

AUTOMATION OF CALCULATING THE COST OF TRANSPORT SERVICES USING THE THEORY OF DECISION TREES

The purpose of research is to develop software to optimize logistics forwarding services. To optimize the operation of logistics, it was defined additional factors that influenced the cost of transportation. Data of analysis in the providing charging services is made on the basis of decision trees. Functional model of and manager of logistics forwarding organization is built. Designing of databases necessary to preserve the original information is implemented by using of Unified Modelling Language UML 2.0. It was founded an algorithm of optimal transportation costs. Software implementation script is made using language PHP and JavaScript. The developed software allows to automate the activities of transport and logistics services and improve the accuracy of calculating the cost of carriage, taking into account the climatic conditions and parameters of vehicles used in transportation.

Keywords: logistics, freight forwarding service, decision trees, functional diagram.

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АВТОМАТИЗАЦІЯ РОЗРАХУНКУ ВАРТОСТІ ТРАНСПОРТНИХ ПОСЛУГ З ВИКОРИСТАННЯМ ТЕОРІЇ ДЕРЕВ РІШЕНЬ

Метою даного дослідження є розробка програмного забезпечення для оптимізації роботи відділу логістики транспортно-експедиторської служби. З метою оптимізації роботи відділу логістики визначено додаткові чинники, що впливають на вартість перевезень. Аналіз даних при тарифікації послуг, що надаються, здійснено на базі дерев рішень. Побудовано функціональну модель діяльності менеджера з логістики транспортно-експедиторської організації. Проектування бази даних, необхідної для збереження початкової інформації реалізовано з використанням уніфікованої мови моделювання UML 2.0. Розроблено алгоритм визначення оптимальної вартості перевезень. Програмна реалізація сценарію виконана з використанням мов PHP та JavaScript. Розроблене програмне забезпечення надає змогу автоматизувати діяльність транспортно-логістичної служби та підвищити точність розрахунку вартості перевезень з урахуванням кліматичних умов та параметрів транспортних засобів, що застосовуються при транспортуванні.

Ключові слова: логістика, транспортно-експедиторська служба, дерева рішень, функціональна діаграма.

Introduction. A modern transport infrastructure of Ukraine, following the standards of world economy, gradually goes back into the side of system structural transformations, oriented to logistics. The prospects of logistics are characterized by the effect of integration IT (information technologies) and logistic subsystems in the informative and of communication systems, which conduces to a significant reduction of costs and growth of quality in the service of shippers and consignees [1].

Raising of problem in a general view and its connection with major scientific and practical tasks. On a background reformation of many enterprises and realization of their plans in relation to an output on domestic and western financial markets, IT becomes a central instrument which provides control after the business processes of organization. Integrated logistics approach to business processes has changed radically for the last decade. A management of logistic operations and supply chain grew into the highly profitable and developed sphere of economy. Optimization of supply chains and multiple access to information allows to get an additional effect from cooperation of their participants.

Object of study. The object of research are informative resources – the key element of logistic chains. Development of information technologies, in particular, allowed progress in the methods of collection, storage and treatments given many organizations to accumulate the enormous arrays of data which must be analysed. Possibilities of experts are not enough in the process of work with the large volumes of information. It generated demand for the methods of automatic research (to the analysis) of information, which with every year is constantly increased.

One of such methods of automatic analysis of data are trees of decisions. In the complement of many packages, intended for the analysis of data, the methods of their construction are already included [2, 3]. In areas, where there is a high cost of error, they serve as an excellent help for analyst or leader.

Formulation of aims of the article (tasks). A research purpose is an analysis of mechanisms process of ratification for transport services which get contractors, determination of factors which influence on changing of tariff, development of determination algorithm for final cost of transportation and it's programmatic realization.

Analysis of the last researches and publications in which the decision of this problem is founded which an author focuses on, excretions still unsolved parts of general issue, to which this article is dedicated

Considerable contribution in research of problems of transport logistics and mechanisms of optimization of logistic chains belongs to the research workers of the world, in particular, Dueker, K.J. and P. Bender. assess and summarize alternative approaches and data sources for the development of a Transportation Framework for the State of Washington [1].

Dueker, Butler, Bender, and Zhang summarize some key points from Sharing Transportation GIS Data [2].

David, Blanchard summarized that logistic guarantee that the correct materials will be delivered to the

correct location at the correct time with the correct quality and with the most competitive cost. [3]

Nuri Mehmet, and Needy Gokhan are presented a development of a simultaneous design for supply chain process for the optimization of the product design and supply chain configuration problem. [4]

A model that is measuring the influence of relational competencies on supply chain resilience: a relational view is discussed in [5].

Also, Anikin O. [6], Golubchik A.M. [7], Kizim A.O. [8], Kobzeva K.V. [9], Mirotn L.B. [10], Prokof'eva T.A. [11], Smekhov O.O. [12], Frolova L.V. [13], Chernopiskiy N.V. [14] and too many others researched this problem. In most of these works an accent is done on the theoretical aspects of logistics, a well as transport logistics. In works, devoted to transport logistics the methods of strategies choice of custom registration, determination of optimum route, choice of transport vehicle for transportation and others like that were investigated. The total worth of transportations was short-changed as a sum of cost of financial charges on transportation, packing and depreciation of transport vehicles.

The presentation of basic material researching with the complete ground of scientific results. The transport logistics is the system for organizations of delivery, namely transferring of any financial objects or matters from one point in other after an optimum route. The optimum route is that which provides an opportunity to deliver a logistic object in the shortest time with minimum charges, and also with minimum harm for the delivery's object.

Logistic charges on a transport include cost load's transporting on the different types of transport, which is determined by a tariff or chartered rate. A tariff is a price for transportation of loads, which sets by ferryman on the certain period of time. A freight – is a price on transporting, which sets by concordance between the owner of goods and ferryman on every concrete transportation.

The prices for services of motor-car ferrymen are set by enterprises independently depending on a tariff rate and tariff chart. The last is the order of calculation for transportation of load for a certain situation. Three schemes are used in practice: piecework, hourly and conditional unit of transport work. A ferryman can differentiate tariff charts and rates for users, types of load, types and brands of rolling stock. The system of tariffs has the features depending on the different types of transport. A tariff must provide the compensation of running expenses and receipt of income for a ferryman, and possibility to cover transport charges for the buyer of transport services.

On fig. 1 the diagram of businesses processes of manager's activity from logistic freight forwarding organization is presented. A diagram is built on the standard of structural design of IDEF0 with the use of Case-mean of AllFuion Process Modeler r7.

A manager gets an order from a customer on load's transportation which includes the following information: a type and weight of load, place of loading/unloading, date of loading, type of transport vehicle for this load and cost of transportation (but frequently cost of transportation is not specified by a customer). The form of addition a load is farther filled in logistics' Internet programs: lardi-trans and della, then the search of transport vehicle is executed.

When the proper transport vehicle is found, there is a process of negotiations between forwarder and the proprietor of auto or his dispatch. After that as participants of negotiations will come to the consent there is an exchange of documents, namely by such documents as: certificate of enterprise's state registration and certificate of VAT's payer. The next step of manager is skidding of got information to the database about a ferryman and customer, and creation on the basis of that information the agreement-request. The agreement-requests prints and then approves by a director or responsible person and sends to contractors on a signature. After that as dispatch will get the signed documents from both sides, transportation is considered settled and a driver can go by a load. When a driver will carry out unloading, transportation considered to be completed, and documents head to the accountant, which writes an account, acts of the executed works and tax invoice for payment of this transportation. A manager does the proper record in a journal. The mechanism of work is uncomfortable, because the incompatible with each other software is used and the result is the considerable exes of time.

Della.ua it is a transport Internet resource which gives possibility to add and dispose a load and transport on territory of Ukraine, and also out of its limits. Lardi-trans is transport-informative server, which is the most visited transport forum of Ukraine. The noted resources realize such functions as calculation of distance of transportations; search of load; search of transport; support of forum. However, on these Internet services the calculation of freightage, access, absent to the client base, possibility of request creation and main – factors which influence on the tariff of transportation are not taken into account.

With the purpose of automation cost calculation for transportations as output data it was taken tariff rates for transportation of loads by awning cars with capacity of 20 tons. Tariffs for this type of transport were determinate, on the base of personnel experience of LTD. «OPS TRANCE TREYDING» and information from transport sites. The noted tariffs set as initial standard information. The mechanism of recalculation standard tariffs in tariffs for other types of transport (refrigerator and isothermal) with other capacity (5–10 tons and 10–20 tons) is offered, season is also considered. The algorithm of recalculation is based on the using of decisions trees, which, in this case, are the method of presentation of rules in a hierarchical, successive structure, where each node checks tree meets one value of factors, which influence on the tariff of transportation.

As a rule a logical construction, presented like «If you select a specific value of factor, then initial tariff multiplied by the appropriate index». Rules are used consistently fallow a route from the root of tree to it end nodes. In the process of researching factors which influence on oscillation of tariffs for transportations of loads appeared, that each of them has more than two possible values. Therefore at the construction of determination tree for

USED AT: AUTHOR: Kostian N. PROJECT: Expeditor's work NOTES: 1 2 3 4 5 6 7 8 9 10	DATE: 28.03.2016 REV: 31.03.2016	WORKING DRAFT RECOMMENDED PUBLICATION	READER DATE CONTEXT: XXXXXXXXXX A-0
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graph TD
    S1[1 Reception of order] -- "Route" --> S2[2 Transport searching]
    S1 -- "Carrier's contacts" --> S3[3 Negotiation with carriers]
    S1 -- "Contract" --> S4[4 Input carrier's data]
    S1 -- "Application filling" --> S5[5 Application filling]
    S1 -- "Sending application to contractors" --> S6[6 Sending application to contractors]
    S1 -- "Registration documents to the archive" --> S7[7 Registration documents to the archive]

    S2 -- "Della" --> S3
    S2 -- "Lardi" --> S3
    S2 -- "Copy of certificate VAT payer" --> S3
    S2 -- "Copy of company registration certificate" --> S3
    S2 -- "Carrier's director" --> S3

    S3 -- "Form 1C" --> S4
    S3 -- "Record in the DB 'Carrier'" --> S4
    S3 -- "Application filling" --> S5
    S3 -- "Sending application to contractors" --> S6
    S3 -- "Registration documents to the archive" --> S7

    S4 -- "Application filling" --> S5
    S4 -- "Sending application to contractors" --> S6
    S4 -- "Registration documents to the archive" --> S7

    S5 -- "Sending application to contractors" --> S6
    S5 -- "Registration documents to the archive" --> S7

    S6 -- "Registration documents to the archive" --> S7

    S7 -- "Record in register" --> S7
  
```

Table 1

Factors which are taken into account on the calculation of tariffs of transportations		
	Value of attributes	Coefficient of increase
Carrying capacity	5 t.	0,4
	10 t.	0,6
	20 t.	1
Autumn	Car awning	1
	Refrigerator	1,15
	Isotherms	1,05
Spring	Car awning	1
	Refrigerator	1,1
	Isotherms	1
Summer	Car awning	1
	Refrigerator	1
	Isotherms	0,9
The winter	Car awning	1
	Refrigerator	1,2
	Isotherms	1,1

- «Contractors» – a file **contracting_parties.dbf**;
- «Requests» – a file **requests.dbf**;
- «Additional information for requests» – a file **additional_info_request.dbf**;
- «Cities» – a file **city.dbf**;
- «A type of vehicle» – a file **car_tipes.dbf**;
- «Auto on a request» – a file **cars.dbf**;

- «Tariffs» – a file **tariff.dbf**.

The information in a database is entered by a manager from logistics and used in the process of determination of initial cost transportations. A main table of bases is a table «Request». For connection between all of tables is used the type of connection «One to many».

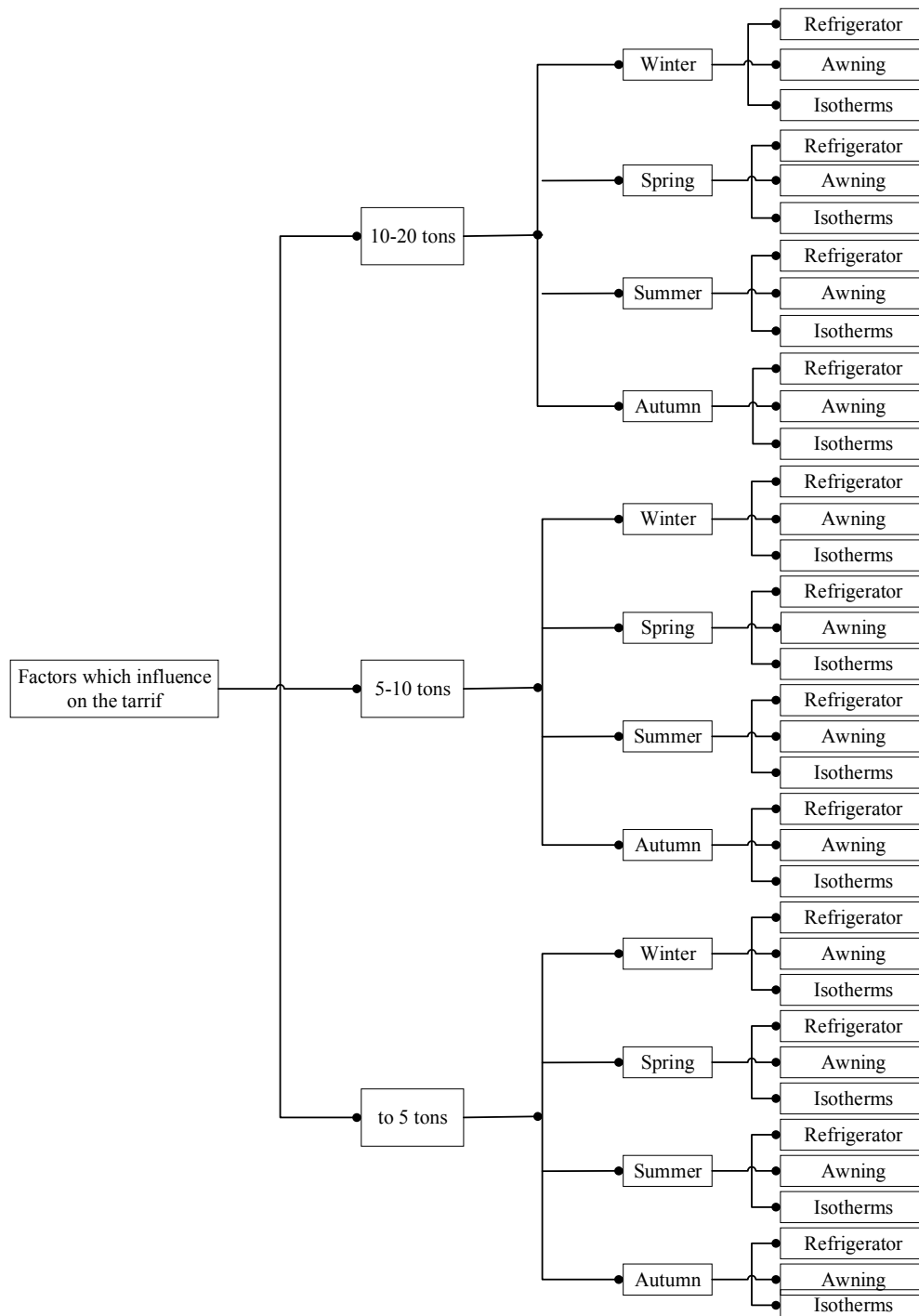


Fig. 2. Tree of factors which influence on the tariff of transportations

Designing of database is carried out in control system of relational database like MYSQL. On fig. 3 a diagram of the designed database «essence-connection» is presented.

The place «driverPrice» in the table «Request» is a calculational and determine on the basis of transportation's tariffs which are saved in a table «Tariff». Tariffs depend on the city of sending and the destination, and also from the regions of unloading points.

Programmatic realization of calculation algorithms of transportation's cost and registration of contract-request is executed in language PHP, which supports conception of the object-oriented programming. For calculation of distance on an optimum route were used objects which interacted with service of interface's routes as API Google Maps. For the normal functioning of all program's tools, it is necessary to connect a computer with the Internet. On a main page a manager enters initial information which gets from a client. At pressure of the button

«Calculate» the program determines distance and cost of transportation and lays a route on a card (fig. 4).



Fig. 3. A diagram is «essence-connection» of DB of evident area

The algorithm of determination of cost transportation considers said factors and also number of unloading cities. Such cities can be from 1 to 3. For every additional place of unloading 300 grn is added. The calculation of cost transportation is determined the following formula:

$$VT = S * P + 300 * k,$$

where VT – a freightage;

S – distance between a city loading and discharge point;

P – a price for a kilometre (tariff);

k – the number of additional unloading seats.

Using the main menu buttons you can add and view database tables records system (fig. 5).

With the purpose of placing or searching of transport vehicle or necessity load provided transition the link from the home page of the program sites lardi-trans.com but della.ua.

In an order to secure an agreement between a forwarding firm and the customer an contract- request is created on transportation of load. For this purpose it is needed to push the button of «Request» in a main menu. After skidding and maintenance of information it is possible to print it (see fig. 6).

Thus, all operations that performs logistics manager executed using a software tool and connected it to the Internet transport services.

Summary. In research the method and its software implementation that illustrate the approach for equipment of logistics automation capabilities for determining of cost of any transportations by a motor transport on the basis of standard tariff plans, taking into account the type of motor transport, and also seasonal conformities to the law of climate.

[Home](#)
[Requests](#)
[Contractors](#)
[Cities](#)
[Auto on request](#)
[Tariffs](#)
[ENGLISH](#)

Type of vehicle
Isothermal
City loading
14/11/2016
Date loading
20
Weight
Uzhhorod
Discharge point
Cherkasy
Discharge point
Dnipropetrovsk
Discharge point
- Select city -

Calculate

Distance 1288.61 km
Price 12,907.24 hrn

Lardi - trans Della

Fig. 4. Result of calculation of distance and cost

[Home](#)
[Requests](#)
[Contractors](#)
[Cities](#)
[Auto on request](#)
[Tariffs](#)

Search for... **GO**

Nr	ID	City loading	Discharge point	Traffic hrn/km.	Activity
1	26	Uzhhorod	Luhansk	8.80	
2	25	Uzhhorod	Donetsk	8.80	
3	24	Uzhhorod	Kharkiv	9.00	
4	23	Uzhhorod	Dnipropetrovsk	9.00	
5	22	Uzhhorod	Zaporizhzhia	9.00	
6	21	Uzhhorod	Sumy	8.80	
7	20	Uzhhorod	Poltava	8.50	
8	19	Uzhhorod	Simferopol	9.50	
9	18	Uzhhorod	Kherson	8.80	
10	17	Uzhhorod	Mykolaiv	8.80	

Showing 1 to 10 of 24 items

Showing 10 records

Showing 1 to 10 of 24 items

Add

Fig. 5. A revision of table is «Tariffs»

Automation of manager's work from logistic considerably will shorten time of preparation of order and will reduce the risk of error, caused overload of manager. Important advantage of the developed programmatic mean is possibility of entering base contractors and possibility of printing the necessary accounting. Areas of future research will be used to identify and use a wide range of factors that affect the cost of transport and objects that describe the scope of transport services. It is necessary to develop a module for calculating the cost of foreign transportation based on their specificity.

Contract request for the provision of freight forwarding services № NPO000000001.1 с. Cherkasy from 08.01.2016		LTD. «OPS TRANCE TREYDING» Ukraine 385524778001 285 556712016 MPO 280805 а.а. 2600995 026 PISC "Raffinon Bank Aval" Address 18015, m. Cherkasy, str. Paster, b. 99	
LLC «OPS TRANCE TREYDING» in the person of Naumchuk A.N., acting under the status of the "Forwarder" on one part and POP A. Michalish, represented by Director Oleg V. Vladimirovich Michalish, the "Customer", on the other part, acting according to the Laws of Ukraine "About automobile transport" from 23.01.2006, № 2491-6, "Rules of transportation of goods by road in Ukraine" № 262 from 14.10.1997, and the Law of Ukraine "About the freight forwarding activity" from July 1, 2004, concluded this agreement on the implementation of freight forwarding on the following conditions:			
Conditions of carriage:			
Route:		Uzhgorod-Dnipro	
1	Date and time of downloading:	20.01.2016	
	Date and time of unloading:	21.01.2016	
	Address of downloading:	Uzhgorod, m. Sotkalsk, 15	
2	Contact person and telephone:	Vladim 067212 1122	
	Address of unloading:	Dnipro, m. Korolenko, 22	
	Contact person and telephone:	Larisa 0972121122	
3	Load (weight and volume):	Pallets 20 x 16 m2	
	The requirements to transport:	dry auto	
4	Calculation:	5 5000.00, 30%, 10 days. For originals	
5	Date of ALTO:	From 01.01.2016	
	Driver (Full name, phone):	Savchenko Taras Semyonovich 0991621121	
Responsibilities of parties:			
Standard time of loading and unloading - 8 hours, including weekends and festive days; For poorly packed and loaded Customer's goods Forwarder does not bear responsibility; For vehicle downtime through Customer, they pay a fine of \$ 500 (five hundred) dollars to Forwarder for each day downtime or delay simultaneously with payment of transportation cost.			
6	The parties agreed that course downtime vehicle confirmed by waybill and in writing documents of carrier, composed in any form; In case of confirmation of the Contract request by customer with followed rejection of down loads in less than 8 hours, The customer pays a fine to Forwarder 1000 (thousand hryvnia) no later than three business days. The refusal must be confirmed in writing form.		
7	Parties commit to not disclose any information which is a trade secret or confidential information. Commercial information is information provided by the parties in the contract, concerning the material conditions of the contract, identified by the legislation of Ukraine for this type of contract. In the case of disclosure from the guilty party will be levy a fine to tenfold of the cost of transportation.		
8	Завантаження здійснюється силами і засобами клієнта, розвантаження здійснюється силами і засобами перевізника. Завантаження здійснюється силами і засобами клієнта, розвантаження здійснюється силами і засобами перевізника. Завантаження здійснюється силами і засобами клієнта, розвантаження здійснюється силами і засобами перевізника.		
ADDRESS AND REQUESTS OF THE PARTIES			
Forwarder:		Customer:	
Limited liability company "OPS TRANCE TREYDING", TIN: 3850 (471) 21-08-24, р.р. 2600995026, Bank PISC "Raffinon Bank Aval", а. Київ, MPO 280805 18015, Cherkasy region, а. Cherkasy, str. Paster, b. 99 Is a liable to income tax on general grounds		18005, а. Cherkasy, str. Solov, b. 55 0503221 199 Ukraine 385524778001 285 556712016, Certificate number 2801120467122	
Director _____ Naumchuk A.N.		Michalish Oleg Vladimirovich _____ Director	

Fig. 6. Printing variant of request

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