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THE IMPACT OF THE ORGANISATION OF TRANSPORT PROCESSES ON THE EFFICIENT USE OF A FLEET OF VEHICLES

Summary. Running business activity in the field of transport requires managing people to coordinate many factors at the same time. The most important factor for the functioning of an enterprise is the planning of execution of transport orders, which is an inherent element of effective management of a fleet of vehicles. The management of logistics and transport is a field of science derived from economic practice, therefore, real events occurring in an enterprise providing transport services at the national and international level were examined. Research and analysis of transport processes were conducted in an enterprise from the TSL sector functioning in the European Union in the aspect of efficient use of a fleet of vehicles.

Keywords: transport corridor, vehicle fleet, transport company

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1. INTRODUCTION

The development of national and international transport services requires that shippers constantly improve their knowledge of stages and all procedures related to the acquisition of transport orders and relocation of cargos, and methods of planning of transports [16,21,13,15,17]. In the environment of entrepreneurs from the TSL (Transport, Spedition, Logistics) sector, the need for planning of transports with the use of appropriate methods is developing despite difficulties [5]. Therefore, the key element to achieve success under conditions of the growing competition is not only to develop appropriate planning actions from the point of view of an entrepreneur, but also the awareness of the benefits resulting from execution of well-planned transport processes [2,3,7,19]. Therefore, transport enterprises that want to achieve organisational efficiency should plan and execute transport processes [6,8,9,14,18]. Nowadays, planning is a key indicator of development in transport companies; the following parameters are becoming increasingly important regarding services: comprehensiveness of service, promptness and flexibility of actions [12]. Finally, the most important factor in this aspect is the improvement of the transport process through, among others, shortening the time of its execution, speedy and on-time deliveries [1,4,11,20].

2. EFFICIENCY OF TRANSPORT PROCESSES

Considering the issues of transport efficiency, it must be emphasised that its basic condition is the efficiency of transport processes. In this aspect, making assessments in due time allows early identification of positive and negative tendencies and allows to rationally control the process of transport and effective use of a fleet of vehicles. Therefore, the following rates can be applied in the assessment [10]:

- Time of transport (duration of journey t_h on the route h) – time of departure of the means of transport from the starting to end point (1) [10]

$$t_h = t_{jh} + t_{wh}\ [hour, minute] \tag{1}$$

where:
t_{jh} – driving time on the route h, that is, when the vehicle is constantly moving,
t_{wh} – time of stopover of a vehicle (for example, mandatory breaks resulting from regulations concerning working time of a driver).

- Time of driving t_h^o on the route h – time of driving in both sides, including time of loading and unloading (2) [10]

$$t_h^o = 2(t_h + \Delta t)\ [hour, minute] \tag{2}$$

where:
Δt – time of loading/unloading.

- A significant parameter of logistic planning is operating speed of a vehicle V_h^e on the route h, which is the ratio of route to a vehicle to its working time in a unit of time (3) [10]

$$V_h^e = \frac{L_h}{T_{ph}}\ [km/h] \tag{3}$$

where:
L_h – route distance,
T_{ph} – working time of a vehicle and all accompanying actions [hour].

- Technical speed of a vehicle V_h^t on the route h, which is the ratio of the route to a vehicle to driving time in a unit of time (4) [10]

$$V_h^t = \frac{L_h}{T_{jh}} = \frac{V_h^e}{V_h^t} \ [km/h] \tag{4}$$

where:
L_h – distance of a route [km],
T_{jh} – driving time of a vehicle on the route h [hour].

3. AN ANALYSIS OF TRANSPORT PROCESSES IN A REAL OBJECT

A careful analysis was conducted on transports executed by the examined transport enterprise in May 2019, of which the subject is transport within standing orders. An initial analysis showed a very long time of loading on section 23, that is, 3 hours 55 minutes. Whereas, the longest time of unloading was1 hour 45 minutes on section 22 (Table 1).

Tab. 1

An analysis of transport processes in May 2019

ROUTE	SECTION NUMBER	DATE OF DEPARTURE	HOUR OF DEPARTURE	PLACE OF DEPARTURE	DISTANCE [km]	CARGO [t]	DATE OF ARRIVAL	HOUR OF ARRIVAL	TIME OF LOADING [h]	TIME OF UNLOADING [h]	TIME OF PAUSE ON A ROUTE SECTION [h]	DAILY REST [h]	TOTAL FUEL CONSUMPTION [l]
1	1	2019-05-04	07:57	JASŁO - BYSTRE (SK)	120	0	2019-05-04	12:00	0:42		0:52		32
	2	2019-05-04	12:42	BYSTRE (SK) - JASŁO	120	24	2019-05-04	15:36				13:39	40
2	3	2019-05-05	05:15	JASŁO - STRASZYN	670	24	2019-05-05	16:45		1:00	1:50	13:45	200
	4	2019-05-06	07:30	STRASZYN - GDYNIA	36	0	2019-05-06	08:00	1:40				10
	5	2019-05-06	09:40	GDYNIA - WIELKA WIEŚ	605	24	2019-05-06	18:10			1:00	11:10	193
	6	2019-05-07	05:20	WIELKA WIEŚ - JASŁO	172	24	2019-05-07	09:20		0:45			52
3	7	2019-05-11	09:40	JASŁO - MICHALOVCE (SK)	150	0	2019-05-11	13:39	0:56		1:00		39
	8	2019-05-11	14:35	MICHALOVCE (SK) - JASŁO	150	18	2019-05-11	17:35				13:30	45
4	9	2019-05-12	07:05	JASŁO - OLSZYNA	605	18	2019-05-12	16:15			1:05	13:05	180
	10	2019-05-13	05:20	OLSZYNA - NAUEN (D)	215	18	2019-05-13	08:45		0:35	0:45		65
	11	2019-05-13	09:20	NAUEN (D) - GUBIN	203	0	2019-05-13	12:35	2:00			10:25	50
	12	2019-05-14	01:00	GUBIN - JASŁO	626	24	2019-05-14	13:00			2:00	18:11	200
5	13	2019-05-15	07:11	JASŁO - HUMENNE (SK)	110	24	2019-05-15	10:30		1:10	0:50		34
	14	2019-05-15	11:40	HUMENNE (SK) - MICHALOVCE (SK)	27	0	2019-05-15	12:20	2:00				6,6
	15	2019-05-15	14:20	MICHALOVCE (SK) - JASŁO	150	15	2019-05-15	17:00					45
6	16	2019-05-17	09:10	JASŁO - OLSZYNA	605	15	2019-05-17	19:10			1:10	11:00	182
	17	2019-05-18	06:10	OLSZYNA - BERLIN (D)	150	15	2019-05-18	08:55		0:35	0:45		45
	18	2019-05-18	09:30	BERLIN (D) - ŻARY	186	0	2019-05-18	12:25	1:35			12:00	38
	19	2019-05-19	02:00	ŻARY - JASŁO	573	24	2019-05-19	11:00			1:25	19:00	184
7	20	2019-05-20	06:00	JASŁO - PRESOV (SK)	120	24	2019-05-20	09:20		1:00	1:00		35
	21	2019-05-20	10:20	PRESOV (SK) - JASŁO	120	0	2019-05-20	12:30	2:30				30
8	22	2019-05-23	05:00	JASŁO - ŁÓDŹ	350	18	2019-05-23	12:45		1:45	0:45		105
	23	2019-05-23	14:30	ŁÓDŹ - STRYKÓW	35	0	2019-05-23	15:05	3:55			9:00	7,2
	24	2019-05-24	04:00	STRYKÓW - JASŁO	375	6	2019-05-24	11:30			0:50	18:30	95

	25	2019-05-25	06:00	JASŁO - HUMENNE (SK)	120	6	2019-05-25	08:30		0:50			25
9	26	2019-05-25	09:20	HUMENNE (SK) - MICHALOVCE (SK)	28	0	2019-05-25	11:05	1:45		0:55		7
	27	2019-05-25	12:50	MICHALOVCE (SK) - JASŁO	150	18	2019-05-25	15:50					45
	28	2019-05-28	04:30	JASŁO - ŁÓDŹ	350	18	2019-05-28	12:15		1:10	0:45		135
10	29	2019-05-28	13:25	ŁÓDŹ - RADOMSKO	90	0	2019-05-28	14:45	2:15			9:05	25
	30	2019-05-29	02:05	RADOMSKO - JASŁO	257	9	2019-05-29	06:30		1:00			70

Conducted analysis showed that standard deviation regarding the average value is 82%, fuel consumption on the section, 88%, whereas, time of daily rest, 26% (Table 2).

Tab. 2

The results of analyses – May 2019

MONTHLY SUMMARY	DISTANCE [km]	TIME OF LOADING [h]	TIME OF UNLOADING [h]	TIME OF PAUSE ON A ROUTE SECTION [h]	DAILY REST [h]	TOTAL FUEL CONSUMPTION [l]
Month in total V	7468	19:18:00	9:50:00	16:57:00	172:20:00	2 219,8
Average	249	1:55	0:59	1:03	13:15	74,0
Maximum	670	3:55	1:45	2:00	19:00	200,0
Minimum	27	0:42	0:35	0:45	9:00	6,6
Variance	40672	0:47	0:07	0:08	11:39	4114,9
Standard deviation	205	0:53	0:20	0:22	3:24	65,2
Standard deviation / Average [%]	82	46	35	36	26	88

As a result of the conducted research, further section parameters were calculated and contained in Table 3.

Tab. 3

An analysis of section parameters in May 2019

SECTION NUMBER	DATE	DISTANCE [km]	SHIPPING WORK [tkm]	TIME OF TRANSPORT [h]	DRIVING TIME [h]	WORKTIME [h]	OPERATING SPEED [km/h]	TECHNICAL SPEED [km/h]	THE RATE OF WORKTIME USE	FUEL CONSUMPTION [l]	CONSUMPTION [l/100 km]
1	2019-05-04	120	0	04:03	03:11	04:45	29,6	37,7	0,85	32	26,7
2	2019-05-04	120	2 880	02:54	02:54	02:54	41,4	41,4	1,00	40	33,3
3	2019-05-05	670	16 080	11:30	09:40	12:30	58,3	69,3	0,92	200	29,9
4	2019-05-06	36	0	00:30	00:30	02:10	72,0	72,0	0,23	10	27,8
5	2019-05-06	605	14 520	08:30	07:30	08:30	71,2	80,7	1,00	193	31,9
6	2019-05-07	172	4 128	04:00	04:00	04:45	43,0	43,0	0,84	52	30,2
7	2019-05-11	150	0	03:59	02:59	04:55	37,7	50,3	0,81	39	26,0
8	2019-05-11	150	2 700	03:00	03:00	03:00	50,0	50,0	1,00	45	30,0
9	2019-05-12	605	10 890	09:10	08:05	09:10	66,0	74,8	1,00	180	29,8
10	2019-05-13	215	3 870	03:25	02:40	04:00	62,9	80,6	0,85	65	30,2
11	2019-05-13	203	0	03:15	03:15	05:15	62,5	62,5	0,62	50	24,6
12	2019-05-14	626	15 024	12:00	10:00	12:00	52,2	62,6	1,00	200	31,9
13	2019-05-15	110	2 640	03:19	02:29	04:29	33,2	44,3	0,74	34	30,9
14	2019-05-15	27	0	00:40	00:40	02:40	40,5	40,5	0,25	7	24,4

15	2019-05-15	150	2 250	02:40	02:40	02:40	56,3	56,3	1,00	45	30,0
16	2019-05-17	605	9 075	10:00	08:50	10:00	60,5	68,5	1,00	182	30,1
17	2019-05-18	150	2 250	02:45	02:00	03:20	54,5	75,0	0,83	45	30,0
18	2019-05-18	186	0	02:55	02:55	04:30	63,8	63,8	0,65	38	20,4
19	2019-05-19	573	13 752	09:00	07:35	09:00	63,7	75,6	1,00	184	32,1
20	2019-05-20	120	2 880	03:20	02:20	04:20	36,0	51,4	0,77	35	29,2
21	2019-05-20	120	0	02:10	02:10	04:40	55,4	55,4	0,46	30	25,0
22	2019-05-23	350	6 300	07:45	07:00	09:30	45,2	50,0	0,82	105	30,0
23	2019-05-23	35	0	00:35	00:35	04:30	60,0	60,0	0,13	7	20,6
24	2019-05-24	375	2 250	07:30	06:40	07:30	50,0	56,3	1,00	95	25,3
25	2019-05-25	120	720	02:30	02:30	03:20	48,0	48,0	0,75	25	20,8
26	2019-05-25	28	0	01:45	00:50	03:30	16,0	33,6	0,50	7	25,0
27	2019-05-25	150	2 700	03:00	03:00	03:00	50,0	50,0	1,00	45	30,0
28	2019-05-28	350	6 300	07:45	07:00	08:55	45,2	50,0	0,87	135	38,6
29	2019-05-28	90	0	01:20	01:20	03:35	67,5	67,5	0,37	25	27,8
30	2019-05-29	257	2 313	04:25	04:25	05:25	58,2	58,2	0,82	70	27,2

Thereafter, data were integrated to obtain daily values using a pivot table (Table 4).

Tab. 4

An analysis of data in May 2019

DATE	SUM OF DISTANCE [km]	SUM OF SHIPPING WORK [tkm]	SUMA OF TIME OF TRANSPORT [h]	SUM OF DRIVING TIME [h]	SUM OF WORKTIME [h]	SUM OF FUEL CONSUMPTION [l]
2019-05-04	240	2 880	6:57	6:05	7:39	72,0
2019-05-05	670	16 080	11:30	9:40	12:30	200,0
2019-05-06	641	14 520	9:00	8:00	10:40	203,0
2019-05-07	172	4 128	4:00	4:00	4:45	52,0
2019-05-11	300	2 700	6:59	5:59	7:55	84,0
2019-05-12	605	10 890	9:10	8:05	9:10	180,0
2019-05-13	418	3 870	6:40	5:55	9:15	115,0
2019-05-14	626	15 024	12:00	10:00	12:00	200,0
2019-05-15	287	4 890	6:39	5:49	9:49	85,6
2019-05-17	605	9 075	10:00	8:50	10:00	182,0
2019-05-18	336	2 250	5:40	4:55	7:50	83,0
2019-05-19	573	13 752	9:00	7:35	9:00	184,0
2019-05-20	240	2 880	5:30	4:30	9:00	65,0
2019-05-23	385	6 300	8:20	7:35	14:00	112,2
2019-05-24	375	2 250	7:30	6:40	7:30	95,0
2019-05-25	298	3 420	7:15	6:20	9:50	77,0
2019-05-28	440	6 300	9:05	8:20	12:30	160,0
2019-05-29	257	2 313	4:25	4:25	5:25	70,0
Final sum	7 468	123 522	139:40:00	122:43:00	168:48:00	2 219,8
Average daily value	415	6 862	7:45:33	6:49:03	9:22:40	123,3
Maksimum	670	16 080	12:00	10:00	14:00	203
Minimum	172	2 250	4:00	4:00	4:45	52

4. FUEL CONSUMPTION IN THE EXAMINED TRANSPORT ENTERPRISE

Fuel consumption in the function of the length of the route section was presented as a result of conducted research in a real object (Fig. 1).

Based on the conducted analysis, it was found that transport on May 28, 2019, between Jasło and Łódź, 350 km long, was characterised by excessive consumption. As many as 3 transports exceeded average consumption, hence, the resulting average consumption in a month was 30,44 l/100 km.

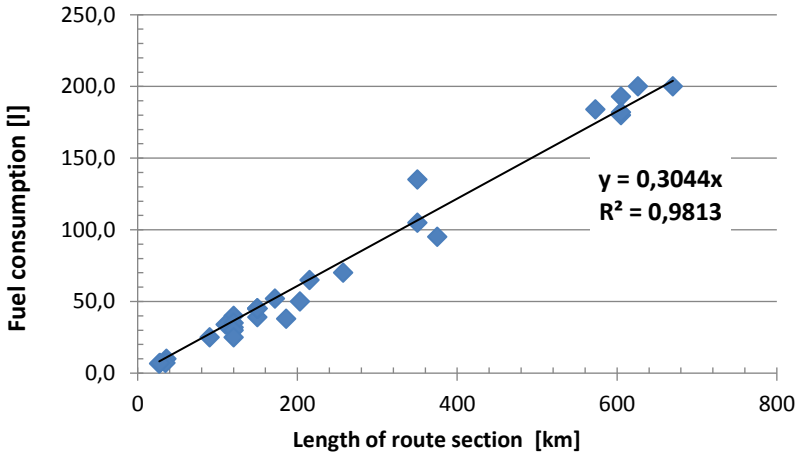

Fig. 1. Fuel consumption in the function of length of route in May 2019

5. THE EXECUTION OF SELECTED TRANSPORT PROCESSES IN THE EXAMINED ENTERPRISE IN A SELECTED TRANSPORT CORRIDOR

There is a limitation in international transport, that is, the number of border crossings available for freight traffic. Therefore, on the route between Jasło and Nauen or between Jasło and Berlin, there is no alternative route other than Jasło – Tarnów A4 – A18 (Fig. 2). However, this distance is too long to be covered in one day; therefore, daily rest is taken in the route at the border crossing in Olszyna. However, the journey to Olszyna is also made at the limit of maximum reach and continuation of driving from the preceding day needs a considered daily rest in the Cracow area.

Other limitations that should be considered in designing the routes are connected with the rigid deadline of execution of loading works. It particularly refers to loading in Gdynia and routes to Nauen and Berlin. Moreover, it is necessary to obey general standard worktime for professional drivers, particularly norms of long driving time and application of pauses.

6. CONCLUSIONS

Ensuring proper efficiency of a transport system is achieved because of the execution of transport tasks at the required level of quality with proper use of transport potential in a transport enterprise. Therefore, planning and execution of transport processes require a broad knowledge of stages and procedures related to relocation of cargos from the planners and a chronic development of the methods of planning of international transports. Furthermore, the goal of every transport enterprise is to become market-competitive through, primarily, increasing efficiency of services offered in the Just-in-Time system.

The actions presented in this article in the aspect of improvement of transport processes and better use of a fleet of vehicles may also contribute to the effective functioning of the whole supply chain because the acceleration of execution of transport processes and increase of flexibility, as well as coordination of particular links of a logistic chain, are necessary. The approach applied allows shortening the driving time and reducing the costs of transport, resulting in more effective disposal of transport potential in an enterprise, whereas, in the context of the complete logistic chain, it allows shortening the time of circulation of cargos.

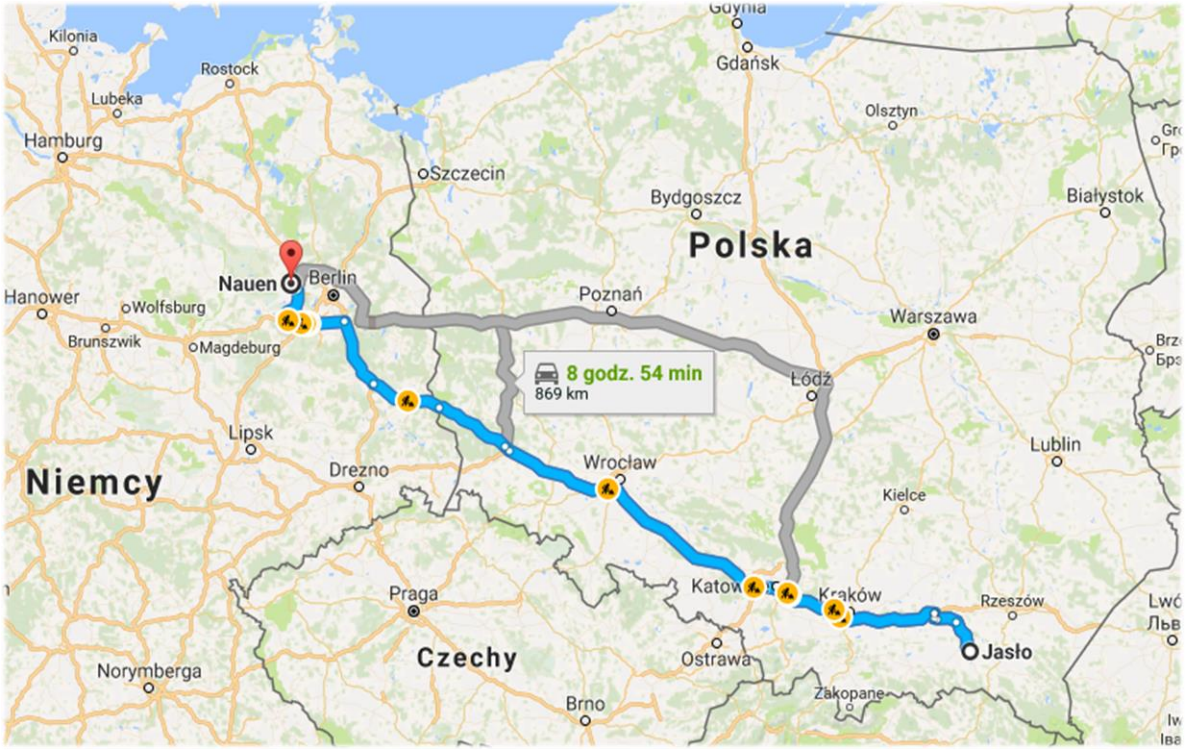

Fig. 2. The variants of the route between Jasło and Nauen

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