THE MAINTENANCE COSTS OF ESTONIAN TRACTOR-FLEET

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Abstract. With the machinery getting more complex, the fields of application getting wider, the automatization rising and the loads and speeds increasing, the operational reliability is gaining importance. The growth of operational reliability is one of the main sources for making the machinery more efficient and decreasing the costs of energy and labour. The complexity of the machinery has brought about a significant rise in the costs of fixing its malfunctions. Keeping a tractor operational during its whole working life means spending twice as much money on repairs and maintenance as one would spend on a new tractor.

Keywords: tractor, tractor fleet, maintenance costs.

Introduction

As an introduction to the research, we will first describe the composition of the Estonian tractor-fleet, its size and its development over the past 20 years. According to the data of the Estonian Road Administration (ERA) there were 23 328 tractors registered on December 31, 2010 (Fig. 1 and Table 2).

In 2001, the biggest number of tractors – 52 441 vehicles – were registered at ERA (ERA, 2010). Starting from 2002 the number of the registered tractors has decreased. The bottom of the decline was reached in 2007, when there were only 20 591 tractors registered at the Estonian Road Administration. Over six years the number of tractors decreased by 31 850 vehicles (60.7 %). From 2008 the number of tractors has started to grow again. By 2009, the number of registered tractors was 23 328. Over the past two years the number of tractors has increased by 2 737 vehicles (11.7 %) [1].

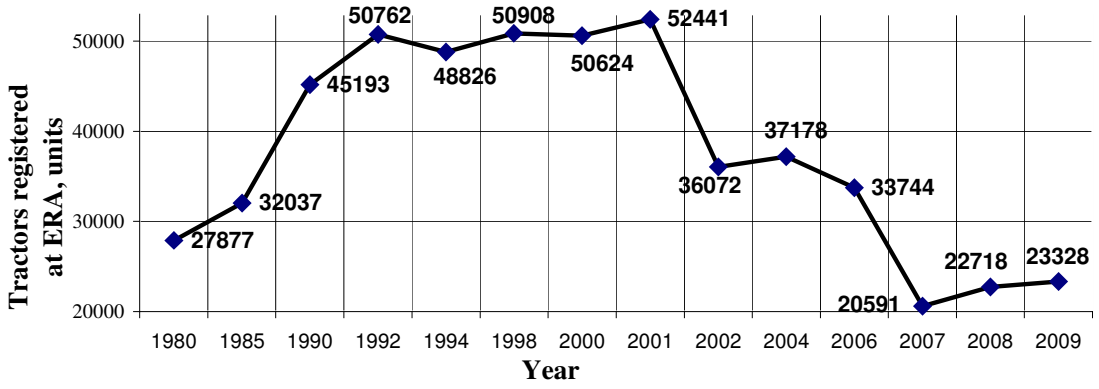

Fig. 1. **The development of the Estonian tractor-fleet 1980-2009**

Dainis Viesturs and Nikolajs Kopiks have analysed the changes and development trends of the tractor-fleet after regaining independence and transition to market economy in Latvia [2].

The aim of the current research was to examine the reliability of the tractor-fleet for the use of competitive agricultural production and processing. From this aim the following tasks were set: determining over a longer period (4-5 years), the technical economic indicators related to the maintenance of the tractor-fleet of Estonia; examining and making recommendations how to ensure the reliability of the tractor-fleet, so that the vehicles could be used for competitive agricultural production and processing [3; 4].

The tractors were examined as part of an agricultural production business, each forming part of a machine park, which as a whole unit does all the necessary work (plant and animal husbandry, land preparation, harvest, cleaning the snow off the roads etc.).

The current research does not evaluate the tractors or compare them to determine the best tractor. The research explains the presence of specific cost parameters and their minimum and maximum values, and calculates the arithmetic mean. At this point we are not able to claim which specific costs

are included in the minimum and maximum values of the tractor maintenance. That should be explored further. But we are able to determine the total value of the maintenance costs [5].

The data were gathered from accounting databases of the companies with the help of the heads of technical units. Most of the data was received via direct communication. Therefore, we can be certain of the correctness and reliability of the data. The collection of data took place in 2008 and spring 2009. The questionnaire interviews were carried out in the Central and South-Estonia. We interviewed 20 companies, including the 10 biggest companies in Estonia on the basis of the turnover.

Materials and methods

The basis of this investigation is the qualitative approach to the research problem. The qualitative approach lets us use different evidence simultaneously – documents, interviews etc. During the different stages of the investigation other methods, such as the quantitative and analytical ones, where used as well, although the qualitative remained the primary one. The qualitative approach does not use numerical showings as primary arguments in order to reach conclusions from empirical materials. It is rather a description about which are the factors influencing the development of the maintenance of the machinery and in which direction it should move forward.

The research concentrated more in-depth on eight agricultural businesses, which possessed specific data concerning the maintenance of their tractors, over the period of 2004-2008. This way we obtained the maintenance data of 460 tractors over the same period. Among those there were 232 MTZ-type tractors and 62 technically older big Russian tractors T-150K, K700 and K701. The engine power of the tractors was empirically divided into the following groups: 1) up to 59 kW, 2) 60-80 kW, 3) 81-120 kW, 4) 121-160 kW, 5) 161-200 kW, 6) over 200 kW.

The shortcomings of the research method: tractors of the same brand were not distinguished, which means that the big and small tractors were analyzed on the basis of the same criteria. Such an approach can be justified by the fact that the heads of the technical units of the larger companies were particularly interested in total costs, i.e., how much the maintenance of all tractors costs, in order to keep the machine fleet running and to ensure the reliability of machines during the high season.

Results and discussion

In 2003, the 21-25 year old tractors formed 55.7 % of the tractor fleet. By 2008 the proportion of such old tractors had decreased to 33.3 %. The proportion of tractors aged 5 years has increased since 2005 from 5.8 % to 19.2 % by 2008. The number of modern tractors is growing and more old tractors are being deleted from the ERA registries. The tractor-fleet average age is diminishing and the proportion of modern tractors is enlarging.

In this research the tractors were divided into groups on the basis of their age: 0-5 years, 6-10 years, 11-15 years, 16-20 years, 21-25 years, 26-30 years and older than 30 years.

The fuel consumption of new tractors is on average 13.3 thousand litres per tractor per year. For 6-10 year old tractors it is 9.6 thousand litres per tractor per year. 11-15 year old tractors have the smallest fuel consumption – 2.8 thousand litres per tractor per year. The fuel consumption of even older tractors is more stable at 5 thousand litres per tractor per year.

The basic maintenance is done to restore the technical resources of the machine. The machine is dismantled, cleaned, the worn-out parts are exchanged for new ones or restored ones, thereafter the machine is assembled and the mechanisms regulated. The spending on technically old tractors has decreased over the years, because more modern tractors are used and the machine-fleet is getting younger. The old tractors are often used only during spring (e.g., picking stones) and on the animal-farms.

The maintenance of older machines is more expensive compared to the newer ones because it demands more work. Although the spare parts are relatively cheap, the cost of working hours is bigger. With Agro IX the cost of one working hour is 7.41 EUR. On average the maintenance of one tractor takes 16 working hours.

The cost of the spare parts also depends on the age of the tractor. The spending on tractors up to 5 year old is 2030 EUR and on tractors of 6-10 year old is 1834 EUR. The cost of spare parts starts decreasing for 5-10 year old tractors. For 11-15 year old tractors the cost of spare parts is 2.6 times less – 701 EUR and for tractors old 26-30 years, it is 457 EUR.

Table 1

The maintenance costs for different tractor brands (EUR)

Indicator, yearly average	New Holland	John Deere	Massey Ferguson	Fendt	Valtra	MTZ	T-150K, K701	T-40, T-25	Deuz Fahr	Average
Engine power, kW	125.3	166.2	139	224.9	137.1	58.6	153.1	21.2	-	112.5
Age, years.	3.70	5.50	1.70	1.70	1.70	20.80	21.60	21.50	-	9.77
Fuel consumption, l	13102.10	18905.6	16597.30	25078.70	22473.70	3723.80	9948.40	792.80	1513.00	12459.49
Price of the fuel, EUR	8220.70	11260.70	10910.10	15841.30	13063.60	1967.40	4838.60	431.20	397.80	6523.41
Cost of spare parts per 1 litre of consumed fuel, EUR	0.20	0.20	0.10	0.20	0.40	0.30	0.10	0.20	0.10	0.20
Maintenance costs per 1 litre of consumed fuel, EUR	1.0	0.9	0.9	0.9	1.0	1.1	0.8	1.0	0.5	0.9
Oil and lubricants, EUR	638.4	568.4	393.0	168.6	95.0	152.2	144.1	91.8	51.1	255.84
Cost of spare parts, EUR	1541.1	4470.0	2750.8	3730.4	5979.2	524.1	923.3	190.8	43.9	2239.29
Cost of workshop, EUR	0	405.8	840.4	595.7	250.7	603.5	589.2	566.60	0.00	550.27
Technical maintenance, EUR	576.3	354.40	3506.70	324.20	1735.70	38.90	0.00	0.00	0.00	1089.37
Total cost including fuel, EUR	10956.5	17508.7	14297.5	19638.7	19001.5	2807.1	6132.6	763.5	467.3	10174.8
Cost of spare parts as a % of tractor maintenance costs including the fuel	14.1	25.5	19.2	18.9	31.4	18.6	15.0	24.9	9.0	21.0
Proportion of oil and lubricants of total cost	5.8	3.2	2.7	0.9	0.5	5.4	2.3	12.0	10.9	2.5
Total cost without fuel	2735.8	6248	3387.4	3797.4	5937.9	839.7	1294	332.3	69.5	3651.39

The costs of the workshop for up to 5 year old tractors are 405 EUR and for 6-10 year old tractors 233 EUR. The costs increase for the tractors aged 11-15 years up to 1184 EUR. This is due to resource exhaustion of the tractors. This confirms the classical erosion theory and our hypothesis that the

resources of the tractor start diminishing after 21 000 working hours and the cost on spare parts grows significantly. The costs increase about five times. After that the costs start decreasing again until the wearing out of certain spare parts. After exchanging of those parts the costs start decreasing again. For tractors aged 16-20 years, the costs per tractor are about 500 EUR per year (Table 2).

To sum up, the maintenance costs of new tractors are on average 11 698 EUR. The maintenance costs of older tractors are lower. The cost of spare parts stabilizes for 11 year old tractors and is on average 3000 EUR. The high maintenance costs of the new tractors are caused by the high price of the spare parts compared to the spare parts of the older tractors (Statistics Estonia).

Table 2

Tractors registered at Estonian Road Authority 1990-2010 (on 31.12.2010)

	Older	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990	Total
CASE, CASE IH	14	-	42	50	36	40	20	1	1	2	4	5	6	11	9	12	2	2	1	1	2	4	267
CLAAS	0	15	10	19	17	8	9	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	75
CNH INTERNATIONAL	0	0	0	1	0	3	2	18	22	0	0	0	0	0	0	0	0	0	0	0	0	0	46
DEUTZ-FAHR	0	5	2	2	6	3	5	12	19	15	1	1	1	2	1	1	0	0	0	0	0	0	73
FENDT	6	20	21	48	39	16	14	4	1	0	1	0	0	0	0	1	1	0	0	1	1	0	168
FIAT	28	0	0	0	0	0	0	0	0	0	0	1	0	1	6	5	0	0	1	0	3	5	50
FORD	41	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	1	1	2	2	0	1	53
HTZ	1	0	0	0	0	0	0	1	0	1	0	0	2	0	0	0	0	0	0	0	0	0	5
INTERNATIONAL	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40
JOHN DEERE	70	43	47	134	102	49	61	63	35	38	22	4	4	9	13	5	9	1	3	3	4	8	701
JUMZ	473	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	4	9	26	38	553
LTZ	1	0	0	0	0	0	0	0	1	18	26	9	19	4	0	0	3	1	22	6	1	4	115
MASSEY FERGUSON	45	19	26	28	57	48	29	9	10	3	5	2	2	11	11	9	3	4	3	1	5	6	324
MCCORMICK	0	5	4	17	10	10	15	7	5	0	0	0	0	0	0	0	0	0	0	0	0	0	69
MTZ	4429	13	18	82	73	120	172	162	151	337	175	140	185	350	192	92	127	245	226	470	425	399	8570
NEW HOLLAND	0	48	43	74	69	57	49	18	13	25	17	8	4	9	15	5	2	2	0	0	0	0	426
ZETOR	29	10	11	24	16	14	6	0	0	0	0	0	1	9	4	4	1	0	0	1	1	1	123
ZTS	0	0	0	0	0	0	0	0	0	0	1	0	0	3	2	3	0	0	0	0	0	0	9
T-40; T-25	4641	1	0	0	4	0	1	9	0	5	1	2	11	3	10	9	147	236	193	361	644	695	6973
TZ	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	36
UNIVERSAL	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	7
URSUS	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	23
VALTRA/ VALMET	50	65	47	142	118	84	76	99	103	32	27	21	16	15	13	19	14	4	13	9	2	1	921
VTZ	0	0	0	0	0	0	5	16	4	27	17	4	5	1	0	0	0	0	0	0	0	0	79
OTHER	0	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL:	**9930**	**288**	**271**	**621**	**547**	**452**	**464**	**423**	**366**	**503**	**297**	**197**	**256**	**428**	**281**	**166**	**310**	**498**	**471**	**864**	**1114**	**1162**	**19907**

The maintenance and repair costs of tractors aged up to 5 years are 2300-30 358 EUR. The costs of tractors aged 6-10 years are varied. The largest proportion (47.6 %) accounts for maintenance

and repair costs in the range of 36-100 thousand EUR. The maintenance costs of tractors aged 11-15 years range 20-36 thousand EUR. The maintenance of newer tractors is more expensive (Fig. 2).

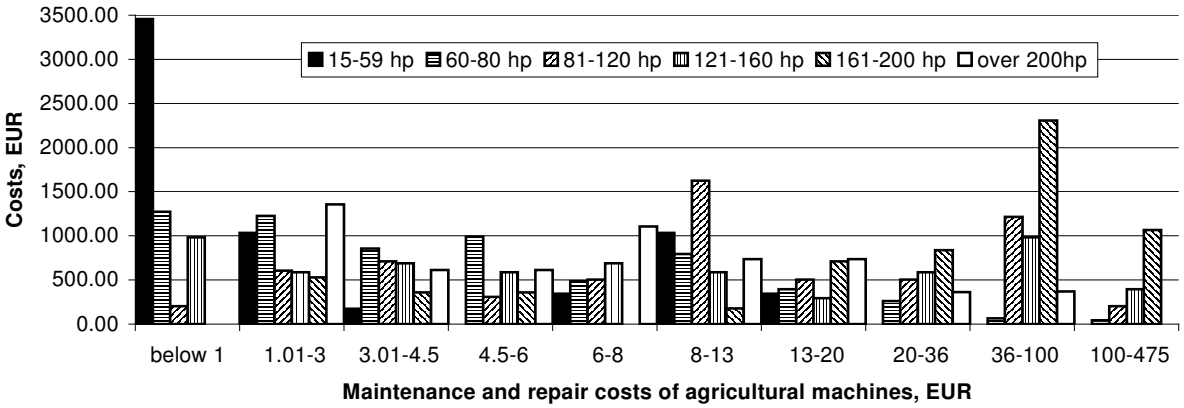

Fig. 2. **Maintance and repair costs of agricultural machines**

Conclusions

1. Economic downturn has also affected the formation of the Estonian tractor fleet, which can be illustrated by the decline in registering tractors in 2007, which got even worse in 2008 and 2009. This downturn is reflected in most types of expenditure and in the number of tractors purchased. The increase in tractor registration (11.7 %) indicates that the economic downturn is ending.
2. The total maintenance cost per 1 litre of consumed fuel is on average 0.9 EUR.
3. The cost of spare parts per 1 litre of consumed fuel is on average 0.2 EUR.
4. The repair and maintenance costs per one tractor vary a lot within the company and between different companies.
5. It has to be taken into consideration that the maintenance and repair costs, varying within hundreds of thousands of Euros, are accompanied by the production risk.

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