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THE ANALYSIS OF SALE RESULTS OF SELECTED GROUP OF TRACTORS SPARE PARTS

Summary

Logistics problems carried out by sales and marketing companies operating in agricultural sector were presented. Research results and their analysis with regard to selected group of spare parts, which were indispensable to both guarantee and after guarantee services of Zetor tractors, were submitted. The research was conducted in Service Department of authorised tractors distributor. A research cycle covered the period 2003-2005. The results were elaborated statistically by determining seasonal index value. Temporal schedules of the amount and value of purchased spare parts were analysed with regard to the calendar of agricultural procedures advisable for crops cultivation in Poland.

1. Introduction

Logistics literature has been enriched with many monographs and papers devoted to this subject. Still there is the need for research and analysis of logistic phenomena, which occur in agricultural vehicles market [6, 7, 9, 10, 13].

Distribution of spare parts for tractors service plays significant role in present deliberations. The essence of distributional activities is to bring the market for vehicles and machinery producer's closer to agricultural customers, therefore dealer companies fulfil this very function with regard to organisational, economic and technical aspect [14, 21]. Companies which are authorised dealers of products and spare parts, provide vehicle services according to valid standards. Market demands are the reason for the fact that companies are obliged to assure functionality of sold devices. Apart from original spare parts supply, service package also encloses user assistance in maintaining exploitation efficiency and technical counselling [4, 5, 11, 12].

2. Objective and scope of research

A crucial aspect which has to be taken into consideration in managing a logistic sector of company, which operates in food producers' sector, is the calendar of agricultural procedures [2, 3].

The phenomenon of unstable demand for selected spare parts in particular time of calendar year was brought up for research in order to obtain layout in time function.

In the period 2003-2005 selected group of parts for Zetor tractors was selected and it included engine oil filters, fuel filters, hydraulic system filters and gearbox filters. Analysed group of filters was selected in terms of quantity and value taking into consideration their cyclical replacement during guarantee and after guarantee service of tractors, which was carried out in Service Department [8, 16].

Research was conducted in sales and marketing company, which offers authorised distribution of tractors and agricultural machinery, spare parts sale and service. The company has operated in Lublin Province market for couple of years.

2.1. Sale of analysed group of filters for 2003

In the analysed period, 164 filters from selected group were sold. The layout of demand for filters for Zetor tractors in 2003 is presented as a histogram (Fig. 1).

The review of periodical sale of filters found the lowest demand in the first quarter. At that time 11% of annual turnover was realised. At the beginning of the month, monthly minimum was registered. In the second quarter sales level reached 27.4% whereas dynamic growth of demand was registered during spring field works. Local maximum was registered in May, whereas in ensuing month decrease in sales occurred. In the third quarter sales reached 29.3% of annual turnover. An increase in number of services occurred in July i.e. in the time of preparations for harvesting and in September, after harvesting. The highest demand for filters was registered in the last quarter and reached 32.3% of annual sale. The need for elaboration of advisable level of motohours by tractors during the time of agricultural procedures generated demand for guarantee and after guarantee services. After the termination of autumn cultivations, a significant decrease in sale of analysed group of filters was registered. The demand in December determined minimum of sales, which was the same as the one at the beginning of the year.

The layout of sales value of analysed group of filters for Zetor tractors is presented as a histogram (Fig. 2).

The analysis of sold filters for Czech tractors showed course approximate to characteristics of quantitative demand. Minimal value of sales (11.5%) was registered at the beginning of the year whereas January determined the lowest monthly demand. Gradual growth proceeded until it reached local maximum in May. Such a course, especially in the second quarter, was influenced by realisation of tractors service immediately after preplanting cultivations and sowing seeds completion. A significant decrease in sales registered in June was caused by lack of intense field works. The level of filters sales in the second and the third quarter was balanced and reached 25.3% and 25.2% respectively of annual turnover. Termination of autumn field works generated immediate growth of filters sales, which was caused by tractors services in October and November. In the fourth quarter sales of 35% of annual value was registered. The end of the year traditionally denoted decrease in demand comparable with minimum for January.

2.2. Sale of analysed group of filters for 2004

In this period, 258 filters for Zetor tractors from analysed group were sold. The layout of demand for filters for Czech tractors is presented as a histogram (Fig. 1).
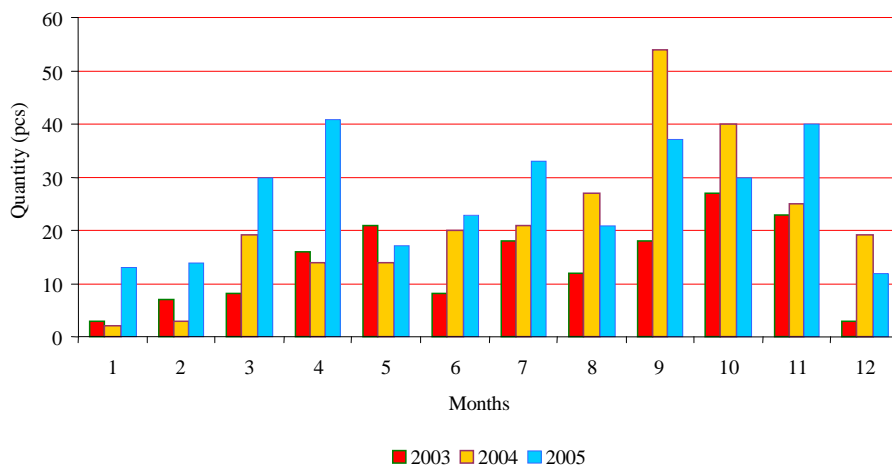

Fig. 1. Layout of the amount of sold filters for Zetor tractors, concerning filters from analysed group for the period 2003-2005 (Own study)
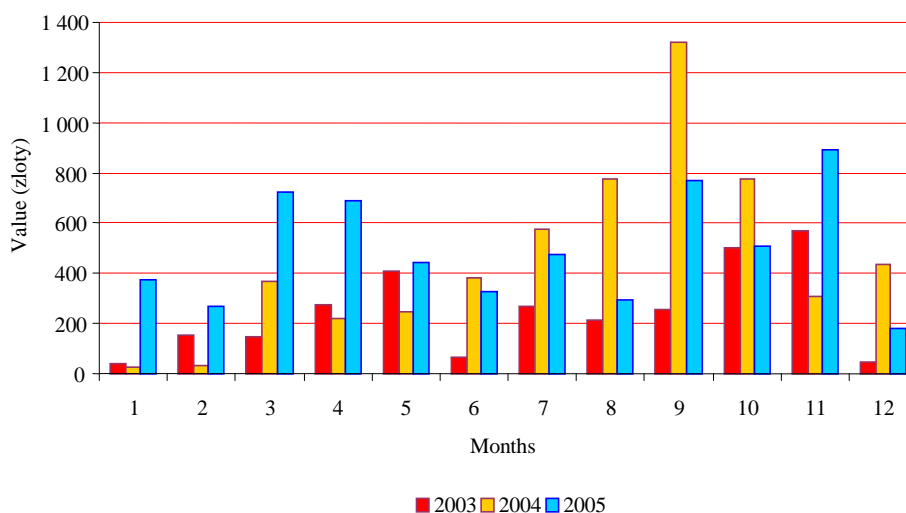

Fig. 2. Layout of value of sold filters for Zetor tractors for analysed period 2003-2005 (Own study)

Estimation of filters sales level in ensuing periods of the year showed minimal demand of 9.3% in the first quarter. The lowest sales were registered in January and February, when no field works were carried out. Set of spring crops caused increase in sales level in March which continued in the entire second quarter and reached 18.6% of annual turnover. The third quarter was characterised by the most dynamic growth of demand and sales at the level of 39.2%. The maximal sales level of analysed filters occurred in September. The last quarter with high sales level reaching 32.6% of annual sale indicated downward tendency.

The course of growth and realised sales level depended on the extent to which tractors were used in field works. Successive elaboration of advisable level of motohours by tractors during the time of agricultural procedures generated demand for services. Therefore, the end of cultivation period naturally was the time of maximal demand for analysed group of filters for Zetor tractors.

The layout of sold filters value for 2004 presented as a histogram (Fig. 2) was comparable in structure to the value of quantitative layout.

The lowest value of analysed group of filters sale was registered in the first quarter and reached 7.8% of annual turnover. In the second quarter there was increase of sales which reached 15.6%. In the third quarter 48.9% of annual sale was realised and it reached maximum in September. Last months registered decrease in value with periodic demand of 27.7%.

2.3. Sale of analysed group of filters for 2005

In analysed period, 311 of filters from tested group of spare parts were sold. The layout of the amount of sold Zetor tractor filters is presented as a histogram (Fig. 1).

Sales level of filters registered in the first quarter reached 18.3% of annual turnover and was the lowest in the

analysed period. Not surprisingly, local minima were determined in January and February. Spring field works caused dynamic growth of sales with local minimum in April. The second quarter reached 26% of annual sale which was caused by significant decrease in May. In the third quarter higher demand was registered in July and September, that is, before and after harvesting whereas sales reached 29.3% of annual level. Another increase in demand occurred in November when most of field works was completed. In December there was a decrease in sales, comparable to the one at the beginning of the year.

The layout of purchased Zetor tractor filters for 2005 is presented as a histogram (Fig. 2).

Layout analysis of purchased filters value was comparable to described quantitative demand. Peculiarity of 2005 consisted in similar level of sales value in ensuing three month periods. The value of turnover in particular quarters reached the level of 23.1%, 24.5%, 25.9% and 26.5% respectively.

Significant differences in sales level occurred in monthly ranges. January and February had low level of demand. Dynamic growth occurred in March and April, that is, the time of intense field works. Local maxima were registered in September and November after a decrease in summer months. The lowest value of purchase occurred in December.

2.4. Comparison of analysed group of filters purchase for 2003-2005

The analysis of sales layout in particular months of the period 2003-2005 included 733 filters; engine oil filters, fuel filters, hydraulic system filters and gearbox filters applied for Zetor tractors.

The comparison of ensuing years confirmed the growth of sales level of analysed group of filters. In the period 2003-2005 demand increased by 57.3% whereas for 2004-2005 it increased by 20.5%. Joining European Union helped Poland to increase sales level of filters as well as caused dynamic purchase of new tractors.

The layout of the amount of sold filters from the group analysed in the period 2003-2005 is presented as a histogram (Fig. 1).

Aggregate layout of the amount of sold filters of analysed group is presented as a graph (Fig. 3).

Comparison of filters sales within the space of three years showed that the lowest demand occurred at the beginning of the year. Sales for the first quarter determined minimum, still dynamic increase in demand was registered. In all three years the time of spring field works caused local maximum in filter sales at the beginning of the second quarter, then decrease in demand. At the beginning of the third quarter, when there was a time of preparation for harvesting, level of filters sales increased. The time of autumn field works generated intensified demand for selected group of filters. Advanced level was present from September until November. Within the space of analysed years decreased sales occurred always in December.
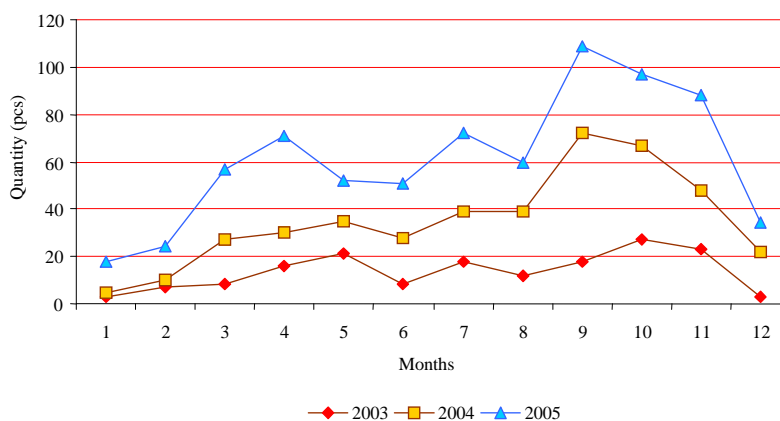

Fig. 3. Aggregate layout of the amount of sold filters for Zetor tractors considering group analysed in the period 2003-2005 (Own study)
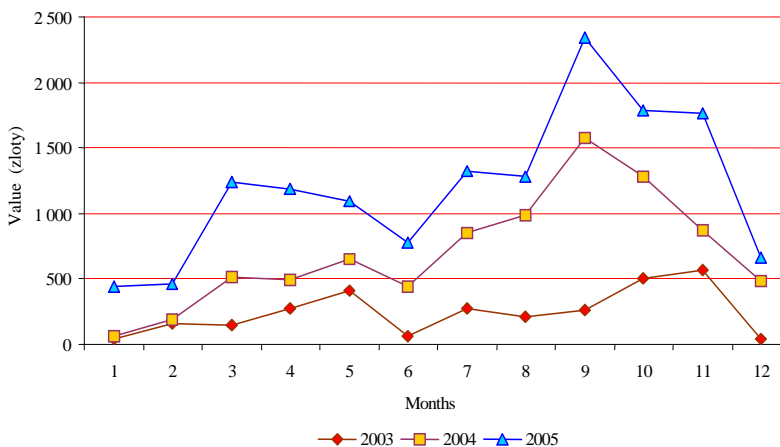
Fig. 4. Aggregate layout of value of sold filters for Zetor tractors considering group analysed in the period 2003-2005 (Own study)

The comparison of layout of sold filters value for Zetor tractors for analysed period is presented as a histogram (Fig. 2). The comparison of sold filters value structure for 2003-2005 confirmed principles of quantitative layout. The beginning of the year was characterised by low value of turnover followed by dynamic growth in the time of spring field works. Typical decrease in sales value occurred at the end of the second quarter whereas growth was registered in the third quarter. Maximal demand for filters was registered in September, that is, after termination of harvesting and after-harvesting procedures. High sales continued for ensuing two months during which guarantee and after guarantee services of tractors were carried out. Significant decrease in sales of parts for Zetor tractors was typical for December.

Aggregate layout of value of Czech tractors purchase is presented as a graph (Fig. 4).

3. Procedure of determining seasonal index value

Conducted research allowed determining time series, that is, set of remarks for variables organised by time function. Within the space of three months, sales of selected group of spare parts for guarantee and after guarantee service were periodical. The analysis of tested phenomena was carried out on the basis of multiplicative model of time series components. Multiplicative model of time series components may be presented as equation [1, 15, 17, 19].

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

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

Movable average series (MA) value is presented by relation:

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

Separation of seasonal variations (S_t) and incidental variations (I_t) according to relation:

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

Standardisation raw seasonal indexes proceeds as follows:

$$S_i = \frac{\overline{w_i} \cdot d}{\sum\limits_{i=1}^{d} \overline{w_i}} \cdot 100\% \qquad (4)$$

where: S_i – seasonal index for its sub-period (month),
$\overline{w_i}$ – 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:

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

and is referred to as refined seasonal indexes.

Seasonal indexes quantitatively determine seasonal effects in time series in reference to the amount and value of selected group of parts sale. In the analysis of seasonal variations influence on layout of sold assortment notion of reference level was applied (average level). In certain months, with regard to seasonal indexes, the reference level was 100% [1, 18, 20].

3.1. Statistical analysis of tested group of filters sales for the period 2003-2005

Sale of tested group of filters for Zetor tractors in analysed period was periodical. Proportional value of seasonal indexes concerning the level of filters sales for 2003-2005 is presented as a graph (Fig. 5).

As a result of seasonal variations at the beginning of the year lowered sales level occurred. Seasonal indexes for January and February were lower than reference level by 69.5% and 65%. Increase in demand in spring caused immediate change of index in March and April which reached 10.5% and 15.9% over average value. Indexes lowered by 32.3% and 8.1% from reference level signified decrease in sales at the end of the quarter. Seasonal variations caused increased demand for filters within the space of ensuing five months.
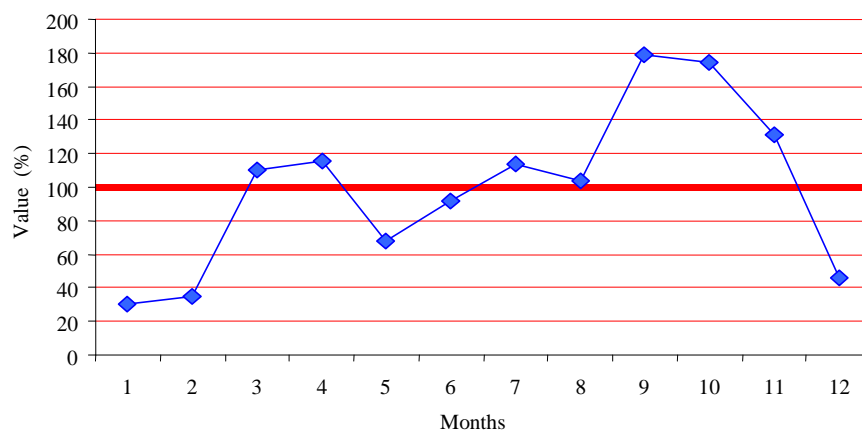
Fig. 5. Seasonal indexes concerning the level of sales, of tested group of filters for Zetor tractors for the period 2003-2005 (Own study)
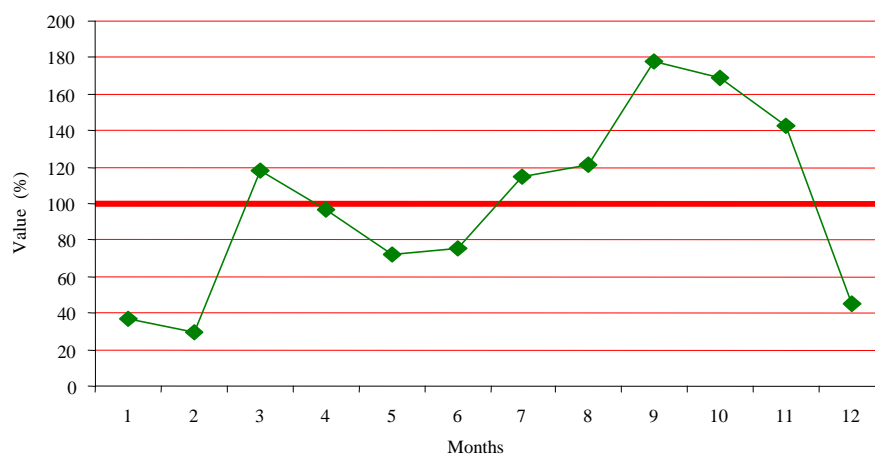

Fig. 6. Seasonal indexes concerning the value of sales, of analysed group of filters for Zetor tractors in the period 2003-2005 (Own study)

Maximal value resulting from tractors service after elaboration of advisable quantity of motohours occurred in period from September till November whereas indexes for this period were higher than reference level by 79.2%, 74.&% and 30.8% respectively. The end of the year was connected with decrease in sales and index reached 53.9%.

Seasonal indexes for sales of analysed group of filters for 2003-2005 is presented as a graph (Fig. 6).

Changes of seasonal indexes for sales value proceeded in accordance with principles observed in quantitative demand for filters. As a result of seasonal variations indexes for January and February were lower by 63.3% and 70.6% from reference level, which equalled 100%. Growth of sales resulting from preparations for spring field works caused one month immediate rise of demand in March and was higher by 18.1% than average value.

The second quarter was characterised by lowered level of filters sale whereas indexes were lower by 3.5%, 27.5% and 24.3% than reference level. As a result of seasonal variations in ensuing five months heightened purchase level was registered. Maximal value of filters sale, generated by carrying out the services, was registered from September until November whereas indexes came to 77.9%, 68.5% and 42.6% respectively above average value. December was characterised by low demand and index which came to 64.6% below reference level.

4. Summary

Logistic actions are multilevel that is why it should be analysed in various aspects. Micro logistics, which serves as the basis of logistics pyramid organizes and controls managing processes in respect of particular transactors. Distribution of spare parts for guarantee and after guarantee services of tractors is one of the elements of sales and marketing companies' logistics. Logistic service of customer provided after post-transaction stage leads to tightening and prolongation of cooperation between the company and the tractors' user. Infallible deliveries of spare parts and service provides customer with proper exploitation of purchased tractors.

Identifying various aspects of periodicity and seasonal indexes value may serve as the basis for applicative procedures in domestic sales and marketing companies. Adjusting the level of spare parts supplies to changeable demand as well as panning the level of exploitation of Service Department in particular time of the year leads to decrease of costs therefore increases competitiveness of the company.

On the basis of analysis of research results following conclusions may be formulated:

- the layout of the amount and value of purchased filters for tractors in 2003 revealed relation between the course and intensity of spring and autumn field works.
- Characteristics of layout of the amount and value of sold filters for 2004 resulted from the structure of implemented agricultural procedures within the space of several ensuing months with local maximum at the end of the third quarter.
- Periods of increased demand for filters from analysed group for 2005 with respect of quantitative and value layout appeared exactly when the calendar of agricultural procedures suggested preplanting cultivation and sowing as well as after harvesting and root plants lifting.
- The analysis of seasonal indexes confirmed the relation between the amount and value of sales for selected group of Zetor tractors filters and field works organised in accordance to the calendar of agricultural procedures.

5. References

[1] Aczel, A.D. 2002: Complete Business Statistics, 4th ed., Richard D. Irwin/McGraw-Hill, Boston.
[2] Agrotechnika roślin uprawnych, 2005: Praca zbiorowa pod red. St. Karczmarczyka, Wyd. Akademii Rolniczej w Szczecinie, Szczecin.
[3] Agrotechnologia, 1999: Praca zbiorowa pod red. J. Banasiaka, Wyd. Naukowe PWN, Warszawa – Wrocław.
[4] Brilman J. 2000, Nowoczesne koncepcje i metody zarządzania, Polskie Wydawnictwo Ekonomiczne, Warszawa.
[5] Blanchard B.S.1998, Logistics engineering and management, Prentice Hall, Upper Saddle River, New Jersey.
[6] Ballou R.H., 1999: Business Logistics Management. Planning,Organizing and Controlling the Supply Chain, Prentice – Hall, Englewood Cliffs, New Jersey.
[7] Chaberek M. 2005, Makro- i mikroekonomiczne aspekty wsparcia logistycznego, Wyd. Uniwersytet Gdański, Gdańsk.
[8] Ciesielski M. 2003, Logistyka w praktyce – studium przypadków, Wyd. Akademia Ekonomiczna, Poznań.
[9] Coyle J.J., Bardi E.J., Langley C.J., 1996: The Management of Business Logistics, West Publishing Company, New York.
[10] Dwiliński L., 2006: Zarys logistyki przedsiębiorstwa, Oficyna Wyd. Politechniki Warszawskiej, Warszawa.
[11] Krawczyk S. 2001, Zarządzanie procesami logistycznymi, Polskie Wydawnictwo Ekonomiczne, Warszawa.
[12] Kempny D., 2001: Logistyczna obsługa klienta, Polskie Wyd. Ekonomiczne, Warszawa.
[13] Logistyka dystrybucji – Specyfika, Tendencje rozwojowe, Dobre praktyki, 2005: Praca zbiorowa pod red. K. Rutkowskiego, Wyd. Szkoła Główna Handlowa, Warszawa.
[14] Mentzer, J.T., Flint, D.J., Hult G.T.M., 2001: Logistics service quality as a segment-customized process, Journal of Marketing, Volume 65, Issue 4, pp. 82–104.
[15] Pułaska – Turyna B., 2005: Statystyka dla ekonomistów, Wyd. Difin, Warszawa.
[16] Skrobacki A., Ekielski A., 2006: Pojazdy i ciągniki rolnicze, Wyd. Wieś Jutra, Warszawa.
[17] Sobczyk M., 2006: Statystyka – aspekty praktyczne i teoretyczne, Wyd. UMCS, Lublin.
[18] Statystyka ogólna, 2002: Praca zbiorowa pod redakcją M. Woźniaka, Wyd. Akademii Ekonomicznej, Kraków.
[19] Starzyńska W., 2005: Statystyka praktyczna, Wyd. Naukowe PWN, Warszawa.
[20] Steczkowski J., 2005: Opis statystyczny – pozyskiwanie, przetwarzanie, i analizowanie informacji, Wyd. Wyższej Szkoły Informatyki i Zarządzania w Rzeszowie, Rzeszów.
[21] Teoria i praktyka modelowania systemów logistycznych, 2004: Praca zbiorowa pod redakcją I.K. Hejduk, Wyd. Politechnika Koszalińska, Koszalin.

ANALIZA WYNIKÓW SPRZEDAŻY WYBRANEJ GRUPY CZĘŚCI ZAMIENNYCH DO CIĄGNIKÓW ROLNICZYCH

Streszczenie

Przedstawiono zagadnienia logistyczne realizowane przez przedsiębiorstwo handlowo-usługowe pracujące w sektorze obsługi rolnictwa. Zaprezentowano wyniki badań i ich analizę dla sprzedaży wybranej grupy części zamiennych niezbędnych do wykonania usług przeglądów gwarancyjnych i 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 ilości i wartości sprzedanych części zamiennych poddano analizie w aspekcie kalendarza zabiegów agrotechnicznych zalecanego dla upraw na terenie Polski.