

THE ANALYSIS OF LOGISTICS OF AFTER GUARANTEE SERVICE OF TRACTORS WITH REGARD TO THE CALENDAR OF AGRICULTURAL PROCEDURES

Summary

A logistics problem concerning the implementation of collective orders for spare parts, which were indispensable for carrying out the repair, was presented. The researches' results and their analysis in reference to the after guarantee service of Zetor tractors were submitted. The research was conducted in Service Department of authorized distributor of tractors. A research cycle covered the period 2003-2005. The results were elaborated statistically by determining seasonal index value. Temporal schedules of after guarantee service were analysed with regard to the calendar of agricultural procedures advisable for crops cultivation in Poland.

1. Introduction

A common usage of operating machines and equipment compatible with tractors in agriculture is the reason why they are widely used in both specialized and traditional farms for vegetable and animal production. Restructuring rural areas, which has been carried out for the last few years involves investments in technical equipment for farms. Modernization of production technology requires implementing changes in machinery, and therefore increases demand for tractors [15].

Assuring professional servicing and supplying purchased tractors with spare parts is an important task of sales and marketing process. Nowadays, in management of foregoing processes logistics systems are indispensable, since their widespread usage contributes to increase the effectiveness of work. The main purpose of realization of logistics procedures is to streamline customer service as well as to increase competitiveness of sales and marketing company [4, 7, 9, 12, 19].

2. Research problem

Production in agricultural branch is seasonal, and therefore requires rational exploitation of tilling aggregates' operating time. Users aim at applying a structure, which prevents from decrease in both amount and quality of harvest. The time of intense tractor usage is to large extent influenced by the area on which agricultural procedures of corn growing take place. In last few years harvest area exceeded the 75% of total amount of crops cultivation in Poland.

The effective exploitation of machines and equipment's operating time in particular agricultural periods is of great import, since it influences accomplishing all field works on time. Infallible and operational tractors are precondition for gaining high level of time devoted to procedures and high efficiency of tilling aggregates [2, 3].

The subject of the research was the authorised service of tractors' distributor, which repaired offered tractors. The aim of analysis, which was conducted, was to learn quantitative distribution of after-guarantee services provided in period 2003-2005 taking into consideration the calendar of agricultural procedures.

3. The analysis of after guarantee service of tractors

Collective orders for purchase of spare parts submitted in sale and marketing companies were subjected to analysis and evaluation. The realization of collective orders for spare parts enabled execution of Zetor tractors after-guarantee service notified by clients. The service was carried out by Service Department at authorised service station's premises. The research of purchase orders was generated by clients' demand. Meeting customer's needs was possible due to logistics systems operating between the producer of parts and its dealer. Deliveries were made by national Distribution Centre within 24 hours from commission. Such system enabled to maintain reduced stock of spare parts needed for after guarantee service [5, 6, 8, 10, 11].

The analysis of demand for after guarantee service of Zetor tractors needs to be considered with regard to specific character of these products. Tractors from the factory in Brno form abundant and diversified in terms of age population, thus in the space of couple of years the chain of spare parts outlets has developed [20]. Another factor hampering the evaluation was broad access to original parts as well as those made by craft workshops. All mentioned phenomena causing market fragmentation had an impact on discerning and valuating a demand structure within the space of research time.

3.1. The after guarantee service of tractors in 2003

Collective orders for the purchase of spare parts and after guarantee services notified by customers in analyzed period of time came to 68. The number of after guarantee service of Zetor tractors in analyzed year is presented as a histogram (Fig. 1).

The valuation of after guarantee services' demand from quarterly perspective for 2003 reached 20.6% and demonstrated the lowest level of demand in the first quarter, while monthly minimum was registered in January.

In the second quarter it reached 27.9% of annual turnover with local maximum in May. Ensuing three months presented balanced sale with 26.5 % turnover. The closing of agritechnical period caused local increase in the number of orders in November, then strong decrease of demand reaching minimal value in December. In the last quarter total sale came to 25% of annual turnover.

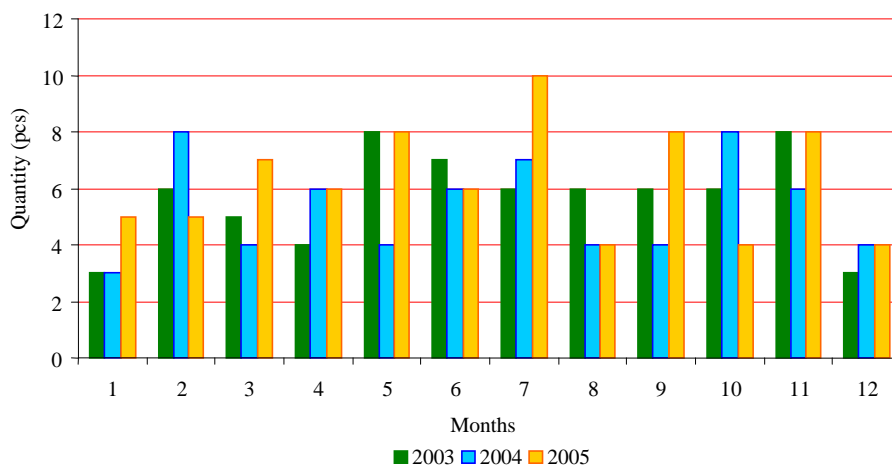


Fig. 1. The layout of after guarantee service of Zetor tractors quantity in the period 2003-2005 (Own study)

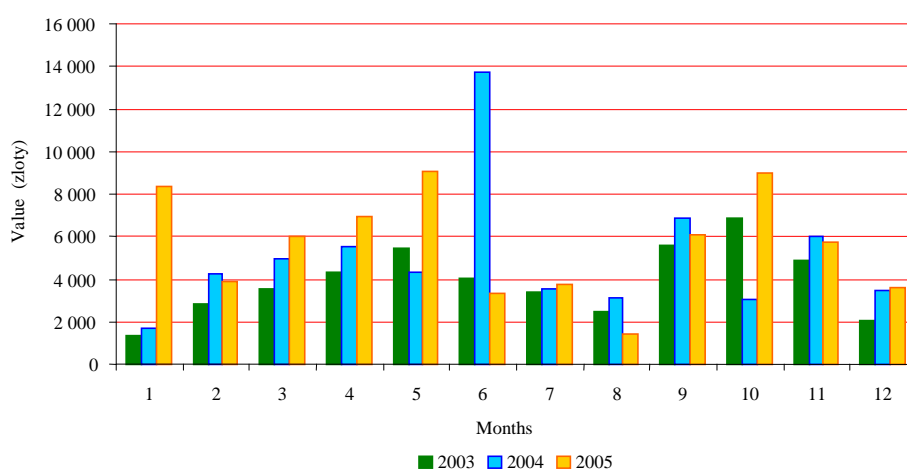


Fig. 2. The layout of value of spare parts for after guarantee service of Zetor tractors in the period 2003-2005 (Own study)

The layout of value of ordered spare parts for after guarantee service of Czech tractors in 2003 is presented as a histogram (Fig. 2).

The ratio of purchased spare parts value to after guarantee service reaffirmed constant upward tendency for the first five months. In the first quarter sale reached 16.5% of annual turnover, while in the second quarter it reached 29.5%. A local maximum was registered after spring field works termination in May. Ensuing three months presented decreasing value of demand, whereas the highest level of parts sale was registered from September to November. In the fourth quarter turnover reached 29.5% of annual sale. Not surprisingly, December was the time of decrease in spare parts purchase.

3.2. The after guarantee service of tractors in 2004

In the analysed year, 64 collective orders for purchase of spare parts were realised in order to carry out service notified by customers. The analysis of after guarantee service of Zetor tractors' standard is presented on histogram (Fig.1).

The analysis of after guarantee service in 2004 confirmed balanced level in the analysed period. In the first and second quarter the demand reached respectively 23.4% and 25% of annual turnover. Local maxima were registered

in February and April. In the third quarter purchase level reached 23.4%, whereas the highest level of purchase occurred in July. The last quarter was characterised by the highest value of turnover of 28.2% in analyzed year, still with downward tendency.

The value of sold spare parts for after guarantee service of Zetor tractors in 2004 is presented as a histogram (Fig.2).

Review of purchased spare parts' value showed constant upward tendency in the period of initial four months of 2004. In the first quarter turnover value reached 17.9% in annual scale, while in the second quarter it was 38.9%. Quarterly maximum equalled the highest purchase in June. The third and fourth quarter presented similar value of 22.4% and 20.8% respectively, in annual turnover.

3.3. The after guarantee service of tractors in 2005

In the analysed period, 75 collective orders for spare parts were submitted in order to carry out service notified by customers. The analysis of after guarantee service of Zetor tractors' standard is presented as a histogram (Fig. 1).

The valuation of needs for after guarantee service in 2005 showed upward tendency in the period of first three quarters. 22.7% of annual turnover was realized from January to March, while in the second quarter it came to 26.7%. Sale of parts for after guarantee service was the

highest in the third quarter and reached 20.3%. Local growth of interests were registered a month before and after the time of intense field works. This time includes March and May for agritechnical procedures and July and September for harvesting. After the end of season another rise of demand was registered in November.

The value of spare parts for after guarantee service sale in 2005 is presented as a histogram (Fig. 2)

The analysis of layout of purchased parts value in the first quarter reached 27.2% of annual turnover, whereas in the second one - 28.7%. Local maxima were registered in January and May. In the third quarter minimal demand value of 16.7% of annual turnover was registered. In the time of intense autumn field works from September to November distinctive raise of purchase was registered, with high level of turnover of 27.3% in fourth quarter.

3.4. The comparison of after guarantee service of tractors in period 2003-2005

The analysis of after guarantee services layout included 207 orders in total. In the space of three years differences in amount of orders occurred, therefore comparison of 2003

and 2004 showed decrease of 5.9%, while of 2004 and 2005 it increased by 17.2%.

Aggregate layout of the amount of after guarantee service of Zetor tractors is presented as a graph (Fig.3).

The comparison of carried out repairs showed mutual features of particular years. The ending and beginning of analysed periods were characterised by distinctive demand decrease. Layout of quantity presented several percent discrepancies quarterly. Local increases of demand were registered before and after spring field works as well as during realisation of after harvest procedures and agritechnical procedures in autumn.

Significant differences in value of parts purchased for after guarantee service occurred in analysed period. Within the space of three years increase in sale was registered. The comparison of 2003 and 2004 showed increase of 30% whereas for 2004 and 2005 the level reached 10.7%. Significantly low level of demand for ordered parts in July, August and December was distinctive for all analysed years. The increase occurred in the first six months, especially the period of field works in spring. Another growth of purchase level appeared in the time of after harvest procedures and agritechnical procedures in autumn (Karczmarczyk, 2005; Banasiak, 1998).

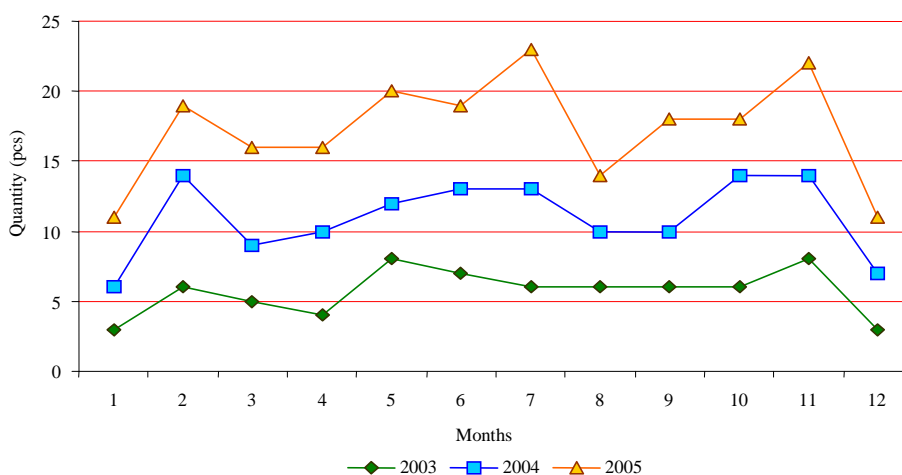


Fig. 3. Aggregate layout of the amount of after guarantee service of Zetor tractors in the period 2003-2005 (Own study)

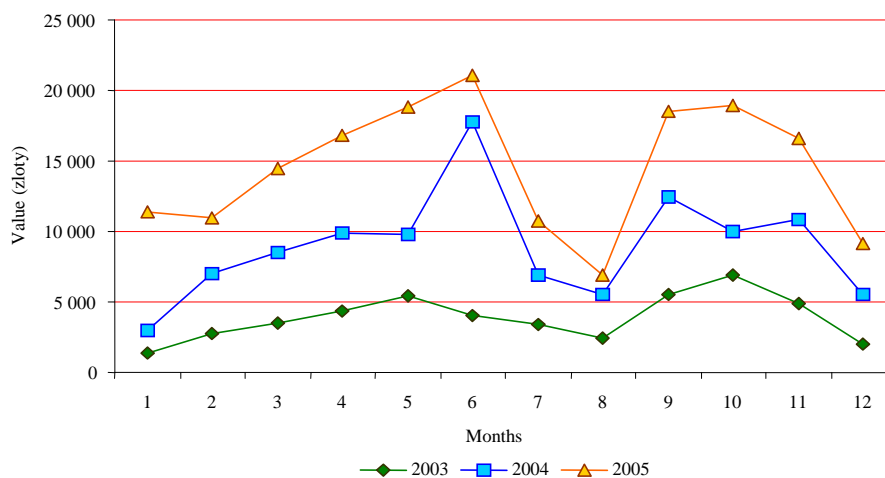


Fig. 4. Aggregate layout of value of spare parts for after guarantee service of Zetor tractors in the period 2003-2005 (own study)

4. Procedure of determining seasonal index value

Seasonal variations are caused by alternation of the season of the year thus are distinctive for, between other, vegetable production. They cause deviation from regular course of farming procedures, therefore are the reason of excessive growth of costs in companies connected with agricultural service. They may be the cause of both insufficient exploitation of companies' potential as well as overloading of sale and service department's in particular periods. Procedures involving sale of parts and repair of tractors are subjected to seasonal variations too. They were analysed in respect of similarity and dependence upon agricultural procedures calendar, which happen to be periodical, and are closely related to particular periods of the year.

Multiplicative model of time series components may be presented as product of four components [1, 13, 15, 16]:

$$Y_t = T_t \cdot S_t \cdot C_t \cdot I_t \quad (1)$$

where:

Y_t – value of series,
 T_t – trend in the series,
 S_t – seasonal variations,
 C_t – cyclical variations,
 I_t – incidental variations.

If we take into consideration multiplicative model of time series, seasonality should be analyzed applying method called "coefficient to flexible mean method".

Flexible mean (*MA*) value is presented by subjugation:

$$MA = T_t \cdot C_t \quad (2)$$

Dividing ensuing original observations (Y_t) by corresponding value of flexible mean (*MA*) will result in isolating seasonal variations (S_t) and incidental variations (I_t) according to:

$$\frac{Y_t}{MA} = \frac{T_t \cdot S_t \cdot C_t \cdot I_t}{T_t \cdot C_t} = S_t \cdot I_t \quad (3)$$

As the result of operation above we get coefficient to flexible mean. Estimated seasonal indexes (S_t) in course of standardisation of monthly coefficient result in so called raw seasonal indexes. Standardisation proceeds as follows:

$$S_i = \frac{\bar{w}_i \cdot d}{\sum_{i=1}^d \bar{w}_i} \cdot 100\% \quad (4)$$

where: S_i – seasonal index for its sub-period (month),
 \bar{w}_i – arithmetic mean of coefficient's value in ensuing months,
 d – the number of months in the year.

The process of raw seasonal indexes' revision was conducted in order to eliminate incidental variations. The sum of seasonal monthly indexes in analysed period equals:

$$\sum_{i=1}^{12} S_i = 1200 \quad (5)$$

and is referred to as refined seasonal indexes.

Seasonal indexes determine quantity of seasonal effects in time series for:

- The size of spare parts sale,

- The value of spare parts sale.

Over a graphical analysis of impact that seasonal variations have on set of variables, the notion of reference level (average level) was applied. In certain months, with regard to seasonal indexes, the reference level is 100% [1, 17, 18].

4.1. Statistical analysis of after guarantee service of tractors

The level of demand for after guarantee service of Zetor tractors in the period 2003–2005 varied in the space of couple of months. The value of seasonal indexes in accordance to the level of after guarantee service of tractors in analysed period is presented as a graph (Fig. 5).

In the course of changes of seasonal indexes for the level of after guarantee service it occurred that it performed less dynamic variations than its value. In January the index was by 30.5% lower from the reference level. As a result of seasonal variations it reached 14.6% above average value. Disproportion between the quantity and quality of sale is the result of minute exploitative repairs of tractor before agritechnical period. In the second quarter indexes surpassed reference level from 3.1% to 5.4%.

In July there was another surplus of demand for exploitative parts over expensive major repairs. In autumn a growth of demand was registered after reduction of number of sale in summer. The purchase of parts generated repairs of tractors in October and November, so after accomplishing agritechnical procedures. Not surprisingly, at the end of the year decrease of seasonal index was registered.

Seasonal indexes for the value of parts sold for after guarantee service of tractors in the period 2003–2005 are presented as a graph (Fig. 6).

The beginning of the year was characterised by lowered value of spare parts' sale. As the result of seasonal variations the second quarter showed the highest interest in the space of analysed period. In following months there was an increase in demand, which reached its maximum in June. The value of indexes surpassed the reference level by 17.5%, 22.1% and 63.2% respectively. Decrease in value of purchased parts for after guarantee service occurred in July and August, whereas indexes came to 24.7% and 42.6% and were below average level.

The time of after harvest procedures and root plants lifting converged with the growth of demand for parts in September, when index value surpassed reference level by 26.6%. In first two months of the last quarter there was a minute growth of sales value, while in December dynamic decrease occurred. As the result of seasonal variations at the end of the year index were lower than average level by 48.6%.

5. Summary

After guarantee service procedures are integral part of vehicles exploitation system. Instant reaction and successfully accomplished by Service Department an after guarantee service depend on work organisation, availability of spare parts as well as on demand structure within the space of calendar year. Repairing tractors in order to restore their functionality should be done in time acceptable for the

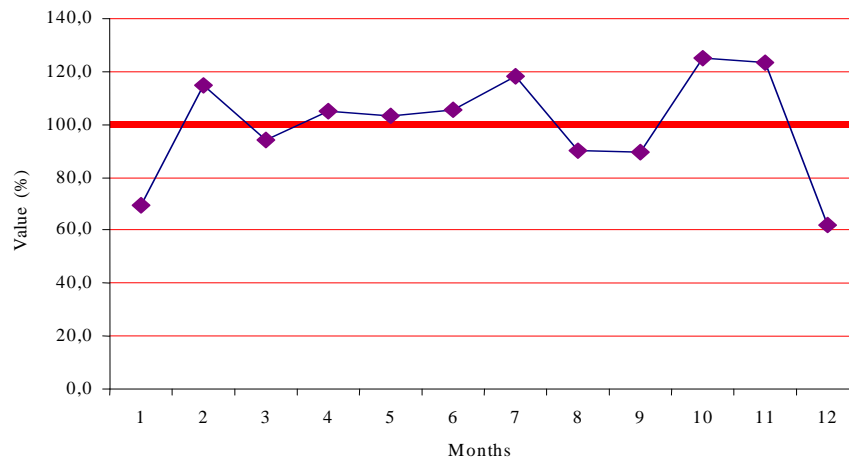


Fig.5. Seasonal indexes in accordance to the level of after guarantee service of Zetor tractors in the period 2003-2005 (Own study)

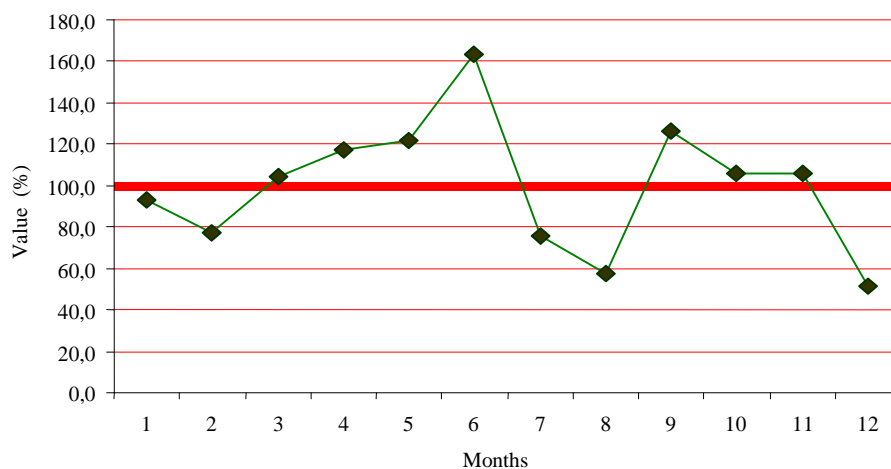


Fig. 6. Seasonal indexes for value of spare parts for after guarantee service of Zetor tractors in the period 2003-2005 (Own study)

customer. Satisfaction from technical service carried out by skilled personnel as well as customizing service to particular customer seems to be of prime importance.

The research allows to formulate following conclusions:

1. The layout of quantity of orders and value of purchased spare parts for after guarantee service was typical for time function.
 - The value histogram of 2003 presents growth of purchase caused by preparations and implementation of field works in spring. Another maximum was registered after the termination of harvesting; after harvest procedures; in the time of root plants lifting. The most orders were realized after spring field works and after the termination of agritechnical season.
 - The value histogram of 2004 shows maximal growth of purchase in June i.e. in the time between spring field works and harvesting. The increase in the number of orders for after guarantee service occurred before and after harvesting.
 - The value histogram of 2005 presents high level of purchase in January and gradual growth connected with preparation and implementation of spring field works with its maximum in May, then after

termination of field works in October. The increase in the number of orders for after guarantee service occurred after spring field works and after harvesting.

2. The change in seasonal indexes value proved the influence that field works, which were carried out according to the calendar of agricultural procedures, have on the number of orders for purchase and value of spare parts ordered for after guarantee service of Zetor tractors.

6. References

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ANALIZA LOGISTYKI NAPRAW POGWARANCYJNYCH CIĄGNIKÓW ROLNICZYCH W ASPEKCIE KALENDARZA ZABIEGÓW AGROTECHNICZNYCH

Streszczenie

Przedstawiono zagadnienia logistyczne przy realizacji zbiorczych zleceń zakupu części zamiennych niezbędnych do wykonania naprawy ciągników rolniczych. Zaprezentowano wyniki badań i ich analizę dla usług napraw pogwarancyjnych ciągników rolniczych marki ZETOR. Badania zrealizowano w Dziale Serwisu autoryzowanego dystrybutora ciągników rolniczych. Cykl badań obejmował lata 2003-2005. Wyniki badań opracowano statystycznie wyznaczając wartość indeksów sezonowych. Rozkłady czasowe napraw pogwarancyjnych poddano analizie w aspekcie kalendarza zabiegów agrotechnicznych zalecanego dla upraw na terenie Polski.