may influence total costs.

Cost analyses show that the share of costs in the value of sold goods range from 10 to 40% [Legutko 2007]. It is within the range of these costs that the greatest potential reserves for savings are found in any enterprise.

Another example focuses on costs of repairs. As it is reported by Polish researchers, considerable costs are incurred when it is attempted to restore the good technical condition in case of old machines. What is essential, an extension of the operation period by 50% (e.g. by approx. 5000 mth) results in an increase in costs of repairs by approx. 50%, while a 100% extension of the operation period requires an 80% increase of costs of repairs [Glazar and Wojtkowiak 2009]. Before we reach the moment when it is necessary to conduct a general overhaul in order to restore the good technical condition of a piece of equipment, we should adequately plan and perform inspection and all maintenance operations specified in the technical and operations documentation of the machine.

As it has already been mentioned, we need to remember that also Polish researchers investigated operating costs of forest multifunction machines. Although these studies were simulations and mathematical models, their analysis also presents certain information on these components which have the greatest effect on the value of total costs.

According to Moskalik [2009], when investigating direct costs of timber harvesting with the use of a harvester in the hour-based system we may distinguish the following components: depreciation at 22.35%, 15.58% interest rate, 14.19% wages, fuel, hydraulic oil, lubricants amounting to 17.57%, repairs and servicing at 24.83%, saw guides at 2.64%, chain saws at 2.39% and chain saw oil amounting to 0.46% total costs.

Moskalik [2009] stated that a considerable cost item in case of forest machines is connected with the costs of repairs. It is estimated at 90-125% in relation to depreciation.

Based on the above models of cost analysis a system used in this study was assumed to be based on the variability of costs, i.e. foxed and total costs.

Collected book-keeping data connected with the analysed machine covered the years 2009, 2010 and 2011. Apart from book-keeping information connected with costs, accurate data were also gathered on the number of m^3 timber extracted in these years. In order to refer total annual costs to the income which the machine generated, information was also collected on average rates paid for extraction of 1 m^3 timber with the use of a forwarder in the years 2010 and 2011 in the Regional Directorate of the State Forests in Wroclaw.

RESULTS

Results indicate that total operating costs K_c of the analysed machine in the last three years 2010-2011 amounted to K_{C2009} = 137 717.00 PLN in 2009, K_{C2010} = 153 379.70 PLN in 2010 and K_{C2011} = 157 906.00 PLN in 2011, respectively.

The amount of timber forwarded with the analysed machine in the investigated period was 7750 m^3 in 2009, 9180 m^3 in 2010, while in 2011 it was 9800 m^3.

The calculations were made assuming the mean extraction cost for 1 m^3 timber at the Regional Directorate of the State Forests in Wroclaw in 2010 and 2011. This value amounted to 23.35 PLN per 1 m^3, which yielded the following income in individual years: 180 962.50 zlotys in 2009, 214 353.00 zlotys in 2010 and 228 830.00 zlotych in 2011.

A comprehensive list of costs and income resulting from the work of the Timberjack 1010 forwarder in the years 2009-2011 is presented in Table 1. What is important, this machine due to its age has been completely depreciated ($K_a = 0$), and the forest division incurs no costs connected with its financing ($K_{kr} = 0$).

Table 1. Total costs and income from forwarding with Timberjack 1010 in individual years of 2009-2011

Tabela 1. Zestawienie kosztów całkowitych i przychodów ze zrywki drewna forwarderem Timberjack 1010 w poszczególnych latach

Years Lata	K_{pso}	$K_{pł}$	K_{ez}	K_{nt}	K_{ub}	K_c	Income Przychód	Profit Zysk
	PLN							
2009	31 136.00	88 791.00	1 845.00	13 507.00	2 438.00	137 717.00	180 962.50	43 245.50
2010	43 162.00	98 655.70	3 829.00	5 284.00	2 449.00	153 379.70	214 353.00	60 973.30
2011	48 575.00	99 773.00	1 883.00	4733.00	2 942.00	157 906.00	228 830.00	70 924.00

Due to the fact that operations were performed at the forest division, which is the owner of the forwarder, storage costs also amount to zero ($K_{prz} = 0$).

As it results from Figure 1 the biggest component of total costs in this specific case is the cost of operator wages. It amounts to almost 64% all costs. The second item in terms of value amounting to over 27% total costs comprises costs of fuel, lubricants and oils.

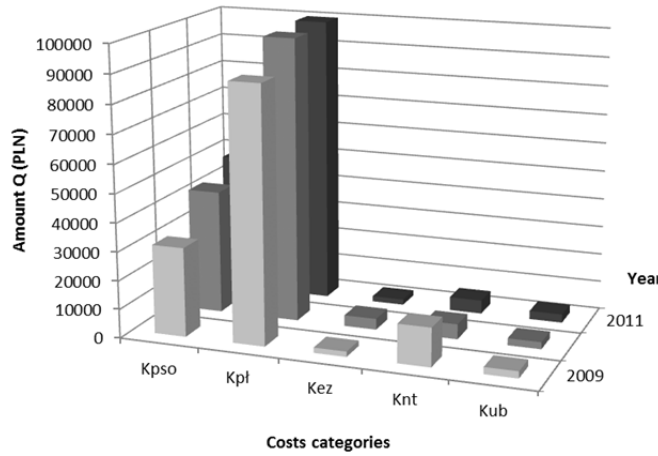

Fig. 1. Maintenance costs of a Timbejack 1010 forwarder in the Bardo Śląskie Forest Division

Rys. 1. Koszty eksploatacji forwardera Timberjack 1010 w Nadleśnictwie Bardo Śląskie

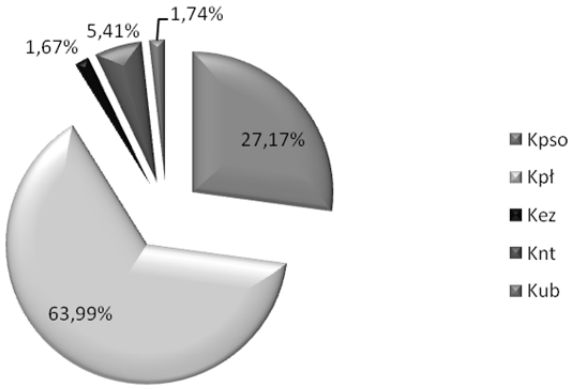

Fig. 2. Average percentage shares of individual costs in total operating cost structure of a Timberjack 1010 forwarder

Rys. 2. Średni udział procentowy poszczególnych kosztów w strukturze kosztów eksploatacji forwardera Timberjack 1010

DISCUSSION AND CONCLUSIONS

Based on the conducted analysis it may be stated that in case of an old machine, which has been depreciated, the primary cost exceeding even 50% total operating costs of a forwarder comprises wages of the operator and related burdens. Costs of fuel and lubricants, constituting over 1/4 operating costs, rank second. A relatively small share of operating costs comprises costs of repairs and spare parts. It results from the appropriate and diligent monitoring of a highly significant element, i.e. regular inspections and repairs using original parts.

On the basis of this machine several regularities may be stated:

1. Proper maintenance of the technical condition and following the recommendations of the manufacturer have a highly advantageous effect on operating costs even in case of a highly used machine.
2. A significant element influencing costs and income include depreciation and costs connected with the financing of the machine.
3. It is essential over a long-time perspective to properly care for technical inspections.

Analyses conducted on this machine reflect perfectly well the conclusions and commonly presented opinions on appropriate and adequate operation of the machine, which in case of forest machines is relatively uncommon. Generally it may be stated that these results indicate that a 10-15-year old machine does not have to be scrapped and replaced with a new, very expensive one. The most important element influencing the level of costs, apart from operator-related costs (ceteris paribus) is the quality of technical maintenance and skills of the operator. Thorough, regular inspections and the use of appropriate spare parts proved to be a benefit extended over time, which effects today are tangible in the form of income from forwarded timber.

Presented results indicate that costs of technical maintenance in the period of three years amounted to almost 5.5% total costs, while costs of spare parts – only 1.67% total costs.

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KOSZTY OPERACYJNE FORWARDERA TIMBERJACK 1010 W WYBRANEJ JEDNOSTCE LASÓW PAŃSTWOWYCH

Streszczenie. Zmiany społeczno-gospodarcze, które zaszły w Polsce po 1989 roku wpłynęły na wiele innych przemian. Również w Lasach Państwowych sprywatyzowano prawie wszystkie usługi wykonywane na rzecz tego przedmiotu gospodarczego, oddając sprzęt i ludzi wykonujących „prace gospodarcze" w ręce prywatnych usługodawców. Chociaż zdarza się, że z różnorakich względów niektóre czynności w lasach wykonuje się w dalszym ciągu własnymi ludźmi i własnym sprzętem. Według ekonomistów istnieje wiele podstawowych przekrojów klasyfikacji kosztów: koszty proste, koszty złożone. Ze względu na działalność operacyjną i finansową wyróżniamy: koszty zwykłej działalności operacyjnej (koszty działalności podstawowej, pomocniczej, ogólnego zarządu), pozostałe koszty operacyjne i koszty operacji finansowych. Związek kosztów z osiągniętymi przychodami decyduje o następującym podziale: koszty uzyskania przychodów, koszty i wydatki niebędące kosztami uzyskania przychodów. W pracy przedstawiono sposób odnoszenia kosztów na wytwarzane produkty, jakim jest zrywka drewna, do kosztów utrzymania (stałe) K_s i kosztów użytkowania (zmienne) K_z. Przy czym uwzględniano następujący rodzaj kosztów: amortyzacja, zużycie materiałów i energii, usługi obce, podatki i opłaty, wynagrodzenia, ubezpieczenia społeczne i inne świadczenia, pozostałe koszty rodzajowe. Analiza kosztów przeprowadzona w przedsiębiorstwie typu nadleśnictwo jest bardzo interesująca w konfrontacji z kosztami rejestrowanymi w przedsiębiorstwach prywatnych. Koszty związane z eksploatacją w takiej firmie muszą być wszechstronnie i szczegółowo

rejestrowane. Ich rzeczywiste koszty są więc bardziej wiarygodne niż w innych przedmiotach gospodarczych, które często nie rejestrują wszystkich wydatków z różnych względów. Uwzględnienie w tej analizie wydajności i czasu pracy maszyny umożliwia oszacowanie jednostkowych kosztów zrywki drewna w porównaniu z prywatnymi właścicielami takich samych maszyn.

Słowa kluczowe: forwarder, koszty eksploatacji, wydajność pracy, jednostkowe koszty zrywki

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