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Model of Value-Based Management in a Multi-Hub Large-Scale Logistics Network

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Abstract:

Purpose: *The dynamic growth of multi-channel sales (including e-commerce) causes a mass flow of cargo in supply networks and large-scale transport and logistics processes in complex multi-hub structures of logistics networks in Europe. One of the key objectives of the effective management of processes and cargo flows in complex structures of logistics networks is an increase in profitability of customer and shipment delivery.*
Design/Methodology/Approach: *In the presented value-based management (VBM) model, multi-factor price lists for logistics services and taxation weight of shipment are the basis for revenue modelling by logistic operators, as well as their multi-criteria conditions for qualifying rates and add-on factors. On the other hand, transport and logistics processes implemented in supply chains and multi-hub network, create a complex cost environment.*
Findings: *Dynamically and segmentally planned process loads in logistics networks according to the changing needs of customers, create complex and variable structures of direct and indirect costs of logistics operators. The allocation of costs in multi-hub logistics networks is determined by dynamic changes in the flow of cargo, through the settlement keys of resources costs used in the processes of the logistics network. Customer service quality indicators established by logistics operators are mapped to operational norms in the final settlement model. The key factor in using the value-based management model by enterprises is achieving the required operational and price competitiveness on the market of transport and logistics services with the assumed profitability of customers and services.*
Originality/Value: *The results of the presented model analysis of the profitability of customers as well as the efficiency of processes in the logistics network influence managerial decisions shaping the appraisal of shipment contracts with customers. The VBM model presented in the article was used to verify the real costs and profitability of corporate customers in large scale multi-hub logistics network, taking into account analysis of the share and allocation of shipment flows, transport options in supply chains, as well as process routes and resource consumption.*

Keywords: *Value management, logistics network, operational controlling, profitability, process cost analysis, cargo flow.*

JEL codes: *C14, D21, D24, C61, H41, H51.*

Paper Type: *Research study.*

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1. Introduction

The dynamic increase in the flow of cargo from e-commerce channels in cross-border and global delivery networks (Sirvi *et al.*, 2021; Śliwczyński *et al.*, 2020) engages logistics operators to continuously control the profitability of business and the efficiency of processes in logistics networks.

Table 1. *Country oriented e-commerce growth*

Country	2019	2023	Five-year growth
China	636,1 M$	1.086,1M$	70,7%
United States	504,6 M$	735,4M$	45,7%
France	49,4M$	71,9M$	45,6%
Australia	18,6M$	26,9M$	44,6%
Russia	17,2M$	24,8M$	44,2%
Canada	39,9M$	55,4M$	38,8%
Germany	70,3M$	95,3M$	35,6%
United Kingdom	86,5M$	113,6M$	31,3%
HJapan	81,7M$	103,6M$	26,8%
South Korea	63,7M$	80,2M$	25,9%

Source: *Statista Digital Market Outlook, 2019.*

Increasing demands on the performance, reliability and resilience of logistics networks force the constant striving to improve the efficiency of the network structure and profitability of investments in their development, including: digitization and automation of logistics hubs with using of IoT (*Internet of Thing*) and AI (*Artificial Intelligence*) systems (Vrontis *et al.*, 2021), as well as the development of digital platforms for cooperation with logistics operators and carriers (Wycislak, 2022). Striving to improve the financial and operational result shifts the burden of enterprise management to value-driven management models (VDM) and value-based management (VBM) (Firk *et al.*, 2021).

Several models are used to measure VBM/VDM in financial terms, including:

- EVA - *Economic Value Added*,
- MVA - *Market Value Added*,
- TSR - *Total Shareholder Value*,
- CFROI - *Cash Flow Return on Investment*.

The VBM model presented in the article and the results of customer profitability research are based on the efficiency of cargo flow handling and processes as well as the efficiency and rotation of logistics network resources in complex multi-hub structures. The results affect the net operating profit (NOPAT - *Net Operating Profit*

After Tax) generated in the network, which is an important component of the EVA indicator (Sousa E, et al., 2020). The presented analysis is focused on operational and financial results, enabling short-term value management - for which the invested capital (IC) and weighted average cost of capital (WACC) were assumed unchanged.

algorithm of operational management impact on value-based management indicator

$$\begin{cases} Gross\ Profit = Revenue - Costs\ Of\ Goods\ Sold \\ Operating\ Income = Gross\ Profit - Operating\ Expenses \\ NOPAT = Operating\ Income \times (1 - Tax\ Rate) \\ EVA = NOPAT - (IC \times WACC) \end{cases}$$

NOPAT - *net operating profit after tax,* IC - *invested capital,* WACC - *weighted average cost of capital*

The maximization of the EVA surplus generated by the company over the cost of capital employed illustrates the mechanisms of managing the company's value in the operational environment of simultaneous and multi-directional transport and logistics processes. NOPAT requires a detailed impact and sensitivity company's core operations performance analysis (Omneya *et al.*, 2021) including revenues from the sale of services, costs and gross profit in European logistics networks.

In VBM model is important to transfer operational efficiency to the company's performance, for example: asset turnover, return on sales and assets, or the operating capital and cash cycle. Hence, in the assessment of the winners of the Gartner Supply Chain 2021 - Top 25 ranking (including Cisco Systems /6.37/, Colgate-Palmolive /5.58/, Johnson & Johnson /5.22/, Schneider Electric /5.07/ and Nestle /4.41/), the related operating and financial results are based on scores on key attributes such as three-year weight return on physical assets (ROPA), revenue growth and inventory turns (cost of goods sold in 2020 / average inventory in 2020).

The operational factors shaping the mass stream of e-commerce shipments consist of hub network, main line transport, delivery and pickup of shipments in the region, customer service, consignments and transactions in the delivery and collection processes, as well as transhipment processes, sorting and consolidation in logistics hubs. Many additional processes like - pallet trading operations, handling returns and complaints or repeated pick-ups/deliveries - increase the load on the network resources. Each hub in the European network hosts various combinations of logistics processes for regional collection of shipments, linear transport and distribution.

The value-based management model applied to the logistic network aims to maintain a balance between the value of the consignment delivery with comprehensive logistic services assessed by the customer and value for the logistics operator which fulfil customer’s requirement and implements appropriate processes and resources (Zhang, 2021). Value in logistics network perceived by operator is assessed on the basis of many financial and operational factors, including: sales revenues, costs incurred in the full supply chain, profit calculated on service/customer/customer’s order, process efficiency, time of the operation, working capital cycle, quality of provided services as well as capacity of available resources and the level of their use.

The analysis model of customers and services profitability takes into account differentiated income/cost ratio intensity and complex valuation of consignment delivery price resulting from the various combinations of logistics processes and consuming different amounts of network resources. Knowledge of how to measure and use the value of logistics is necessary for valuation of transport charges for the customer and the carrier (Santoso *et al.,* 2021).

Potential of multidimensional value creation by logistics operator includes many factors of consignments flow processes in the supply network, delivery connections density of the logistics network and locations of its hubs, processes of consolidation and completion of shipments, rules of cooperation with carriers and many others.

2. Research Environment of Value-Based Management Model

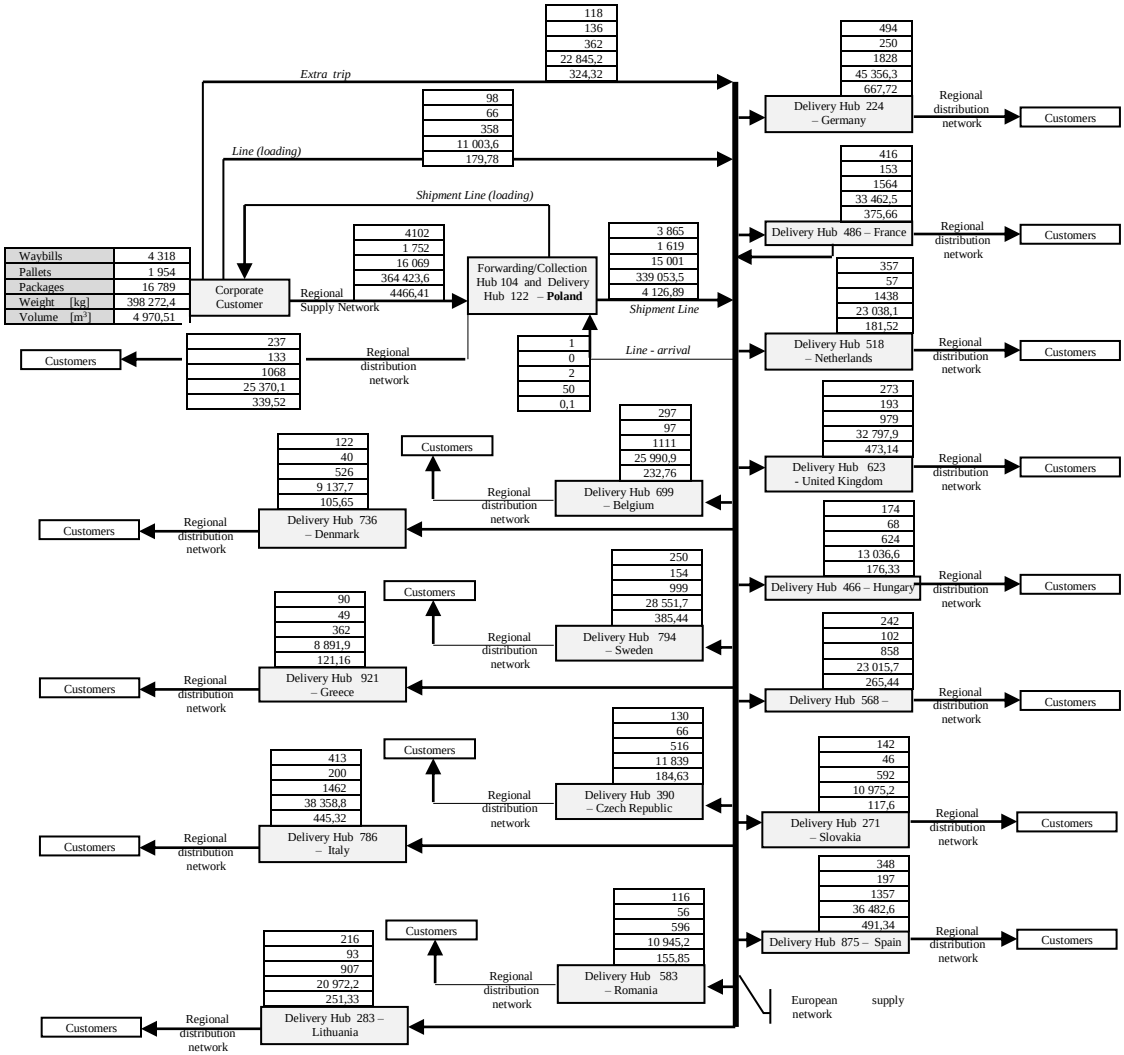
The flow diagram of one of the surveyed European multi-hub large-scale logistics networks operated by selected logistics operator for selected corporate customer is shown in Figure 1.

In the research were used a sample of forwarding and transhipment-warehouse operational data as well as financial and accounting data registered in 17 hubs and general cargo lines of logistics network, from the period July 2020 - September 2021. The research analysis covered 15.648.420 shipment transaction in the logistics network for 5 selected corporate customers. The research used non-random purposeful selection of corporate customers, whose current profitability ratio of shipment contracts was above 6,0% (gross profit/revenue).

The rules for calculating revenues from corporate customers for the handling and delivery of shipments are set out in the contracts according to the methodology of shipments valuation and pricing based on their taxation weight. The customer profitability calculation takes into account the direct and indirect cost surcharges allocated to the customer and shipment.

The heterogeneous environment of cargo flows in European multi-hub logistic networks is characterized by a high daily dynamics of the variability of the contract customer flow structure. The volatility of contractual shipment flows results from market needs and is caused by daily changes in the number and type of shipments (according to the analysis: m^3, kg, waybills, consignment notes, packages and pallets) at the points of dispatch and collection. Detailed analysis of the variability of flows and transhipments of contract shipments in network structures shows high values of individual quantitative dynamics index (based on a fixed basis qt/q0 <1,64; 0,71>, with a variable basis qt/qt-1 <1,37; 0,64>), with a relatively low value of Fisher's aggregate quantitative dynamics index $^{F}Iq = 1.115$ for all shipments in the surveyed network.

Figure 1. *Flow chart in the multi-hub large-scale logistics network for a selected corporate customer.*



Source: *Own study according to the registered shipments in the period 7 - 10 June 2021.*

The variable share of corporate customers' shipments in the structure of the total cargo stream causes the need to implement the allocation of operating costs and service pricing for corporate customers, and thus the operating income, EBIT and profitability of customers according to the requirements of the value-based management model.

The financial result of contract for the handling of cargo flow for corporate customers depends on the implementation of many processes in the supply chain,

from sending to receiving, as well as handling returns and complaints of shipments and pallet turnover, generally including:

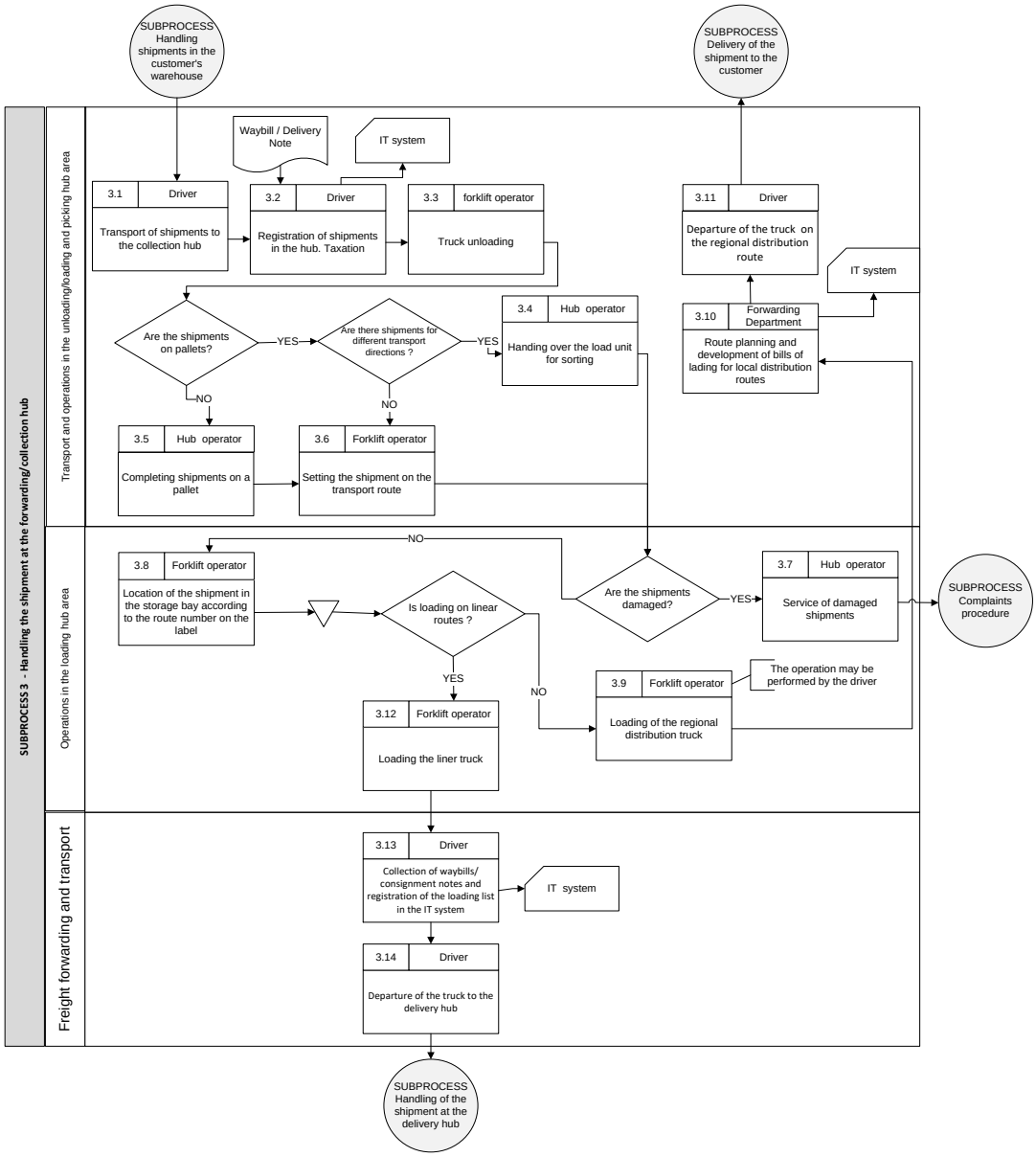
- handling during collection processes and additional services for customers,
- transport of shipment to the collection hub,
- transhipment and terminal services in the collection hub – registration, taxation, unloading, shipment sorting and collection, planning and forwarding service, loading for linear or regional distribution transport,
- linear transport between hubs,
- transhipment and terminal services in the delivery hub,
- transport of shipment in the regional distribution network.

An example of the map of shipment handling processes in the collection hub (indexed 3.1 - 3.14) – one of the analysed process sections in the complete shipment supply chain being researched - is shown in Figure 2. The measurement and analysis of indexed flows and processes are essential for identifying the resources used in processes.

Operation times and shipment flow volumes are the basis for calculating resource consumption and costs allocation. Linking the data on revenues from the sale of shipment delivery with the costs of delivery processes enables the calculation and evaluation of the customer's profitability in VBM model. The structure of the flow, process and financial data used in the research is presented in Table 1.

The quantitative analysis of the cargo flow according to the identified processes is the basis for calculating the size of the resources used in the network, cost standard/normative and cost accounting keys as well as the valuation of services. The allocation of resources used in the logistic service processes of selected corporate customers with direct and indirect costs recorded according to the Corporate Chart of Accounts at logistics operator, allows binding the used resources cost with cost objects (customers, contracts, orders, services, waybills) (Křečková, 2017). The cost allocation structure and service profitability were also influenced by direct transport (excluding hubs reloading), partial transports and added loads at the customer's in line deliveries and drop offs.

Figure 2. *Map of shipment handling processes in the collection hub*



Source: *Own study*

Table 1. *The structure of data used in the research of the customer's profitability in VBM model*

Cargo flow data							
Waybill No	*Loading lists*	*Collection Hub*	*Delivery Hub*	*Number of pallets*	*Number of packages*	*Tax weight*	*Load weight*
Process/operations/resources data							
Index of process/operation		*Resource /Asset*	*Measure of throughput of operation*		*Operation time*	*Volume of resource use*	
Financial (revenue, costs) data							
Freight charge	*Value of additional services*		*Fuel addition*	*Value of resource consumption*		*Normative cost*	*Operation cost*

Source: *Own study.*

The presented VBM model based on the process cost and gross profit calculation (EVA components) in a multi-hub logistics network, enables the verification of the customer's profitability (gross profit/revenue) and valuation of the contract pricing.

3. Methodology: Model of Value-Based Management in a Multi-Hub Large-Scale Logistics Network

The VBM model algorithm used in multi-hub network - successive stages, their components of operation and the tools/techniques used - are presented in Figure 3.

The basis for the valuation of shipment delivery services for corporate customers in the analysed European multi-hub logistics network is the shipment taxation. It takes into account many factors and cost drivers, including e.g., distance, ADR category, general cargo, palletized load, full truckload shipment, payment code, returnable pallets, etc., as well as add-on transport and other transport and logistics cost factors (e.g., electronic toll collection system).

The presented VBM model for calculating customer profitability allows to verify the services valuation, taking into account the complexity of the operating environment, cargo flows as well as processes and resource consumption.

Figure 3. *The VBM model algorithm used in multi-hub logistics network.*

No	Stage of VBM model	Stage activities	Tools and techniques
1	Shipment process mapping for corporate customers	– developing a map of shipment handling processes – identification of resources in processes – analysis of flows and sequence of activities – analysis of methods and measures of resource consumption in activities	– mapping methods - *IDEF, BPMN* notation, ... – *ICOM* technique – *VSM* method
2	Analysis of the stream of shipments of corporate customers in the logistics network	– analysis of waybill registers – analysis of loading lists	– IT calculation sheets according to waybills assigned to customers – IT calculation sheets for collection and delivery hub by type of loading list
3	Measurement of processes and quantitative assignment of resources to operations	– calculation of operations throughput measures – calculation of operational norms of resource consumption	– process score-card – resources consumption analysis
4	Allocation of quantitative consumption of resources to corporate customers in shipment handling processes	– calculation of resource consumption in processes according to flow volumes based on operational norms	– IT calculation sheets and registers of resource load by the logic of assigning types of loading lists to processes
5	Methodology of calculating the costs of handling shipments and allocating costs to corporate customers	– calculation of standard unit costs (norms) – calculation of resource costs in processes – calculation of process costs – allocation of indirect costs for activities (including settlement of additional services and e-toll) – calculation of shipment costs	– system relations of assigning analytical cost accounts (within *Corporate Chart of Accounts*) by type of resources – IT calculation sheet and system relations of unit consumption costs based on resource inventory value – resource normative cost worksheet based on process operational norms – IT calculation sheet of direct and indirect hub cost
6	Methodology of calculating the customer's profitability	– calculation of revenues from the sale of services under the contract – calculation of profitability of the corporate customer	– IT calculation sheet of sales revenue by waybills and loading lists – IT calculation sheet of profitability of the corporate customer (relations to income and cost accounts in the *Corporate Chart of Accounts*)

Source: *Own study.*

4. Method and Material: Study of Customer Profitability with the Use of VBM Model in the European Multi-Hub Logistics Network

In the shipment process mapping for corporate customers (according to 1st stage of the algorithm presented in Figure 3 - an example of the process map in collection hub is shown in Figure 2), where in a repetitive manner for 17 hubs were identified 10 main processes and 42 activities (on the map in Figure 2 are shown 14 activities

in the 3rd process), which formed the basis for further measurements of flows, resource consumption and costs.

The results of the network flow studies showed differences in the logistic parameters of loads sent by the surveyed customers (e.g. palletization of shipments, fragmentation of loads, weight and unit volume of loads) (Table 2).

Table 2. *Analysis of shipments stream of corporate customers in the logistics network*

	Customer 1	Customer 2	Customer 3	Customer 4	Customer 5
number of waybills (wb)	45 954	99 103	184 557	71 445	137 261
pallets (plt)	21 615	2 721	287	77 957	29 086
parcels (prl)	172 946	454 955	224 864	271 328	269 998
shipments (sht)	194 561	457 676	225 151	349 285	299 084
weight (kg)	4 842 314,00	9 169 532,10	4 729 367,00	25 715 843,40	13 063 887,10
volume (m^3)	49 465,69	62 288,80	36 481,49	72 312,90	18 786,90
		Logistics parameters			
plt / wb	0,4704	0,0275	0,0016	1,0912	0,2119
prl / wb	3,7635	4,5907	1,2184	3,7977	1,9670
plt / sht (%)	11,11%	0,59%	0,13%	22,32%	9,73%
prl / sht (%)	88,89%	99,41%	99,87%	77,68%	90,27%
weight / wb (kg)	105,3731	92,5253	25,6255	359,9390	95,1755
weight / sht (kg)	24,8884	20,0350	21,0053	73,6241	43,6797
volume / wb (m^3)	1,0764	0,6285	0,1977	1,0121	0,1369
volume / sht (m^3)	0,2542	0,1361	0,1620	0,2070	0,0628
weight/volume (kg/m^3)	97,8924	147,2100	129,6374	355,6190	695,3722

Source: *Own study.*

The differences affect the efficiency of reloading and handling time, and thus affect the differences in operating costs in hubs and in transport (e.g., palletization of cargo: C4=1,0912, C3=0,0016; W/M: C1=97,89, C5=695,37).

Shipment data flow has been linked according to the logic of loading list numbers in the hub network from the sender to the recipient in Europe. The standard combination of transport - *transport to the collection hub → linear transport to the delivery hub → delivery in local distribution to the recipient* - in practice is extended to many other combinations, with extra trips, local transports and top-ups. Depending on the location of corporate customers and their recipients in many European countries, 14 out of 17 hubs also act as a terminal for collection of shipments from the delivery region, loading hub for linear transport and delivery hub in the local distribution network.

The results of process measurements were averaged for the purposes of calculating the operating time norms for the execution of processes (according to waybills, parcels, pallets) and the norms of the amount of resources used in the processes. Allocation of all shipment combinations flows of corporate customers in the logistics

network enabled the calculation of resource consumption in transport and shipment handling processes based on operational norms of resource consumption (López Avil *et al.*, 2020). The example for monthly results of resource load calculation (hub No 9, shipment stream for one corporate customer, processes 3.1−3.10) are presented in Table 3.

Table 3. *The results of resource load calculation*

Number of waybills (wb)	4 050	pallets	(plt)	1 600	weight	(kg)	336 053,5
		parcels	(prl)	15 341	volume	(m^3)	4 128,67

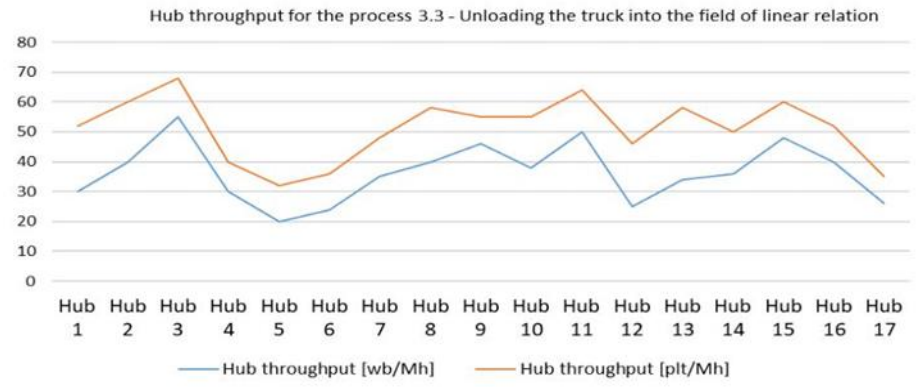
	Norm of operating time			**Norm of resource consumption**				
Process / Activity	Mh/wb	Mh/prl	Mh/plt	Hub work operations/office (Man-hour)	Shipment rotation by office area (m^2 x Mh)	Reloading equipment (Working-hour)	Shipment rotation by terminal area (m^2 x Mh)	Hub infrastructure (% of use)
3.1 – 3.10	0,75	0,21	1,91	3052/2258	27 492,34	1 509	11 896,24	28,6

Source: *Own study.*

Measurement of resource efficiency according to the VBM model enables the definition of areas of efficiency improvement. Table 3 shows the need to improve the use of the hub's reloading/storage infrastructure (28.6%) and cargo rotation in the terminal's operating area (11,896.24 (m^2xMh) = 14.87% of 4,000m^2 x 20Mh = 80,000 (m^2xMh)).

The result analysis of flows and shipment handling processes show significant differences in the capacity of 17 European hubs in the measured 42 activities for 10 processes in the logistics network. Differences in the level of throughput measures affect the work productivity, efficiency of equipment and infrastructure use, as well as resource rotation. Examples of throughput differences in 17 hubs of European logistics network for the activity/process 3.3 - *Unloading the truck into the field of linear relation* - are presented in Figure 1.

Figure 1. *Throughput in 17 hubs of European logistics network for the activity/process 3.3 - Unloading the truck into the field of linear relation*



Source: *Own study.*

The allocation keys of the load and indirect cost per corporate customer are calculated on the basis of the ratio (WSc/Ss) of the share of the surveyed customer's shipment stream (Sc) in the total shipment stream (Ss), taking into account the maximum capacity of the hub WPmax. The solution allows to eliminate changes in the value of allocation keys with changes in the total shipment stream (monthly range of changes in one hub < 63.936 ÷ 78.664 > during the research period) and analysis of absolute indicators of the share of corporate customer shipment costs in total costs.

Relations of financial data according to the Corporate Chart of Accounts and operational data registered according to the customer's ID (shipments, processes and resources) in order to allocation the costs and profitability of services per customer, are presented in Table 4.

Table 4. *Registration of financial and operational data to allocate profitability to the customer*

Account specification	Account No	Customer	Product/Services	Process	Resources
Costs by type in cost centres	400XXX - 499XXX 700000 - 700050	Customer ID	Customer waybill numbers pallets, parcels, shipments, weight, volume	Type and number of the loading list Consignment line number Customer's shipment handling process ID	Postal code of the sender and recipient Carrier No. Collection and delivery hub ID / Resource ID
Sales revenue by type of service in revenue centres	800000 - 800050				

Source: *Own study.*

The cost allocations key and settlement per customer may be used according to:

- share in the stream of shipment,
- participation in freight transport performance,
- share in direct operating costs (taxation weight of the cargo based on freight table and price list),
- share in revenues (according to the valuation of transport and logistics services, additional transport costs and additional shipment services).

The method and scope of aggregation of costs incurred per customer in VBM Model results from the identified chain of handling the shipment. The flow analysis has shown 18 variant combinations of logistics and transport processes and costs incurred. In the Table 5 are presented 7 selected variants of cost aggregation from the analytical accounts of the Corporate Chart of Accounts according to shipment chains with the ID of the surveyed customers in the European logistics network.

Table 5. *Variants of data aggregation in cost accounts according to the customer's shipment handling processes*

<table>
<tr><td rowspan="2">Customer ID</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr>
<tr><td>The cost of handling the shipment at the sender’s location</td><td>The cost of delivery to the collecting hub</td><td>The cost of service at the collecting hub</td><td>The cost of linear transport</td><td>The cost of service at the delivery hub</td><td>The cost of the shipment delivery to the recipient</td><td>The cost of service at the recipient's and final settlement</td></tr>
<tr><td>Variant 1</td><td>700000 – 700005</td><td colspan="4">700006 - 700017</td><td></td></tr>
<tr><td>Variant 2</td><td colspan="4">700000 – 700014</td><td>400XXX – 499XXX</td><td colspan="2" rowspan="2">700018 – 700050</td></tr>
<tr><td>Variant 3</td><td colspan="4">700000 – 700014</td><td rowspan="2"></td></tr>
<tr><td>Variant 4/5</td><td colspan="2">700000 – 700009</td><td>400XXX – 499XXX</td><td>700010 – 700014</td><td></td></tr>
<tr><td>Variant 6</td><td rowspan="2">700000 – 700005</td><td colspan="3">700006 - 700014</td><td rowspan="2"></td><td rowspan="2" colspan="2"></td></tr>
<tr><td>Variant 7</td><td colspan="3">700006 - 700014</td></tr>
<tr><td colspan="8">Variant 1: Loading a full truck shipment - full truck delivery to the recipient
Variant 2: Collecting the shipment from the customer by linear transport (top-up) - service at the delivery hub - delivery to the recipient
Variant 3: Collecting the shipment from the customer by irregular transport (extra trip) - service at the delivery hub - delivery to the recipient
Variant 4: Delivery to the collecting hub - service at the collecting hub - linear cargo transport - service at the delivery hub - delivery to the recipient
Variant 5: Cargo handling at the customer’s site by the carrier's employees - delivery to the collecting hub - service at the collecting hub – linear transport - service at the delivery hub - delivery to the recipient
Variant 6: Cargo handling at the customer's site by the carrier's employees - collection of the shipment from the customer by linear cargo transport (loading at the customer's site) - service at the delivery hub - delivery to the recipient
Variant 7: Cargo handling at the customer's site by operator employees - collection of the shipment by linear transport (top-up) - service at the delivery hub - delivery to the recipient</td></tr>
</table>

Source: *Own study.*

The analysis of transport costs in conjunction with the usage rates of tracks, according to the VBM model, allows for an effective variants selection of the freight relationship, transport route, fleet, loading and transport schedule.

Standard unit costs calculated for each European hub were used to allocate costs per customer, apply to variants aggregated costs of shipment delivery processes and shipment flows. In the Table 6 are presented standard unit costs for 4 selected hubs in logistics network.

Table 6. *Standard unit costs of resource settlement in hubs of European logistics network*

Hub	Unit cost of office work (EUR/Mh)	Unit cost of operation work (EUR/Mh)	Unit aggregated cost of office area (EUR/(m^2 x Mh))	Unit aggregated cost of terminal area (EUR/(m^2 x Mh))	Unit aggregated cost of equipment (EUR/(Wh))	Unit aggregated cost of materials (EUR/(sht))
1	43,41	35,56	0,051	0,022	1,284	2,41
2	42,48	40,23	0,020	0,010	1,036	3,28
3	40,66	38,39	0,029	0,017	0,891	4,17
4	46,76	41,31	0,047	0,037	2,409	3,62

Source: *Own study.*

Revenues of shipment operational handling of surveyed corporate customers results from the valuation of shipment delivery services based on the cargo taxation weight according to the freight table and price list. The profitability of customers in the VBM model is calculated on the basis of sales revenues and total direct and indirect costs adequately to the variants of shipment delivery processes and the resources used in multi-hub European logistics network. An example of the resulting profitability calculation for one of the five surveyed customers (C1 - Table 2) is presented in Table 7.

Table 7. *The resulting profitability calculation of Customer 1st in VBM Model*

	Customer 1		Revenue [EUR]		Costs [EUR]
waybills [wb]	45 954	Freight	4 102 405,71	Hub operation costs	1 764 903,36
pallets [plt]	21 615	Value of additional services	201 523,40	Collection hub – 84,13%	1 484 813,20
parcels [prl]	172 946			Delivery hubs – 15,87%	280 090,16
shipments [sht]	194 561	Valuation of additional transport costs	802 020,31	Linear & irregular transport costs	1 174 247,16
weight [kg]	4 842 314,00			Collection & delivery transport costs	1 910 134,80
volume [m³]	49 465,69			Additional transport costs	390 081,12
		Total revenue	**5 105 949,42**	**Total costs**	**5 239 366,44**
		Gross Profit / Loss	**- 133 417,02**	**Profitability of Customer 1**	**-2,61%**

Source: *Own study.*

The comparative results in the research sample of the non-random purposeful selection of 5 corporate customers with the profitability of the contract for handling shipments exceeding 6.0% (calculated according to freight table, valuation weight and multi-factor price list) are presented in Table 8.

Table 8. *The comparative results of profitability for sample of corporate customers.*

		Customer 1	Customer 2	Customer 3	Customer 4	Customer 5
Total revenue	(EUR)	5 105 949,42	11 609 619,53	6 647 925,76	9 067 449,55	15 859 554,91
		Valuation weight of the shipments and multi-factor price lists				
Total costs	(EUR)	4 787 848,77	10 867 764,84	6 203 844,32	8 512 521,64	14 863 574,86
Gross Profit / Loss	(EUR)	318 100,65	741 854,69	444 081,44	554 927,91	995 980,05
Profitability of Customer	(%)	6,23	6,39	6,68	6,12	6,28
			VBM Model			
Total costs	(EUR)	5 239 366,44	11 198 639,00	6 304 228,00	9 256 052,50	15 785 015,00
Gross Profit / Loss	(EUR)	- 133 417,02	410 980,53	343 697,76	-188 602,95	74 539,91
Profitability of Customer	(%)	- 2,61	3,54	5,17	-2,08	0,47
Profitability difference	(%)	-8,84	-2,85	-1,51	-8,20	-5,81

Source: *Own study in the period July 2020 - September 2021.*

5. Conclusions

The VBM model was used to verify the real costs and profitability of corporate customers in large scale multi-hub logistics network, taking into account analysis of

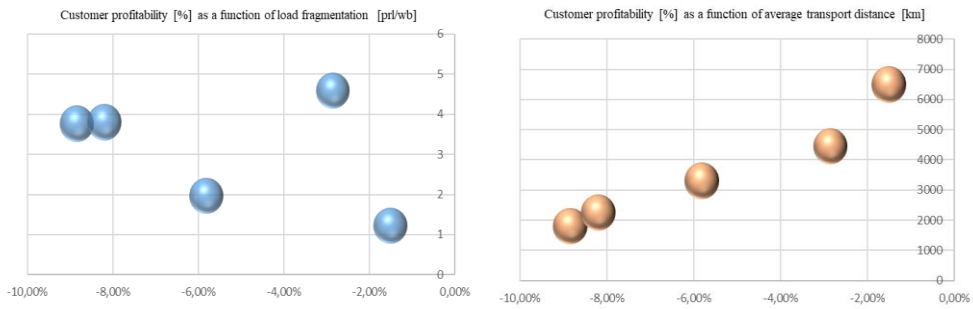
the share and allocation of shipment flows, transport options in supply chains, as well as process routes and resource usage.

Similar results of EVA improvement studies were obtained from the marginal direct cost model (CVU - Cost Volume Utility) that could be generally used as a key management tool for verify of strategic planning of multi-hub logistics network and day-to-day decisions of transport processes planning, shipment delivery and cargo flows planning.

The methods of valuation used by logistics operators are focused on measuring transport factors (e.g. distance, ADR category, palletized load, full truckload shipment, returnable pallets) and calculating transport costs. Underestimating the costs of reloading, picking, resource rotation and efficiency of their use in hubs, causes a reduction in real customer's profitability and the variation of results. The increase in the share of transport factors in the total costs of shipment delivery (e.g. distance of shipment transport or load fragmentation affecting the increase in the taxation weight) (presented in Figure 2) causes convergence of calculation results in the compared models.

The VBM model is a universal tool for the analysis and support of managerial decisions and the calculation of their financial results of EVA. The VBM model algorithm used in multi-hub network enables effective organization of processes for customers and rational planning of cargo flows variants.

Figure 2. *Customer profitability as a function of transport factors in shipment delivery.*



Source: *Own study.*

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