CONSOLIDATION OF CARGOS IN THE ROAD TRANSPORT AS A KEY METHOD TO SUCCESS

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Resume
The problem of consolidation of goods for the provider of logistic services, which is a third part that delivers goods from many suppliers to one business client in time horizon was analysed in this article. Every parcel has a fixed date of reception in the source and delivery schedule in a destination. In the age of highly developed economy, time pressure and costs, outsourcing is a condition necessary to improve the functioning of enterprises. New logistic chains, networks of terminals and intermodal connections are built every year to reduce the transport costs and improve the whole process. In this article, the authors presented the benefits resulting from consolidation of cargos in the road transport. Special emphasis was put on determination of the role of the transport costs reduction using the cargo consolidation services.

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1 Introduction

Large carriers have more potential to survive any crisis. Therefore, the Polish transport industry, analogically to companies in Western Europe, will have to consolidate. Consolidation allows to transport smaller goods (e.g. put on a few pallets) from distant areas for a reasonable price [1-2] Nowadays, time and price are the most important factors; therefore, consolidation of cargos is a good solution [3]. It is also particular facilitation for smaller exporters. Dense network allows combining parcels, both within national and international connections [4]. Moreover, it is a safe form of transport of goods [5]. The consolidation of parcel to one transport means, above all, one shipping order, one parcel number, one customs clearance and one company that deals with transport service [6-8].

The digitization of transport processes can be achieved thanks to the systems of management of transports and invoices or applications monitoring the position of the transport means [9-11]. Programs of the cost optimization are ideal for enterprises having the networks of terminals, which are the most important on the market due to pressure put on the cost reduction [12]. In the last few years, transport business has drastically changed. Due to globalization of economy, range and frequency of transports have considerably increased. New logistic chains, networks of terminals and intermodal connections are built every year [13-15] to reduce the transport costs and improve the whole process. The movement of goods guarantees the functioning of cities and regions, however, motor trucks, due to their size, pace of moving and frequency of stops cause huge difficulties in the road traffic. In addition, they contribute to formation of hold-ups, increased noise and environmental pollution. These difficulties still have a growing trend; therefore, consolidation of cargos in road transport is the future of knowledge-based. Consolidation of cargos is a combination of a few various shipments into one cargo (Figure 1). Such a solution mainly allows optimizing costs. In the event of smaller shipments from a few suppliers (Client A, Client B, Client C), it would be unprofitable to load a few separate pallets. It is also more comfortable for the clients from logistics point of view. All the cargos are delivered within one delivery, which makes end client more satisfied.

A comprehensive analysis of the transport processes efficiency requires a broad view, taking into account both the organizational and financial aspects. The effectiveness analysis is mainly based on use of a set of indicators assessing the transport process [16], bearing in mind the specificity of transport processes in financial and organizational aspects (Tables 1 and 2). In Tables 1 and 2, examples of the rates of assessment of the transport processes effectiveness, from financial (Table 1) and organizational (Table 2) points of view, were presented. Effectiveness of the transport process

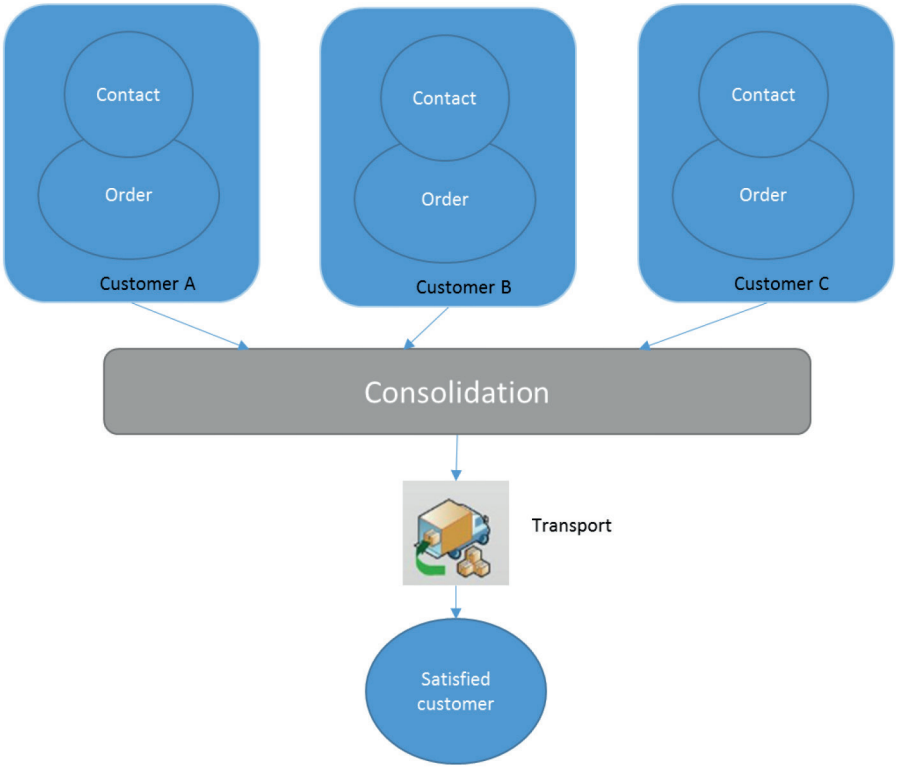

Figure 1 *Cargo consolidation*

Table 1 *Selected indicators for assessing the efficiency of transport processes in organizational terms [16]*

indicator	formula	characteristics	units of measure
load fleet load indicator	$\frac{a}{b}$	a - number of kilometers driven, b - number of means of transport	kg/car
rate of use of the transport means		a- weight of transported load b- number of means of transport	kg/car
transport intensity index		a- transport time, b- total number of deliveries	h/ delivery
timeliness of transport indicator	$\frac{a}{b} \times 100$	a - number of timely journeys b - total number of journeys	%
load damage indicator during the transport		a - load transported (mass or volume) b - load capacity or capacity of the transport fleet	%
cargo planning		a - value of incomplete deliveries b - value of all deliveries	%

is the most visible in a list of meters in the organizational aspect. It is not surprising, because the processes occurring at the operational level have the greatest contribution to the assessment of effectiveness of the transport process.

2 The consolidation of two means of transport illustrated through an example of client B

The fundamental research goal of the authors of this article was determination of the role of reduction of the transport costs using the consolidation services, illustrated through an example of client B. To achieve the goal, the research and analyses presented were conducted. The client is located in Prague. It now uses two systems of transportation (3.5 t and 6 t) that are sent to specific regions of Germany (Table 3 and Table 4).

In the event if the first means of transport, transit is two days, for the second one, one and a half day (Figure 2 and Figure 3).

Average speed accepted for the analysis of transit is 65 km/h. LDM a loading meter is the standard unit of measurement for transport by truck. One meter of cargo space, calculated as the product of the total width of the trailer and one meter of length. Most often, the width of the trailer is 2.4 meters, so 1 LDM - 2.4 m2. LDM calculations can be made using the goodloading.com application. Transport costs based on average rates on the current transport market

Table 2 *Selected indicators for assessing the efficiency of transport processes in financial terms [16]*

indicator	formula	characteristics	units of measure
shipping costs per shipment	$\frac{a}{b}$	a - transport cost b - number of shipments	€
costs of the transport fleet i		a - cost of kilometers travelled b - number of means of transport	€/car
costs of the transport fleet ii		a - value / cost of transported load b - number of means of transport	€/car
transport costs per tkm		a - transport cost b - number of tkm	€/tkm
complaints and returns	$\frac{a}{b} \times 100$	a - value / cost of returns complaints b - value / cost of all supplies of materials and raw materials	%
valuable incompleteness of supply		a - value of incomplete deliveries b - value of all deliveries	%

Table 3 *Transport schedule of client B - means of transport no. 1 - 3.5-ton*

code	city	date	time	distance	working time	driving time	comment
33098	Paderborn	2.07	08:00-09:00	0	1	0	loading
37001	Gottingen	2.07	11:00-12:00	135	3	2	
38440	Wolfsburg	2.07	14:00-15:00	135	5	4	45 min pause on the way to Potsdam
14467	Potsdam	2.07	19:00-20:00	205	10	9	pause 11 hours
8001	Zwickau	3.07	11:30-12:30	278	4.5	4.5	start 7:00
1099	Dresden	3.07	15:00-16:00	116	8	6.5	
10000	Prague	3.07	18:30	149	10.5	9	unloading
				1018			

Table 4 *Transport schedule of client B - means of transport no. 2 - 6-ton*

code	city	date	time	distance	working time	driving time	comment
36001	Fulda	2.07	08:00-09:00	0	0	1	loading
68159	Mannheim	2.07	12:00-13:00	187	4	3	
76131	Karlsruhe	2.07	14:00-15:00	68	5	4	pause 45 min on the way to Augsburg
86150	Augsburg	3.07	19:30-20:30	228	10.5	9	pause 11 hours
93047	Ratisbon	3.07	10:00-11:00	146	2	2	start 8:00
10000	Prague	3.07	16:00	268	8	6	pause 45 minutes unloading on the way
				897			

and consolidation tariff of the company (Table 5). The cost of every additional place of the so-called stop is 25 €.

The first means of transport must cover 1018 km (0.65 €/km), stopping in five places (125 €), generating the costs of 786.7 €. The second means of transport will cover 897 km (0.8 €/km) and will stop in four additional loading places (100 €). In this case, freight rate is 817.6 €.

The utilization of both means of transport stays within the range of 86% (Tables 5-7).

Transport enterprise offers delivery of every cargo within 2 working days. In this case, the cargo loaded on 02/07 shall be available for reception in the warehouse only on 04/07 (Tables 8 and 9).

The cargo will be ready on 4th of July at 9 pm (Table 10). The means of transport that will take goods must be 24-ton and will have to cover 300 km. According to a price list, the rate for such distance is 1.3 €/km (Table 5). Therefore, the cost of this transport will be 390 €.

Transit will last two and a half days, that is, one day longer than now (Figure 4).

Using defined weight tariff that verifies the costs of transport of cargos to the warehouse in Nuremberg in

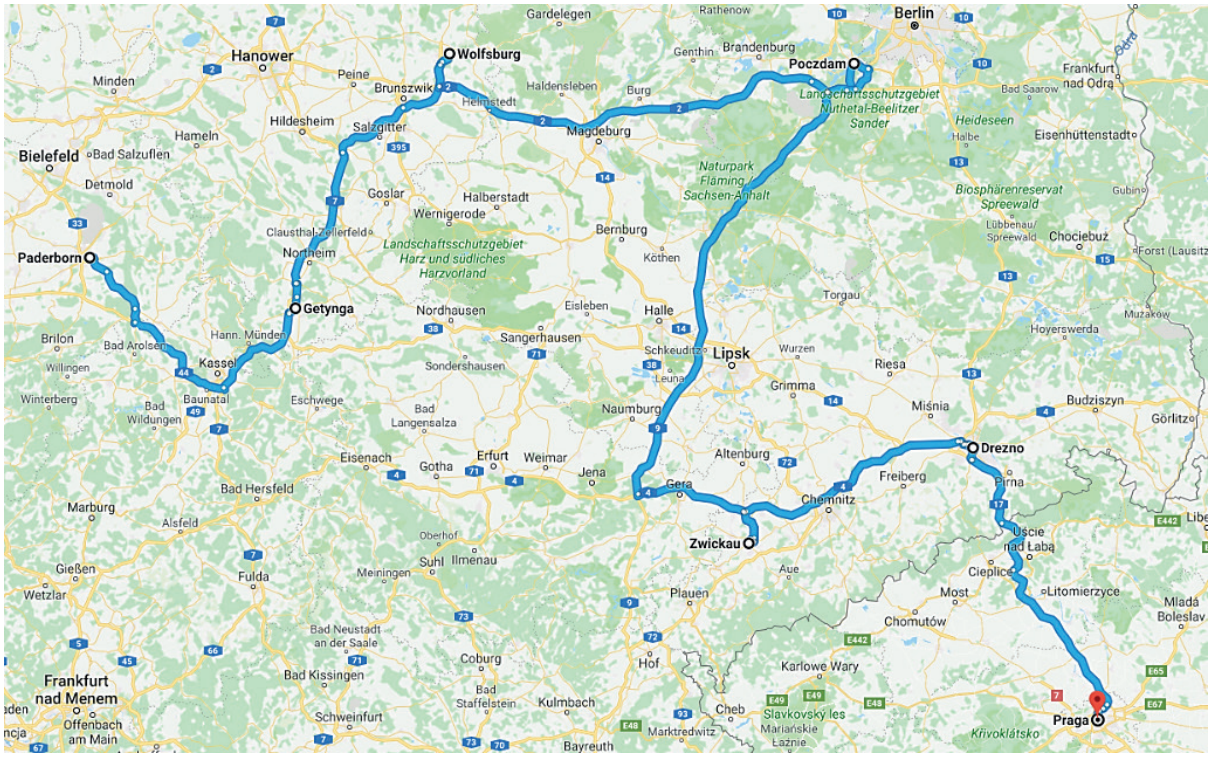

Figure 2 *Current organization of transport of a client B - means of transport no. 1 (based on Google Maps pl)*

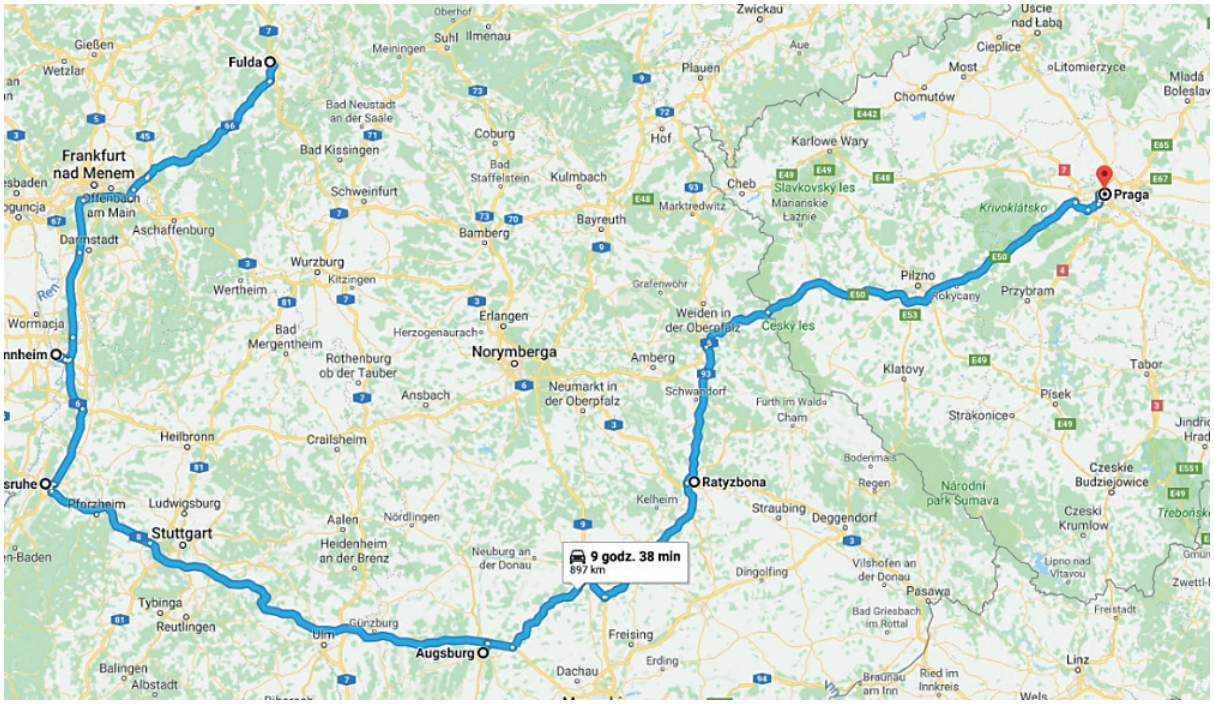

Figure 3 *Current organization of transport of a client B - means of transport no. 2 (based on Google Maps pl)*

Table 5 *The average rates for a kilometre for specific cars (the author's own work)*

car type (t)	dimensions (length / width / height) (m)	0-300 km (€/km)	300-800 km (€/km)	>800 km (€/km)
3.5	6.0/2.4/2.7	0.8	0.75	0.65
6	7.2/2.4/2.7	0.9	0.85	0.8
24	13.6/2.5/3	1.3	1.25	1.2

Table 6 *The cost of consolidation service for client B - means of transport no. 1, LDM -length of a load box*

code	city	number of pallets	LDM (m)	mass (kg)	handling(€)	transport (€)
33098	Paderborn	4	1.6	400	8	62.20
37001	Gottingen	1	0.4	300	2	45.71
38440	Wolfsburg	2	0.8	300	4	49.21
14467	Potsdam	3	1.2	500	6	71.08
8001	Zwickau	2	0.8	800	4	73.27
1099	Dresden	1	0.4	50	2	15.90
	total	13	5.2	2350	26	317.36
		utilization of means of transport	86.67%	78.33%		343.36 €

Table 7 *The cost of consolidation service for client B - means of transport no. 2 LDM - length of a load box)*

code	city	number of pallets	LDM (m)	mass (kg)	handling (€)	transport (€)
36001	Fulda	2	0.4	200	4	26.14
68159	Mannheim	3	0.6	500	6	55.97
76131	Karlsruhe	2	0.8	300	4	41.55
86150	Augsburg	5	2	1000	10	86.80
93047	Ratisbon	6	2.4	1000	12	82.44
	total	18	6.2	3000	36	292.94
		utilization of means of transport	86.11%	78.33%		328.94 €

Table 8 *Delivery time of cargos to Nuremberg (Client B) - means of transport no. 1*

code	city	date	time	code	city	date	time
33098	Paderborn	2.07	08:00	90402	Nuernberg	4.07	08:00
37001	Gottingen	2.07	11:00	90402	Nuernberg	4.07	08:00
38440	Wolfsburg	2.07	14:00	90402	Nuernberg	4.07	08:00
14467	Potsdam	2.07	09:30	90402	Nuernberg	4.07	08:00
8001	Zwickau	2.07	11:30	90402	Nuernberg	4.07	08:00
1099	Dresden	2.07	15:00	90402	Nuernberg	4.07	08:00

Table 9 *Delivery time of cargos to Nuremberg (Client B) - means of transport no. 2*

code	city	date	time	code	city	date	time
36001	Fulda	2.07	08:00	90402	Nuernberg	4.07	08:00
68159	Mannheim	2.07	12:00	90402	Nuernberg	4.07	08:00
76131	Karlsruhe	2.07	14:00	90402	Nuernberg	4.07	08:00
86150	Augsburg	2.07	19:30	90402	Nuernberg	4.07	08:00
93047	Ratisbon	2.07	10:00	90402	Nuernberg	4.07	08:00

Table 10 *Transport of consolidated cargo to Prague*

code	city	date	time	code	city	date	time
90407	Nuernberg	4.07	09:00	10000	Praga	4.07	13:30

terms of postal code of a supplier, the rate of reception of all suppliers and for handling operations is 343.36 € Client B - means of transport no. 1, and for Client B means of transport no. 2 is 328.95 €. Total cost of movements for client B is 1604.3 € per week (Table 11).

There is one issue to be determined yet, the impact of extended transit on the costs frozen in material. The value of cargo and number of production days of the plant are needed. The value of goods is forty-five thousand euro, in six-day production line; it is seven and a half thousand euros a day. Increasing the transit by one day will give negative impact for value of one day, that is, seven and a half thousand euro. Comparing the losses in material and savings in transport, one gets a positive result in

Figure 4 *Nuremberg - Prague (based on use of the Optimizing XYZ)*

Table 11 *The savings of a client B, proposed offer of a transport enterprise*

route	type of a car (t)	distance	feet	costs (€)
suppliers -> client B Prague 1	3.5	1018	5	786.70
suppliers -> client B Prague 2	6	897	4	817.60
actual total cost				1604.30
suppliers -> Nuremberg 1	consolidation			343.4
suppliers -> Nuremberg 2	consolidation			328.9
Nuremberg -> client B Prague	24	300	0	390
proposed total cost				1062.31
weekly saving				-541.99
annual saving				-26015.75

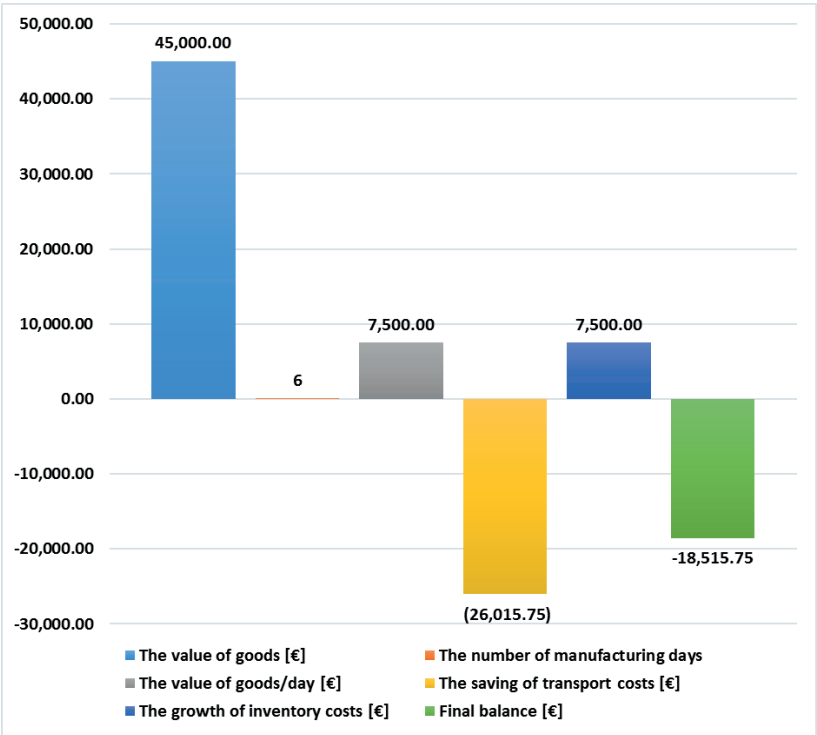

Figure 5 *Comparison of transport savings and inventory losses of a client B*

the form of thirty thousand euros of saving for client B (Figure 5).

3 Conclusions

The fundamental goal of the authors of this article was to determine the role of reduction of transport costs with the use of consolidation service. To achieve the goal, execution of the following plans was used:

- An analysis of current transport organization of a client,
- An assignment of particular suppliers to warehouses towards terminal network of a transport enterprise providing consolidation services,
- Calculation of costs of consolidation service, taking transport and handling costs into account,
- Determination of the impact of transport organization on inventory costs,
- Comparison of current costs with proposed solution,

Conducted analysis allowed to prove that consolidation services reduce the costs of transport of small cargos. In the event of direct transports, the cars must cover many kilometres, only to take one small parcel or pallet. Medium and large cargos are not cost-effective for such organizations, however, direct and consolidation method can be combined to get the optimal results. Impact on inventory costs was also taken into consideration in the analysis. Extended time of transit, caused by use of a consolidation service, should be in majority of cases covered by the transport savings.

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