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# STRATEGY FOR THE IMPLEMENTATION OF TRANSPORT PROCESSES TOWARD IMPROVING SERVICES

**Summary.** The current situation in the commodities market has forced suppliers to change their ways of satisfying customer needs. The supply chain aims to deliver raw materials, semi-finished products and finished products to the right place at the right time, incurring the lowest costs. Therefore, high-quality transport services have become indispensable in competing with other entities, enterprises are guided by the timeliness of deliveries in the Just-in-Time and Door-to-Door systems, and the costs incurred. Hence, to ensure that the pursued actions are implemented effectively, it is imperative to apply a process strategy comprising a characteristic component of the transport process management that would have a significant impact on the improvement of the services provided. In this paper, the authors conducted research on a real object of cargo transport on fixed routes and established a concept of streamlining the transport processes carried out at a company. The improvement concept proposed by the authors permits

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the minimization of the time of loading operations on routes related to a specific load. The result is a reduced total time of cargo transport, which offers the possibility of taking more orders at the studied company.

**Keywords:** shipping process, service quality, transport order, transport fleet

## 1. INTRODUCTION

Dynamic economic development has had a substantial impact on transport, which has formed the basis of a thriving enterprise in the goods and services market. To avoid excessive costs and save time, companies without their own rolling stock began using the services of other specialized companies [1, 4, 6, 7]. Partnering with new business partners led to the creation of a supply chain in which transport plays a key role [20]. Transport companies are entities that condition the correct flow of goods from suppliers to recipients [11]. Delays that occur during cargo transport adversely affect the entire supply chain. Thus, an important issue is the analysis of the implemented routes to improve the transport process and prevent undesirable situations that impede transport [2, 10, 13, 15]. Since the transport service market creates a huge scale of competition, entrepreneurs seek to achieve an advantage in terms of modernity, speed, and the quality of services provided [3, 8-9, 14].

The concept of supply chain management as a management strategy is based on cooperation centered on linking business operations between enterprises to achieve a common vision of market opportunities [17, 19, 22]. Therefore, running a transport company is associated with the management of key processes, which include fleet management and transport processes [24-25]. Therefore, management of the transport process should be regarded as a sequence of mutual interactions that transform the input state into the initial state, implementing the plan of delivering goods to the customer in line with the Just-in-Time and Door-to-Door principle [12, 16, 23].

This article analyzed the number of services provided by regular and other business partners as well as the number of orders carried out with their own fleet and through forwarding at a company in the years 2019-2020. A comparative analysis of transport processes carried out on fixed routes in the examined enterprise was carried out. Based on the analysis, the authors posited a concept of improving the transport processes by reducing the times of loading operations. The improvement was carried out using operational parameters indicators: transport time, operational speed, and vehicle performance.

## 2. CHARACTERIZATION OF THE TRANSPORT COMPANY STUDIED

The investigated company provides services in the transport of goods by road in Poland. The transported load consists of building materials and furniture boards. In 2017, the company purchased its first truck tractor unit. The turn of 2018-2019 was a crucial time due to the long-standing cooperation with companies that became their main customers, contributing to the expansion of the carrier's fleet by another 2 sets of tractor units with trailers in 2019 (Figure 1).

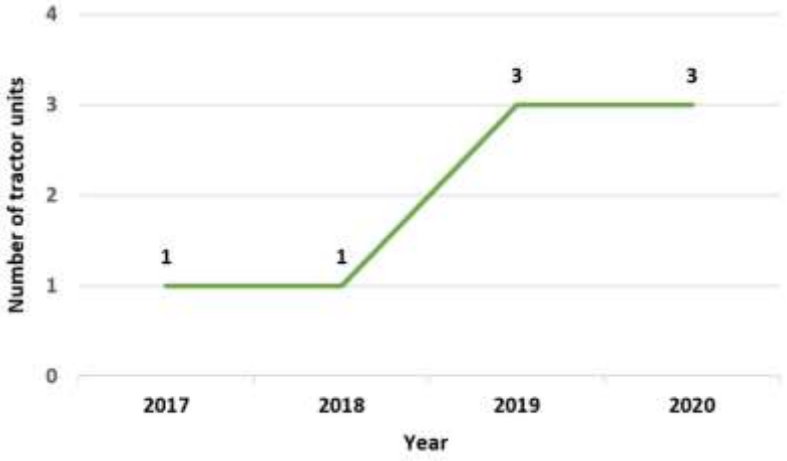


Fig. 1. Development of rolling stock at the turn of 2017-2020 at the enterprise

The company's fleet includes only Scania tractor units with mega curtain trailers. The specification of mega semi-trailers is as follows: length of 13.61 m, a width of 2.48 m, a lowered structure and smaller wheels. As a result, the cargo space can be increased up to 3 m while maintaining the requirement not to exceed the maximum vehicle height of 4 m. The sides are covered with a curtain, allowing for quick loading and unloading from the side, back and top due to the use of a raised roof. The height of the loading space can be adjusted in the range of 2.9 - 3 m, for example, to match the load to the vehicle [21] (Figure 2).

As a result of the research carried out on a real object, the analysis of the transport process was presented in the form of an algorithm (Figure 3).

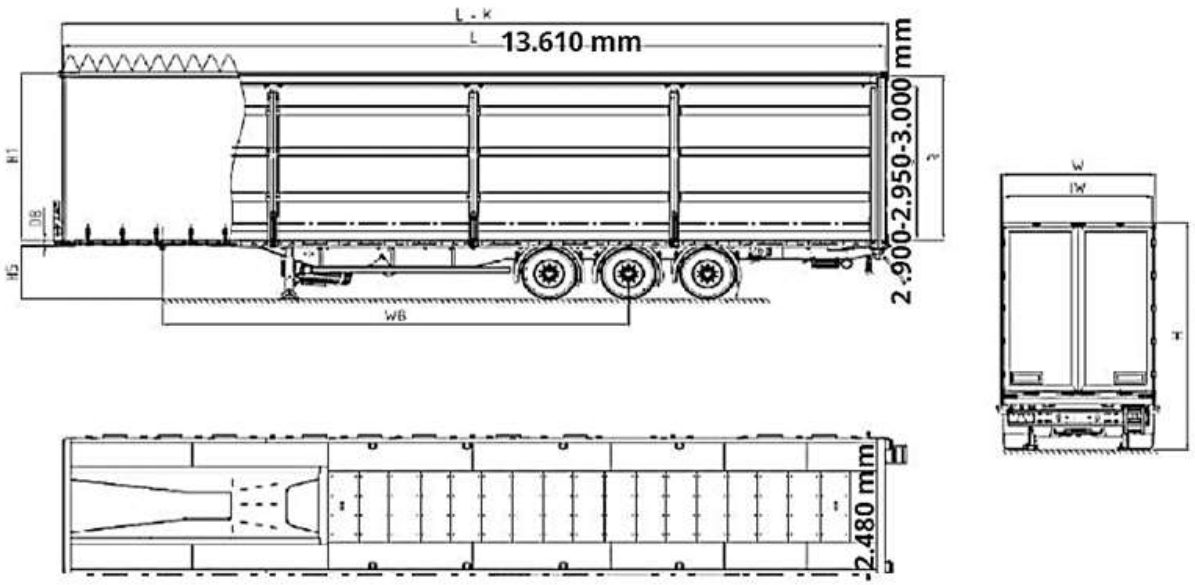


Fig. 2. Cross-section of a mega curtain semi-trailer [21]

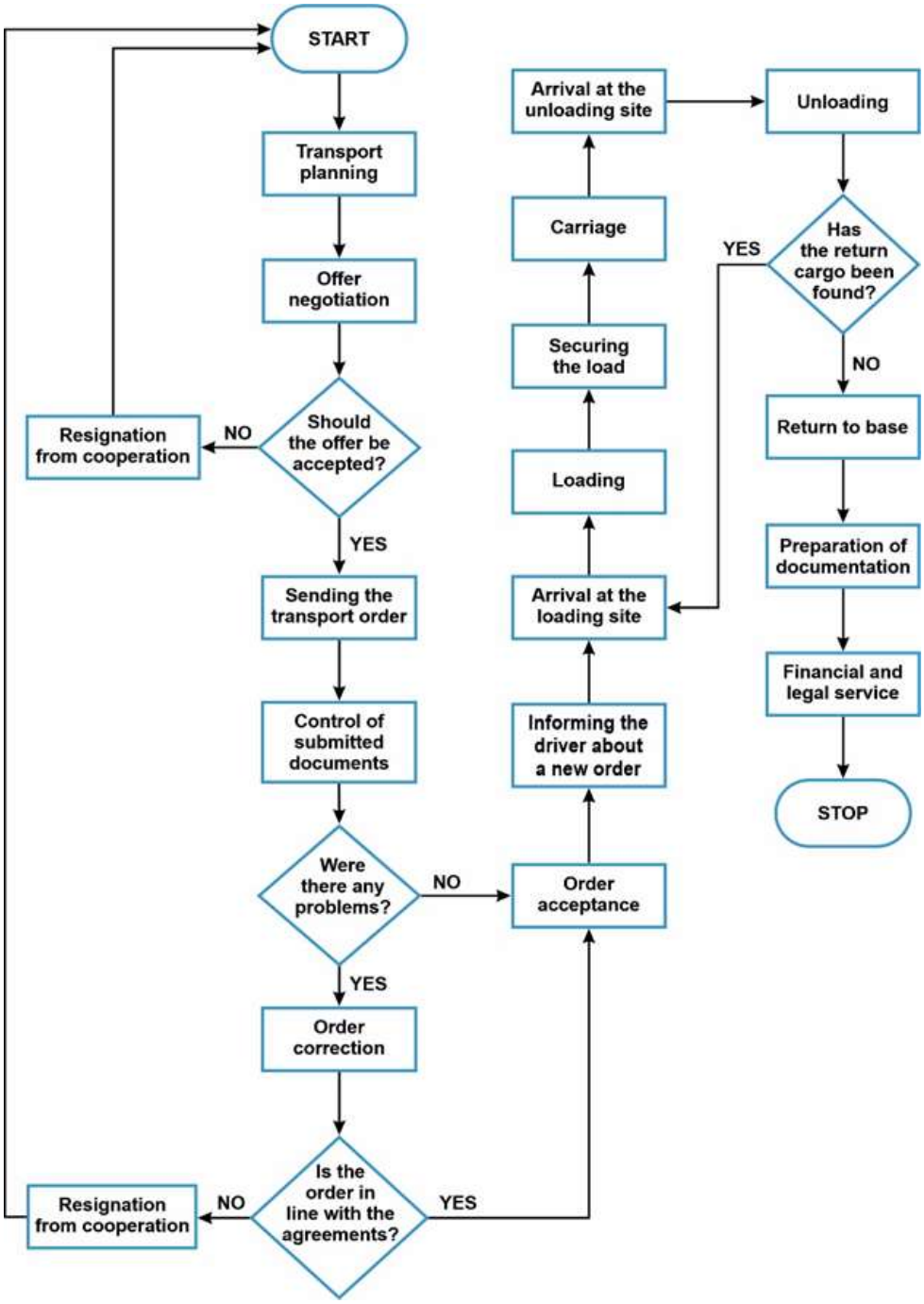


Fig. 3. Organization of the transport process at the enterprise

Based on the analysis of the company, the business partners with whom cooperation was usually undertaken for the total number of completed orders were indicated. In 2018, the most frequent cooperation took place with contractors no. 3 and 4, which accounted for 54.3% and 19.8%, respectively, of all orders. The remaining 25.9% of executed orders were from other contractors who were not regular customers of the analyzed carrier. In 2019, there was an increase in the total number of transport services provided by 349, representing an increase in the number of services delivered by 177%. The recorded progress stemmed from the development of the carrier's rolling stock and the cooperation established with contractor no. 2,

for whom 187 transport services were implemented yearly, amounting to 34.2% of all orders. In 2019, contractor no. 3 was provided 159 services, which accounted for 29.1% of all orders. Comparing 2020 to 2019, there was an increase in the number of services provided by 176% (416 more completed orders compared to the previous year). Contractors no. 1 and 2 represent 54.3% of all orders in 2020 at a level of 523 services provided (Figure 4).

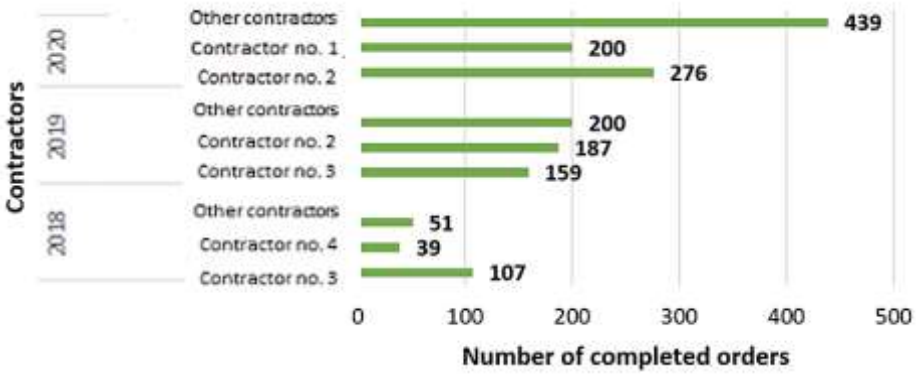


Fig. 4. Business partners of the company at the turn of 2018-2020 [18]

Based on the analysis and the adopted growth rate of the number of services provided at the level of 176%, an increase in the number of completed orders by 2023 was forecast. In effect, the most favorable variant of the company's development was presented, assuming no disruptions in the execution of orders related to the technical aspects of the carrier's rolling stock, staffing problems and external factors, for example, changes in legal regulations or epidemiological situation (Figure 5).

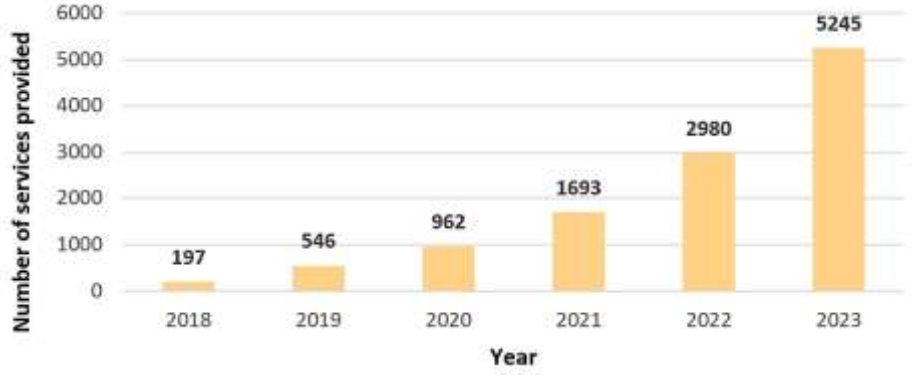


Fig. 5. Forecast growth in the number of services provided until 2023 at the enterprise

## 3. ANALYSIS OF TRANSPORT PROCESSES CARRIED OUT AT THE ENTERPRISE

The analysis covered the service recipients for the number of services rendered for regular contractors and others, and the number of services provided by own transport and forwarding (Table 1).

Tab. 1

Source data of the services provided in 2019-2020 at the enterprise.

| | YEAR 2019 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Month | Number of services provided to regular contractors | Number of services provided to other contractors | Total | Structure of the share of regular contractors in all services provided [%] | Number of services provided by own fleet | Number of forwarding services provided | Structure of the number of services provided by own fleet [%] | Structure of the number of services provided by forwarding [%] |
| **January** | 6 | 10 | 16 | 38 | 16 | 0 | 100 | 0 |
| **February** | 6 | 9 | 15 | 40 | 15 | 0 | 100 | 0 |
| **March** | 32 | 5 | 37 | 86 | 37 | 0 | 100 | 0 |
| **April** | 32 | 10 | 42 | 76 | 42 | 0 | 100 | 0 |
| **May** | 34 | 15 | 49 | 69 | 36 | 13 | 73 | 27 |
| **June** | 23 | 35 | 58 | 40 | 49 | 9 | 84 | 16 |
| **July** | 41 | 31 | 72 | 57 | 65 | 7 | 90 | 10 |
| **August** | 37 | 20 | 57 | 65 | 57 | 0 | 100 | 0 |
| **September** | 38 | 17 | 55 | 69 | 55 | 0 | 100 | 0 |
| **October** | 39 | 21 | 60 | 65 | 60 | 0 | 100 | 0 |
| **November** | 28 | 23 | 51 | 55 | 51 | 0 | 100 | 0 |
| **December** | 29 | 5 | 34 | 85 | 34 | 0 | 100 | 0 |
| | **YEAR 2020** | | | | | | | |
| Month | Number of services provided to regular contractors | Number of services provided to other contractors | Total | Structure of the share of regular contractors in all services provided [%] | Number of services provided by own fleet | Number of forwarding services provided | Structure of the number of services provided by own fleet [%] | Structure of the number of services provided by forwarding [%] |
| **January** | 44 | 18 | 62 | 71 | 62 | 0 | 100 | 0 |
| **February** | 43 | 29 | 72 | 60 | 71 | 1 | 99 | 1 |
| **March** | 35 | 37 | 72 | 49 | 72 | 0 | 100 | 0 |
| **April** | 19 | 50 | 69 | 28 | 69 | 0 | 100 | 0 |
| **May** | 33 | 37 | 70 | 47 | 70 | 0 | 100 | 0 |
| **June** | 43 | 38 | 81 | 53 | 81 | 0 | 100 | 0 |
| **July** | 127 | 47 | 174 | 73 | 164 | 10 | 94 | 6 |
| **August** | 90 | 24 | 114 | 79 | 101 | 13 | 89 | 11 |
| **September** | 23 | 38 | 61 | 38 | 42 | 19 | 69 | 31 |
| **October** | 26 | 45 | 71 | 37 | 46 | 25 | 65 | 35 |
| **November** | 22 | 39 | 61 | 36 | 44 | 17 | 72 | 28 |
| **December** | 18 | 37 | 55 | 33 | 45 | 10 | 82 | 18 |

In 2019, there was an upward trend in the number of services provided throughout the months, as a result of which 546 orders were completed during the year, and of these, 517 were carried out by the company's own fleet. Throughout the months, an average of 46 transport orders were carried out. At the turn of January and April, a significant increase of 15 to 42 orders was recorded. In February, the impact of establishing cooperation with regular business partners became visible, constituting 86% of the services provided. From May to July 2019, the provision of forwarding services recorded 5.3% of the annual number of fulfilled orders. From August to November, the company only used its own fleet and oscillated around 60 orders per month. In December, there was a decrease to 34 services rendered, of which 85% involved regular contractors. In 2020, the number of performed services equaled 962. Compared to the previous year, the increase was 176%, which proves the carrier's rapid development. An increase in the average number of services performed during the month by 34 orders was also evident, which entailed a 174% improvement. The year 2020 recorded 95 forwarding services, representing 9.9% of all completed orders, that is, an increase of 4.6%.

The following routes were the subject of the analysis:

- **route no. 1**: Stare Żukowice - Pustków Osiedle - Wrocław - Oleśnica - Tarnów - Stare Żukowice,

- **route no. 2**: Stare Żukowice – Tarnów – Sucha Górna – Lubin – Dębica – Stare Żukowice,
- **route no. 3**: Stare Żukowice – Dębica – Kłodnica – Tarnów – Stare Żukowice.

As a result of the analysis of routes no. 1, 2 and 3 in 2019-2020, Tables 2-7 were prepared, including the route number, distinguished sections on the route, the date, time and place of departure and arrival, section distance, load weight, travel time and pause on the route, time of loading operations and total fuel consumption on the route section. Based on the source data, the following values were calculated: minimum, maximum, average and the sum of distances, driving time, pauses on sections, loading activities, total work, and total fuel consumption.

In 2019, route no. 1, totaling 860 km, was covered in 14 h 30 min. The total transport time included: driving – 11 h 05 min, pause while driving 1 h 35 min, loading 1 h 35 min, unloading 1 h 50 min. The route was completed within two working days. During the first day, 3 sections with a total length of 475 km were covered in 9 h 30 min. On the second day, the remaining 2 sections with a length of 385 km were driven within 6 h 35 min. During transport, the total fuel consumption was 260.4l, and the average consumption on the route section was 52.1l (Table 2).

Tab. 2

Source data for route no. 1 in 2019

| ROUTE: STARE ŻUKOWICE - PUSTKÓW OSIEDLE - WROCŁAW - OLEŚNICA - TARNÓW - STARE ŻUKOWICE | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Route number | Section | Route of section | Place of departure | Date of departure [day: month: year] | Hour of departure [hour: minute] | Distance [km] | Weight of load [t] | Driving time [h] | Pause time at the route [h] | Place of arrival | Hour of arrival [hour: minute] | Time of loading [h] | Time of unloading [h] | Total working time [h] | End of work [hour: minute] | Total fuel consumption [l] |
| 1 | 1 | Stare Żukowice-Pustków Osiedle | Stare Żukowice | 01.03.2019 | 06:00 | 45 | - | 00:40 | - | Pustków Osiedle | 06:40 | 00:50 | - | 01:30 | - | 9,3 |
| | 2 | Pustków Osiedle-Wrocław | Pustków Osiedle | 01.03.2019 | 07:30 | 400 | 20 | 05:00 | 00:50 | Wrocław | 13:20 | - | 01:00 | 06:00 | - | 125 |
| | 3 | Wrocław-Oleśnica | Wrocław | 01.03.2019 | 14:20 | 30 | - | 00:25 | - | Oleśnica | 14:45 | 00:45 | - | 01:10 | 15:30 | 7 |
| | 4 | Oleśnica-Tarnów | Oleśnica | 02.03.2019 | 06:00 | 370 | 24 | 04:40 | 00:45 | Tarnów | 11:25 | - | 00:50 | 05:30 | - | 115,6 |
| | 5 | Tarnów-Stare Żukowice | Tarnów | 02.03.2019 | 12:15 | 15 | - | 00:20 | - | Stare Żukowice | 12:35 | - | - | 00:20 | 12:35 | 3,5 |
| | | | | | **Sum** | **860** | - | **11:05** | **01:35** | - | - | **01:35** | **01:50** | **14:30** | - | **260,4** |
| | | | | | **Minimum** | 15 | - | 00:20 | 00:45 | - | - | 00:45 | 00:50 | 00:20 | - | 3,5 |
| | | | | | **Maximum** | 400 | - | 04:30 | 00:50 | - | - | 00:50 | 01:00 | 06:00 | - | 125 |
| | | | | | **Average** | 172 | - | 02:13 | 00:48 | - | - | 00:48 | 00:55 | 02:54 | - | 52,1 |

In 2020, there were changes during the transport process. The times were extended: total work was extended by 1 h 25 min, loading activities by 1 h 15 min, driving by 10 min and pauses on the section by 10 min. The route was covered in two working days. During the first day, three sections with a length of 475 km were covered in 10 h 55 min, and on the second day, the remaining two sections with a length of 385 km were driven in 6 h 45 min. As a result of the comparison to route no. 1 in 2019, it was observed that the travel time of sections 1-3 was extended by 1 h 25 min, while sections 4-5 were extended by 10 min. The extended loading and unloading times were associated with longer vehicle operations and the necessity to increase speed during transport, as a result of which, the fuel consumption on the route

increased by 19 liters, and the average fuel consumption on the route section grew by 3.8 liters (Table 3).

Tab. 3

Source data for route no. 1 in 2020

| ROUTE: STARE ŻUKOWICE - PUSTKÓW OSIEDLE - WROCŁAW - OLEŚNICA - TARNÓW - STARE ŻUKOWICE | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Route number | Section | Route of section | Place of departure | Date of departure [day: month: year] | Hour of departure [hour: minute] | Distance [km] | Weight of load [t] | Driving time [h] | Pause time at the route [h] | Place of arrival | Hour of arrival [hour: minute] | Time of loading [h] | Time of unloading [h] | Total working time [h] | End of work [hour: minute] | Total fuel consumption [l] |
| 1 | 1 | Stare Żukowice-Pustków Osiedle | Stare Żukowice | 01.03.2020 | 06:00 | 45 | - | 00:40 | - | Pustków Osiedle | 06:40 | 01:10 | - | 01:50 | - | 11,3 |
| | 2 | Pustków Osiedle-Wrocław | Pustków Osiedle | 01.03.2020 | 07:50 | 400 | 20 | 05:00 | 01:00 | Wrocław | 13:50 | - | 01:15 | 06:15 | - | 133,4 |
| | 3 | Wrocław -Oleśnica | Wrocław | 01.03.2020 | 15:05 | 30 | - | 00:40 | - | Oleśnica | 15:45 | 01:10 | - | 01:50 | 16:55 | 7,5 |
| | 4 | Oleśnica-Tarnów | Oleśnica | 02.03.2020 | 06:00 | 370 | 24 | 04:30 | 00:45 | Tarnów | 11:15 | - | 01:05 | 05:35 | - | 123,4 |
| | 5 | Tarnów-Stare Żukowice | Tarnów | 02.03.2020 | 12:20 | 15 | - | 00:25 | - | Stare Żukowice | 12:45 | - | - | 00:25 | 12:45 | 3,8 |
| | | | | | **Sum** | **860** | - | **11:15** | **01:45** | - | - | **02:20** | **02:20** | **15:55** | - | **279,4** |
| | | | | | **Minimum** | 15 | - | 00:25 | 00:45 | - | - | 01:10 | 01:05 | 00:25 | - | 3,8 |
| | | | | | **Maximum** | 400 | - | 04:30 | 01:00 | - | - | 01:10 | 01:15 | 06:15 | - | 133,4 |
| | | | | | **Average** | 172 | - | 01:53 | 00:53 | - | - | 01:10 | 01:10 | 03:11 | - | 55,9 |

In 2019, route no. 2 with a length of 1015 km was covered in 16 h 10 min. The total transport time included: driving 13 h 35 min, pause while driving 1 h 45 min, and loading activities 2 h 35 min. The route was covered in 2 days; on the first day, 510 km were covered in 9 h 20 min. The remaining two sections with a length of 505 km were covered in 9 h 5min the next day. During transport, the total fuel consumption was 321.5l and the average consumption on the route section was 64.3l (Table 4).

Due to the analysis of route no. 2 in 2020, there was an improvement in the total time needed to cover the route. The total working time on the route was 15 h 35 min. This progression proceeds from the reduction of driving time on sections no. 2 and 4 by 35 minutes and more efficient loading activities by 5 minutes. The time improvement negatively affected fuel consumption of 22.4 l on the entire route, which resulted from the increased speed during the transport with a load (Table 5).

From the study of route no. 3, it was observed that the route with a length of 450 km was covered in 9 h 25 min. The total transport time included the following times: driving - 6 h, loading activities 3 h 25 min. After unloading, the required pause of 1 h 05 min was completed on the second section. The remaining sections no. 3 and 4 were completed in 3 h 30 min, and work was finished at 6:30 p.m. During transport, the total fuel consumption was 141.4 l, and the average fuel consumption on the route section was 68.8 l (Table 6).

Based on the analysis of route no. 3, it was noticed that the route was covered 10 minutes faster than in the previous year. The 450 km route was covered in 1 working day. The reduction of the time needed for loading activities by 25 minutes had a positive effect on the total working time, despite the extended driving time of 15 minutes. There was a major increase in the total

fuel consumption on the route by 13.4 l and the average fuel consumption on the section by 3.3 l (Table 7).

Tab. 4

Source data for route no. 2 in 2019

| ROUTE: STARE ŻUKOWICE - TARNÓW - SUCHA GÓRNA - LUBIN - DĘBICA - STARE ŻUKOWICE | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Route number | Section | Route of section | Place of departure | Date of departure [day month: year] | Hour of departure [hour: minute] | Distance [km] | Weight of load [t] | Driving time [h] | Pause time at the route [h] | Place of arrival | Hour of arrival [hour: minute] | Time of loading [h] | Time of unloading [h] | Total working time [h] | End of work [hour: minute] | Total fuel consumption [l] |
| 2 | 1 | Stare Żukowice -Tarnów | Stare Żukowice | 05.03.2019 | 06:00 | 15 | - | 00:20 | - | Tarnów | 06:20 | 00:30 | - | 00:50 | - | 3,6 |
| | 2 | Tarnów-Sucha Górna | Tarnów | 05.03.2019 | 06:50 | 470 | 15 | 6:00 | 00:45 | Sucha Górna | 13:35 | - | 00:40 | 06:40 | - | 151,6 |
| | 3 | Sucha Górna-Lubin | Sucha Górna | 05.03.2019 | 14:15 | 25 | - | 00:25 | - | Lubin | 14:40 | 00:40 | - | 01:05 | 15:20 | 6 |
| | 4 | Lubin-Dębica | Lubin | 06.03.2019 | 04:00 | 475 | 23 | 6:20 | 01:00 | Dębica | 11:20 | - | 00:45 | 07:05 | - | 153,2 |
| | 5 | Dębica-Stare Żukowice | Dębica | 06.03.2019 | 12:05 | 30 | - | 00:30 | - | Stare Żukowice | 12:35 | - | - | 00:30 | 13:05 | 7,1 |
| | | | | | **Sum** | **1015** | - | **13:35** | **01:45** | - | - | **01:10** | **01:25** | **16:10** | - | **321,5** |
| | | | | | **Minimum** | 15 | - | 00:20 | 00:45 | - | - | 00:30 | 00:40 | 00:30 | - | 3,6 |
| | | | | | **Maximum** | 475 | - | 04:30 | 01:00 | - | - | 00:40 | 00:45 | 07:05 | - | 153,2 |
| | | | | | **Average** | 203 | - | 01:56 | 00:53 | - | - | 00:35 | 00:43 | 03:14 | - | 64,3 |

Tab. 5

Source data for route no. 2 in 2020

| ROUTE: STARE ŻUKOWICE - TARNÓW - SUCHA GÓRNA - LUBIN - DĘBICA - STARE ŻUKOWICE | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Route number | Section | Route of section | Place of departure | Date of departure [day month: year] | Hour of departure [hour: minute] | Distance [km] | Weight of load [t] | Driving time [h] | Pause time at the route [h] | Place of arrival | Hour of arrival [hour: minute] | Time of loading [h] | Time of unloading [h] | Total working time | End of work [hour: minute] | Total fuel consumption [l] |
| 2 | 1 | Stare Żukowice -Tarnów | Stare Żukowice | 19.04.2020 | 06:00 | 15 | - | 00:20 | - | Tarnów | 06:20 | 00:30 | - | 00:50 | - | 3,8 |
| | 2 | Tarnów-Sucha Górna | Tarnów | 19.04.2020 | 06:50 | 470 | 15 | 05:45 | 00:45 | Sucha Górna | 13:20 | - | 00:30 | 06:15 | - | 162 |
| | 3 | Sucha Górna-Lubin | Sucha Górna | 19.04.2020 | 13:50 | 25 | - | 00:25 | - | Lubin | 14:15 | 00:50 | - | 01:15 | 15:05 | 6,4 |
| | 4 | Lubin-Dębica | Lubin | 20.04.2020 | 04:00 | 475 | 23 | 6:00 | 01:00 | Dębica | 11:00 | - | 00:45 | 06:45 | - | 164 |
| | 5 | Dębica-Stare Żukowice | Dębica | 20.04.2020 | 11:45 | 30 | - | 00:30 | - | Stare Żukowice | 12:15 | - | - | 00:30 | 12:15 | 7,7 |
| | | | | | **Sum** | **1015** | - | **13:00** | **01:45** | - | - | **01:20** | **01:15** | **15:35** | - | **343,9** |
| | | | | | **Minimum** | 15 | - | 00:20 | 00:45 | - | - | 00:30 | 00:30 | 00:30 | - | 3,8 |
| | | | | | **Maximum** | 475 | - | 04:30 | 01:00 | - | - | 00:50 | 00:45 | 06:45 | - | 164 |
| | | | | | **Average** | 203 | - | 01:52 | 00:53 | - | - | 00:40 | 00:38 | 03:07 | - | 68,8 |

Tab. 6

Source data for route no. 3 in 2019

| ROUTE: STARE ŻUKOWICE - DĘBICA - KŁODNICA - TARNÓW - STARE ŻUKOWICE | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Route number | Section | Route of section | Place of departure | Date of departure [day: month: year] | Hour of departure [hour: minute] | Distance [km] | Weight of load [t] | Driving time [h] | Pause time at the route [h] | Place of arrival | Hour of arrival [hour minute] | Time of loading [h] | Time of unloading [h] | Total working time [h] | End of work [hour: minute] | Total fuel consumption [l] |
| 3 | 1 | Stare Żukowice -Dębica | Stare Żukowice | 20.05.2019 | 08:00 | 45 | - | 00:40 | - | Dębica | 08:40 | 00:50 | - | 01:30 | - | 11,3 |
| | 2 | Dębica-Kłodnica | Dębica | 20.05.2019 | 09:30 | 210 | 20 | 02:50 | - | Kłodnica | 12:20 | 00:40 | 00:55 | 04:25 | - | 70 |
| | 3 | Kłodnica-Tarnów | Kłodnica | 20.05.2019 | 15:00 | 180 | 18 | 02:15 | - | Tarnów | 17:15 | - | 01:00 | 03:15 | - | 56,3 |
| | 4 | Tarnów-Stare Żukowice | Tarnów | 20.05.2019 | 18:15 | 15 | - | 00:15 | - | Stare Żukowice | 18:30 | - | - | 00:15 | 18:30 | 3,8 |
| | | | | | **Sum** | **450** | - | **06:00** | - | - | - | **01:30** | **01:55** | **09:25** | - | **141,4** |
| | | | | | **Minimum** | 15 | - | 00:15 | - | - | - | 00:40 | 00:55 | 00:15 | - | 3,8 |
| | | | | | **Maximum** | 210 | - | 02:50 | - | - | - | 00:50 | 00:55 | 04:25 | - | 70 |
| | | | | | **Average** | 112,5 | - | 01:30 | - | - | - | 00:40 | 00:38 | 02:21 | - | 35,4 |

Tab. 7

Source data for route no. 3 in 2020

| ROUTE: STARE ŻUKOWICE – DĘBICA – KŁODNICA – TARNÓW – STARE ŻUKOWICE | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Route number | Section | Route of section | Place of departure | Date of departure [day: month: year] | Hour of departure [hour: minute] | Distance [km] | Weight of load [t] | Driving time [h] | Pause time at the route [h] | Place of arrival | Hour of arrival [hour: minute] | Time of loading [h] | Time of unloading [h] | Total working time [h] | End of work [hour: minute] | Total fuel consumption [l] |
| 3 | 1 | Stare Żukowice -Dębica | Stare Żukowice | 24.03.2020 | 08:00 | 45 | - | 00:40 | - | Dębica | 08:40 | 00:45 | - | 01:25 | - | 11 |
| | 2 | Dębica-Kłodnica | Dębica | 24.03.2020 | 09:25 | 210 | 20 | 02:50 | - | Kłodnica | 12:15 | 00:50 | 00:45 | 04:25 | - | 77,8 |
| | 3 | Kłodnica-Tarnów | Kłodnica | 24.03.2020 | 15:00 | 180 | 18 | 02:25 | - | Tarnów | 17:25 | - | 00:40 | 03:05 | - | 62 |
| | 4 | Tarnów-Stare Żukowice | Tarnów | 24.03.2020 | 18:05 | 15 | - | 00:20 | - | Stare Żukowice | 18:25 | - | - | 00:20 | 18:25 | 4 |
| | | | | | **Sum** | **450** | - | **06:15** | - | - | - | **01:35** | **01:25** | **09:15** | - | **154,8** |
| | | | | | **Minimum** | 15 | - | 00:20 | - | - | - | 00:45 | 00:40 | 00:20 | - | 4 |
| | | | | | **Maximum** | 210 | - | 02:50 | - | - | - | 00:50 | 00:45 | 04:25 | - | 77,8 |
| | | | | | **Average** | 112,5 | - | 01:34 | - | - | - | 00:48 | 00:43 | 02:19 | - | 38,7 |

## 4. RESULTS AND DISCUSSION

Based on the analysis of the services provided in 2019-2020 at the company under study, the structure of the share of regular contractors among the total number of services provided was prepared. The data was analyzed to demonstrate the changes and their sources (Figure 6).


Fig. 6. Structure of share of regular contractors in the total number of services provided at the turn of 2019-2020 at the enterprise [18]

In January and February 2019, the share of regular business partners in the total services provided was 38 and 40%, respectively. At the turn of February and March 2019, there was a sharp increase in the share by 46%. The change was caused by establishing cooperation with contractor no. 2, who became the main recipient of transport services. From March to June 2019, a downward trend continued; as a result, in June, the share of regular business partners in total services provided was 40%, analogous to February. In July 2019, there was an increase in the share of regular contractors in the total number of services provided. This stemmed from the purchase of two new truck sets. Progressive growth was recorded till the end of 2019. At the turn of January and April 2020, there was a sharp decrease of 57%. April was at the lowest level having 28%. The existing permanent business partners – contractors no. 2 and 3 – limited the purchase of transport services. The decrease was recorded because of a reduced demand for external transport services and the activities of contractors to prevent disruption of the continuity of their own fleet. In the following months, there was an upward trend of up to 79% in August 2020. On the other hand, there was a sharp decline of 41% in September, and the negative situation continued until the end of 2020. Similarly, in the first half of the year, there was a decrease of 33% in December 2020; the value of the share of regular contractors in the total number of services provided was 33%. The issue of the company was poor customer diversification. To avoid sudden fluctuations caused by economic shifts and external factors, the transport company should expand its contractor base.

Based on the analysis carried out in the aspect of the transport process on routes no. 1, 2 and 3 in 2019-2020, Tables 8, 9, and 10 were prepared. There were differences in the key areas of the transport process regarding total fuel consumption, average fuel consumption, average speed during transport, total driving time, and total working time in 2019-2020.

For route no. 1, the transport performance was at the level of 16 880 tkm. The cargo transport ratio was 90%, which proves that the vehicle traveled 770 km with load on the route of 860 km. In 2020, the total working time was extended by 1 h 25 min, that is, 9.8%, while the following increased: total fuel consumption by 7.1%, average fuel consumption with load by 12.1%, and empty fuel consumption by 7.1% (Table 8).

Regarding route no. 2, it was noted that the cargo transport ratio was 93%. Transport with cargo was performed on a distance of 945 km, which translates into transport performance at the level of 17 975 tkm. In 2020, there were changes compared to the previous year. The differences illustrated a reduction of total working time of 3.6%, composed of driving time and loading activities. The reduction in the time needed for transport was caused by an increase in

the average speed by 3.4 km/h. Consequently, there was an increase in total fuel consumption by 7%, average fuel consumption with load by 6.9% and empty fuel consumption by 7% (Table 9).

Tab. 8

Results of analysis of route 1

| | ROUTE: STARE ŻUKOWICE - PUSTKÓW OSIEDLE - WROCŁAW - OLEŚNICA - TARNÓW - STARE ŻUKOWICE | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Route number | Section | Distance [km] | Carriage with cargo [km] | Empty transport [km] | Weight of load [t] | Transport work [tkm] | Freight factor with load [%] | Fuel consumption [l] | Average fuel consumption [l/100km] | Average empty combustion [l/100km] | Average fuel consumption with load [l/100km] | Driving time [h] | Time of work [h] | Average speed during transport [km/h] | Average speed during transport with cargo [km/h] | Average speed during transport empty [km/h] |
| **2019** | 1 | 1 | 45 | 0 | 45 | - | 0 | **90** | 9,30 | **30,28** | 20,67 | - | 00:40 | 01:30 | **77,4** | **79,6** | **63,4** |
| | | 2 | 400 | 400 | 0 | 20 | 8000 | | 125,00 | | - | 31,25 | 05:00 | 06:00 | | | |
| | | 3 | 30 | 0 | 30 | - | 0 | | 7,00 | | 23,33 | - | 00:25 | 01:10 | | | |
| | | 4 | 370 | 370 | 0 | 24 | 8880 | | 115,60 | | - | 31,24 | 04:40 | 05:30 | | | |
| | | 5 | 15 | 0 | 15 | - | 0 | | 3,50 | | 23,33 | - | 00:20 | 00:20 | | | |
| **Sum** | | | **860** | **770** | **90** | **-** | **16880** | | **260,40** | | **22,4** | **31,2** | **11:05** | **14:30** | | | |
| **2020** | 1 | 1 | 45 | 0 | 45 | - | 0 | **90** | 11,30 | **32,49** | 25,11 | - | 00:40 | 01:50 | **76,2** | **81,1** | **51,4** |
| | | 2 | 400 | 400 | 0 | 20 | 8000 | | 133,40 | | - | 33,35 | 05:00 | 06:15 | | | |
| | | 3 | 30 | 0 | 30 | - | 0 | | 7,50 | | 25,00 | - | 00:40 | 01:50 | | | |
| | | 4 | 370 | 370 | 0 | 24 | 8880 | | 123,40 | | - | 33,35 | 04:30 | 05:35 | | | |
| | | 5 | 15 | 0 | 15 | - | 0 | | 3,80 | | 25,33 | - | 00:25 | 00:25 | | | |
| **Sum** | | | **860** | **770** | **90** | **-** | **16880** | | **279,40** | | **25,1** | **33,4** | **11:15** | **15:55** | | | |

Tab. 9

Results of analysis of route 2

| | ROUTE: STARE ŻUKOWICE - TARNÓW - SUCHA GÓRNA - LUBIN - DĘBICA - STARE ŻUKOWICE | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Route number | Section | Distance [km] | Carriage with cargo [km] | Empty transport [km] | Weight of load [t] | Transport work [tkm] | Freight factor with load [%] | Fuel consumption [l] | Average fuel consumption [l/100km] | Average empty combustion [l/100km] | Average fuel consumption with load [l/100km] | Driving time [h] | Time of work [h] | Average speed during transport [km/h] | Average speed during transport with cargo [km/h] | Average speed during transport empty [km/h] |
| **2019** | 2 | 1 | 15 | - | 15 | - | 0 | **93** | 3,60 | **31,67** | 24,00 | - | 00:20 | 00:50 | **74,7** | **76,6** | **56** |
| | | 2 | 470 | 470 | - | 15 | 7050 | | 151,60 | | - | 32,26 | 06:00 | 06:40 | | | |
| | | 3 | 25 | - | 25 | - | 0 | | 6,00 | | 24,00 | - | 00:25 | 01:05 | | | |
| | | 4 | 475 | 475 | - | 23 | 10925 | | 153,20 | | - | 32,25 | 06:20 | 07:05 | | | |
| | | 5 | 30 | - | 30 | - | 0 | | 7,10 | | 23,67 | - | 00:30 | 00:30 | | | |
| **Sum** | | | **1015** | **945** | **70** | **-** | **17975** | | **321,50** | | **23,89** | **32,25** | **13:35** | **16:10** | | | |
| **2020** | 2 | 1 | 15 | - | 15 | - | 0 | **93** | 3,80 | **33,88** | 25,33 | - | 00:20 | 00:50 | **78,1** | **80,4** | **56** |
| | | 2 | 470 | 470 | - | 15 | 7050 | | 162,00 | | - | 34,47 | 05:45 | 06:15 | | | |
| | | 3 | 25 | - | 25 | - | 0 | | 6,40 | | 25,60 | - | 00:25 | 01:15 | | | |
| | | 4 | 475 | 475 | - | 23 | 10925 | | 164,00 | | - | 34,53 | 06:00 | 06:45 | | | |
| | | 5 | 30 | - | 30 | - | 0 | | 7,70 | | 25,67 | - | 00:30 | 00:30 | | | |
| **Sum** | | | **1015** | **945** | **70** | **-** | **17975** | | **343,90** | | **25,53** | **34,50** | **13:00** | **15:35** | | | |

Following the analysis of route no. 3, it was observed that the cargo transport ratio was 87%. This proves that transport work was performed at the level of 7 440 tkm on the section with a length of 390 km. In 2019, the driving time was 6 hours, while the total working time was 9 hours 25 minutes. On the other hand, in 2020, there was a decrease in the total working time by 1.8% and an extension of driving time by 4.1%. Hence, the total fuel consumption increased by 9.5%, the average fuel consumption with a load by 1.3%, and empty fuel consumption by 10.6% (Table 10).

Tab. 10

Results of analysis of route 3

| | ROUTE: STARE ŻUKOWICE - DĘBICA - KŁODNICA - TARNÓW - STARE ŻUKOWICE | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Route number | Section | Distance [km] | Carriage with cargo [km] | Empty transport [km] | Weight of load [t] | Transport work [tkm] | Freight factor with load [%] | Fuel consumption [l] | Average fuel consumption [l/100km] | Average empty combustion [l/100km] | Average fuel consumption with load [l/100km] | Driving time [h] | Time of work [h] | Average speed during transport [km/h] | Average speed during transport with cargo [km/h] | Average speed during transport empty [km/h] |
| **2019** | 3 | 1 | 45 | - | 45 | - | 0 | **87** | 11,30 | **31,42** | 25,11 | - | 00:40 | 01:30 | **75,0** | **76,7** | **65,5** |
| | | 2 | 210 | 210 | - | 20 | 4200 | | 70,00 | | - | 33,33 | 02:50 | 04:25 | | | |
| | | 3 | 180 | 180 | - | 18 | 3240 | | 56,30 | | - | 31,28 | 02:15 | 03:15 | | | |
| | | 4 | 15 | - | 15 | - | 0 | | 3,80 | | 25,33 | - | 00:15 | 00:15 | | | |
| **Sum** | | | **450** | **390** | **60** | **-** | **7440** | | **141,40** | | **25,22** | **32,31** | **06:00** | **09:25** | | | |
| **2020** | 3 | 1 | 45 | - | 45 | - | 0 | **87** | 11,00 | **34,40** | 24,44 | - | 00:40 | 01:25 | **72,0** | **74,3** | **60** |
| | | 2 | 210 | 210 | - | 20 | 4200 | | 77,80 | | - | 37,05 | 02:50 | 04:25 | | | |
| | | 3 | 180 | 180 | - | 18 | 3240 | | 62,00 | | - | 34,44 | 02:25 | 03:05 | | | |
| | | 4 | 15 | - | 15 | - | 0 | | 4,00 | | 26,67 | - | 00:20 | 00:20 | | | |
| **Sum** | | | **450** | **390** | **60** | **-** | **7440** | | **154,80** | | **25,56** | **35,75** | **06:15** | **09:15** | | | |

The driving time and the total working time on the routes oscillated around the base values from 2019. There was a substantial extension of the working time by 1 h 35 min on route no. 1, which was the reason for the extension of loading and unloading time by 1 h 15 min, driving time by 10 minutes, and pause while driving by 10 minutes. The increase in the time necessary for loading and unloading accelerated the process of cargo transport; at the same time, affecting the amount of fuel consumed because, in 2020, the total fuel consumption increased: on route no. 1 by 19 liters, on route no. 2 by 22.4 liters, on route no. 3 by 13.4 liters.

## 5. THE CONCEPT OF IMPROVING THE TRANSPORT PROCESSES CONDUCTED AT THE ENTERPRISE

The subject of the study is routes no. 1, 2 and 3 in the years 2019-2020 in a transport company. Two loads were carried on each route.

**Route no. 1:**

- the first one on the Pustków Osiedle – Wrocław route;
- the second one on the Oleśnica – Tarnów route.

**Route no. 2:**

- the first one on the Tarnów – Sucha Górna route;
- the second one on the Lubin – Dębica route.

**Route no. 3:**

- the first one on the Dębica – Kłodnica route;
- the second one on the Kłodnica – Tarnów route.

In 2020, the number and type of loads carried on the given routes remained unchanged compared to 2019. Following this research, the authors observed that the loading and unloading times may be shortened. The extended period of handling activities negatively affects the transport time, speed during transport, fuel consumption, and the generation of additional transport-related costs. The proposed improvement concept will permit the minimization of the time of loading operations, which provides the possibility of taking additional orders by cutting down the total time of transport. The following indicators were used in this research [5]:

- transport time

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

where:
$t_{jh}$ – driving time on route h, that is, when the vehicle is constantly in motion,
$t_{wh}$ – waiting time for operational activities, for example, stop at traffic lights, loading and unloading.

- operating speed

$$V_h^e = \frac{L_h}{T_{ph}} \text{ [km/h]} \tag{2}$$

where:
$L_h$ – length of the road on line h,
$T_{ph}$ – vehicle working time and all accompanying activities [hour].

- vehicle performance

$$W_h = \frac{Q_h}{T_h^p} [\frac{\text{tkm}}{\text{h}}] \tag{3}$$

where:
$Q_h$ – transport work on route h, which is the product of the load transported on a given route and the route length.

Based on the source data of routes no. 1, 2 and 3, in the years 2019-2020, there was an improvement using the following indicators: transport time, operational speed, and vehicle performance on the route (Table 11).

Tab. 11
Improvement of the implemented routes no. 1, 2 and 3 in 2019-2020

| Route | Year | Time of transport [h] | Operational speed [km/h] | Vehicle performance [tkm/h] |
|---|---|---|---|---|
| **1** | **2019** | 14:30 | 59,31 | 1164,14 |
| | **2020** | 15:55 | 54,03 | 1060,52 |
| **2** | **2019** | 16:10 | 62,78 | 1111,80 |
| | **2020** | 15:35 | 65,13 | 1153,20 |
| **3** | **2019** | 09:25 | 47,78 | 790,20 |
| | **2020** | 09:15 | 48,65 | 804,60 |

In 2019, the time of loading activities related to the first load from Pustków Osiedle to Wrocław on route no. 1 was 1 h 50 min, while on route no. 2 from Oleśnica to Tarnów was 1 h 35 min. With the first load, the time can be shortened by 10 minutes, and with the second load, the time can be shortened by 5 minutes. The travel time of route no. 1 in 2020 was extended by 1 h 25 min; the delay was caused by an increase in the time necessary for loading activities by 1 h 25 min. The increase in transport time resulted in additional fuel consumption of 19 liters compared to the previous year. Assuming the handling times from 2019, it is possible to shorten the loading and unloading process by 45 minutes for the first load from Pustków Osiedle to Wrocław, while for the second load from Oleśnica to Tarnów, 45 minutes can be gained.

In 2019, the travel time of route no. 1 was 14 h 30 min. Because of the improvement, the loading time will be reduced by 15 minutes, which will translate into an increase in: operating speed by 1,04 km/h, vehicle performance by 20.26 tkm/h and the total transport time, which will be shortened by 15 minutes, ultimately amounting to 14 hours 15 minutes. Due to the progression on route no. 1 in 2020, the handling time of 4 h 40 min will be reduced by 1 h 30 min, which will have a positive effect on the transport time, standing at 14 h 25 min. The reduced transport time will increase the operational speed by 5.62 km/h, while the vehicle performance will record progress at 110.08 tkm/h (Table 12).

Tab. 12

Improvement of route no. 1 in 2019-2020

| | Route | Year | Time of transport [h] | Operational speed [km/h] | Vehicle performance [tkm/h] |
|---|---|---|---|---|---|
| **Before improvement** | **1** | **2019** | 14:30 | 59,31 | 1164,14 |
| | | **2020** | 15:55 | 54,03 | 1060,52 |
| **After improvement** | | **2019** | 14:15 | 60,35 | 1184,40 |
| | | **2020** | 14:25 | 59,65 | 1170,60 |

In 2019, the travel time of route no. 2 was 16 h 10 min. During this time, handling activities lasting 2 h 35 min were recorded. The loading time will be reduced – for the first load from Tarnów to Sucha Górna by 10 minutes, while for the second load from Lubin to Dębica, the loading and unloading time will be reduced by 5 minutes. In 2020, the loading process related to the first load on route no. 2 was 1 h 10 min, while for the second load from Lubin to Dębica, the cargo handling processes lasted 1 h 35 min. It is possible to reduce the loading time during the second load by 15 minutes.

In 2019, the time needed to travel route no. 2 was a total of 16 h 10 min. Based on the improvement, the loading time will be reduced by 10 minutes for the first load from Tarnów to Sucha Górna, while for the second load from Lubin to Dębica, the time will be shortened by 5 minutes. Improving the time of handling operations on the route will have a positive effect on the total time of cargo transport, reducing it by 15 minutes, which will translate into an increase in the operating speed on the route by 0.99 km/h and an increase in vehicle performance by 17.52 tkm/h. Considering the improvement of route no. 2 in 2020, the loading time during the transport of the second cargo from Lubin to Dębica, amounting to 1 h 35 min, will be reduced to 1 h 20 min. Subsequently, there was a decrease in the time necessary to transport the cargo by 15 minutes, which will increase the operational speed by 0.35 km/h and increase the vehicle performance by 6.48 tkm/h (Table 13).

Tab. 13

Improvement of route no. 2 in 2019-2020

| | Route | Year | Time of transport [h] | Operational speed [km/h] | Vehicle performance [tkm/h] |
|---|---|---|---|---|---|
| **Before improvement** | **2** | **2019** | 16:10 | 62,78 | 1111,80 |
| | | **2020** | 15:35 | 65,13 | 1153,20 |
| **After improvement** | | **2019** | 15:55 | 63,77 | 1129,32 |
| | | **2020** | 15:30 | 65,48 | 1159,68 |

In 2019, the handling time on route no. 3 for the first load from Dębica to Kłodnica was 1 h 45 min, while for the return cargo from Kłodnica to Tarnów, the loading process time was 1 h 40 min. Due to the improvement, loading times will be shortened – for the first load by 15 minutes, and the second load by 20 minutes. In 2020, the loading and unloading time during the transport of the first load to Kłodnica on route no. 3 was 1 h 30 min; for return cargo, loading operations were performed within 1 h 30 min. Because of the enhancement, the time of loading processes during the transport of the second load will be reduced by 10 minutes.

The travel time on route no. 3 in 2019 was 9 h 25 min. the improvement of the transport process, the time of loading operations will be reduced by 35 minutes. In effect, the total transport time will be reduced by 25 minutes, which will increase the operational speed of the vehicle on the route by 2.22 km/h and increase the vehicle performance by 36.47 tkm/h. In 2020, route no. 3 was covered in 9 h 15 min. By improving the route, the loading time will be reduced by 10 minutes. Accordingly, the total time of cargo transport will be 9 h 5 min, which will translate into an increase in operating speed by 0.89 km/h and an increase in vehicle performance by 14.48 tkm/h (Table 14).

Tab. 14

Improvement of route no. 3 in 2019-2020

| | Route | Year | Time of transport [h] | Operational speed [km/h] | Vehicle performance [tkm/h] |
|---|---|---|---|---|---|
| **Before improvement** | **3** | **2019** | 09:25 | 47,78 | 790,20 |
| | | **2020** | 09:15 | 48,65 | 804,60 |
| **After improvement** | | **2019** | 09:00 | 50,00 | 826,67 |
| | | **2020** | 09:05 | 49,54 | 819,08 |

As a result of the improvement of the implemented processes, it is possible to enhance the total time of cargo transport on all routes in the years 2019-2020 at the studied transport company. In 2019, the reduction of loading times on route no. 1 will improve the transport time by 1.72%. For route no. 1, in 2020, the improvement will be at the level of 9.42%. Compared to the previous year, this will lead to over five times greater progress. Due to the reduction in handling times on route no. 2, in 2019 and 2020, the time needed for cargo transportation will

be shortened by 1.55 and 0.53%, respectively. On the other hand, in terms of streamlining the transport processes on route no. 3 in 2019-2020, it is possible to reduce the transport time in 2019 by 25 minutes and in 2020 by 10 minutes. Reducing the time of handling operations by 35 minutes will translate into an improvement in the time of transporting loads by 4.42%. In 2020, the improvement of the transport process by reducing the time of loading and unloading operations on route no. 3 will result in an enhancement of 1.80%. Summarily, the enhancement of the cargo transport process by reducing the time of loading operations will result in an improvement in the transport time on all routes, and consequently, the company will be able to accept additional loads (Figure 7).

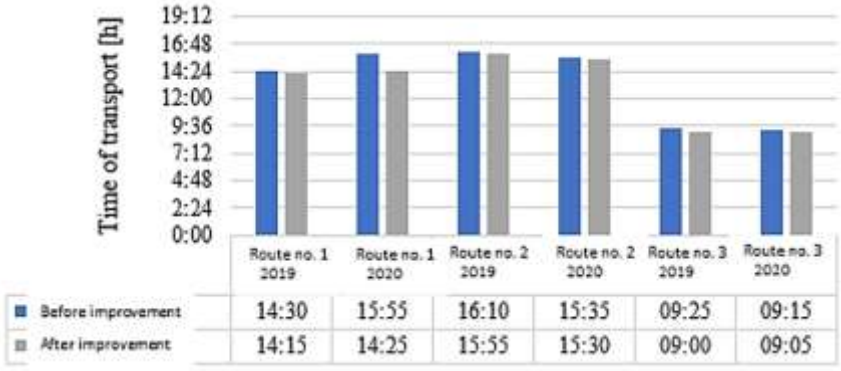


Fig. 7. Improvement of transport time on routes no. 1, 2 and 3 in 2019-2020 at the company [18]

Due to the improvement of transport processes on routes no. 1, 2 and 3 in 2019-2020, it is possible to shorten the times of loading operations. Hence, the operational speed of vehicles on the routes will increase. During the transport of cargo on route no. 1 in 2019, before the progression, the operating speed was 59.31 km/h, and the reduction in the time of handling operations will trigger progress by 1.75%, while in 2020, the increase will be 10.40%. Reducing the transport time by 15 minutes on route no. 2 in 2019 will increase the operational speed of the vehicle on the route to 63.77 km/h. Given more efficient loading operations on route no. 2, in 2020, the vehicle will increase its speed by 0.53%. Because of the improvement of the transport process, there was a positive effect on the increase in the vehicle's operational speed on route no. 3 in 2019 by 4.42%, and in 2020 by 1.83% (Figure 8).

Owing to the improvement of transport processes carried out on routes no. 1, 2 and 3 at the investigated company, it is possible to enhance the vehicle performance on each of the tested routes. Due to more efficient loading operations on route no. 1, in 2019, the vehicle performance will increase by 20.26 tkm/h, representing an increase of 1.74%. Regarding route no. 1, the most progression was recorded in 2020, amounting to 10.38%. On route no. 2, the vehicle realizing cargo transport will see an increase in productivity of 1.58% in 2019, which will result from the opportunity to reduce transport times, while in 2020, the performance will increase by 0.56%. The vehicle performance on route no. 3 in 2019, amounting to 790.20 tkm/h, will increase by reducing the time of loading operations. Because of the progression, the vehicle performance will improve by 4.62%, while in 2020, it will increase from 804.60 to 819.08tkm/h, representing an improvement of 1.80% (Figure 9).


Fig. 8. Improvement of operational speed on routes no. 1, 2 and 3 in the years 2019-2020 at the company [18]

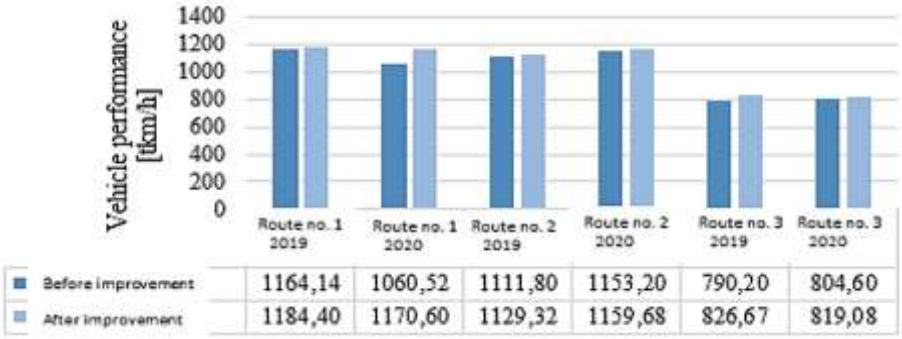


Fig. 9. Improvement of vehicle performance on routes no. 1, 2 and 3 in the years 2019-2020 at the investigated company [18]

## 6. CONCLUSIONS

The analysis of the recipients of transport services provided at the company under review revealed considerable deviations in the share of regular contractors in the total number of services provided at the turn of 2019 and 2020. The percentage share of business partners recorded the largest drops in the wake of December 2019 to April 2020 by 57% and from August to December 2020 by 46%. Extensive fluctuations were caused by a sharp reduction in the purchase of transport services by contractors no. 2 and 3. To avoid similar situations in the future, it is recommended that the surveyed transport company expands its contractor base. Based on this research on transport processes on a real object, the following operational parameters were analyzed: driving times, loading activities, pauses on sections, fuel consumption, transport work performed, and vehicle speeds. The analysis of the transport processes revealed that they can be improved. The improvement concept proposed by the authors allows for the minimization of the time of loading operations on routes related to a specific load. The loading times on routes no. 1, 2 and 3 in 2019-2020 will be reduced, namely cargo transport times will improve from 0.53% to 9.42%, which will translate into an increase in the operational speed of vehicles from 0.54 to 10.40% and an increase in vehicle performance from 0.56 to 10.38%. In effect, the total time of transporting cargo was reduced, which offers the possibility of accepting more orders.

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