Multimodal Transportation Optimization For An Automobile Production in Vietnam

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Abstract. The article presents the problem of transportation cost optimization from the perspective of a Vietnam automobile manufacturer which uses multimodal transportation. One of the determining factors to the competitiveness between companies is reducing logistics cost, so the aim of this thesis is to provide the company an effective model on planning the outbound transportation network with the objective of minimizing total transportation cost. The transport cost of outbound logistics is considered and minimize objective cost optimization model in the form of Mixed Integer Linear Programming is presented. CPLEX software is applied. The model and testing data bases on the company case. The implementation details and the result of numerical experiment are presented and discussed. The article is scoped in transportation of outbound logistics of the company only.

Keywords: multimodal transportation, cost optimization, MILP.

1. INTRODUCTION

Nowadays, transportation cost takes place 30-40% logistics cost, in the case of the automobile manufacturer, 4% of the total cost for a unit of product is transportation cost. Therefore, reducing the cost in transport can save a great amount of money for companies and also make products more competitive on the market. The multimodal transportation, which can help improving transport efficiency, is defined as the transportation of goods under a single contract but performed with at least two different modes of transport (by road, sea, rail …). Outbound logistics relates to the part of supply chain which finished goods are delivered to customers.

This paper presents a mathematical model for outbound logistics cost optimization in the form of Mixed Integer Linear Programming from the perspective of a Vietnam automobile manufacturer. In the previous work, the authors presented cost optimization of supply chain with multimodal transportation, which considered three main stages of supply chain manufacturer, distribution center and customer. This paper focuses on multimodal transport of the outbound logistics and as the case study, the company use two main possible modes which are road and sea, so, four main stages are considered which are finished goods warehouse, port, distribution center and customer. Some parameters are included such as demand, production, transport, inventory etc. The purpose of this model is to determine which mode should be used in which route with suitable quantity and number of courses taken. This model can be helpful in outbound logistics transportation management as a decision support.

The rest of the paper is organized as follows: section 2 takes a short review in literature, section 3 presents the case study that this paper bases on, section 4 is the mathematical model, section 5 shows the method for model implementation, section 6 presents computational examples, section 7 is the paper conclusion.

2. LITERATURE REVIEW

The role of transportation in logistics chain is presented in a study of Tseng, Yue and Taylor in 2005 [11]. The efficiency of moving flow of products is determined by the operation of transportation and transportation takes an important part in the manipulation of logistic. A strong system needs a clear frame of logistics and a proper transport implements and techniques to link the producing procedures, and logistics services, information systems and infrastructure and resource are linked components of the system. Logistics services support movement of materials and products from inputs through production to customers. It comprises physical activities like transport and storage, etc. Information systems of logistics includes modeling and management of decision making, tracking and tracing. Infrastructure of logistics comprises human resources, financial resources, packaging materials, warehouse, transport and commutations. Transportation system is the most important economic activity among the components of business logistics systems. Value of transportation varies with different industries. For products with small volume, low weight and high value, transportation cost occupies a very small part of sale; heavy and low-valued product, transportation occupies big part of sale and affects profits more.

Maritime industry plays an important role in international freight. The advantage is that it needs longer transport time and the schedule is strongly affected by weather factors. Air freight logistics provides delivery with speed, low risk of damaged, security flexibility, accessibility and good frequency of destinations, but the disadvantage is high delivery fee. Land logistics is very important link in logistics activities. Most positive characteristic is the high accessibility level in land areas. Main transport modes of and logistics is railway, road and pipeline transport. Railway can carry large capacity, low influence by weather, low energy consumption but high cost in facility and maintenance, time consumption. Road has cheaper investment fund, high accessibility, mobility and availability, but low capacity, low safety, slow speed.

Multimodal transportation or combined transport is transportation of goods under a single contract but performed by at least two modes of transport (by rail, sea, road or air, etc.). Multimodal transportation becomes more common and continuously developed because of globalization trend, transportation with container and pallets, etc. Applying multimodal transportation would be more effective in cost minimization since advantages of every transport modes are combined such as flexibility, high frequency, just-in-time of road transport, bulk and heavy cargo, transport cost saving of sea/water transport, and others. It helps balancing the overall transportation structure, effectively serve global supply chain management, reduces unnecessary costs in logistics and just-in-time leading to reduce production cost, increases competitiveness in terms of price and quality, helps enterprises and commercial production have faster access to markets, international markets through the transport network connection and creates a partnership between government and business in order to minimize the unnecessary documents.

In 2012, the cost optimization of supply chain with multimodal transport was studied by Sitek and Wikarek [6]. This is the main article that is considered to implement this thesis. The article presents the problem of supply chain optimization from perspective of multimodal logistics provider in form of MILP. Cost of production, transport, distribution and also environmental protection are adopted in the model of the article with time, volume, capacity and mode of transport. The optimization result of the model relate to short-term decision on minimizing the cost and long-term decision on capacity of distributors or production capacity of producers. The article provides in background supply chain management problems from perspective of logistics provider. It presents the constraints relating delivery quantity between supply chain participants (manufacturers, suppliers, carriers and end users) and delivery time. The parameters relate to the multi-level of costs, capacity, all kinds of time appears in delivery flow etc. This thesis is used to plan on transportation not supply chain, therefore, some constraints and parameters are not used. The model presented by Sitek and Wikarek does not account the factor that not all kinds of product can be transported by all modes and if the mode is sea, they do not consider the port as a participant, so, these ones and some new constraints and parameters are added in the model of the thesis to adapt the case study.

Similarly in 2011, Liansheng and Jiazhen [8] also studied optimization for supply chain with multimodal transportation. But, the objective of the model is maximizing the entire supply chain profits and in addition, they considered two areas transportation and transfer parts. The article also uses not only cost of transport but also fixed capital cost and operation cost of each mode, production cost of factories keeping and handling cost at distribution centers, sell price at market, penalty cost etc. which are not considered in the model of Sitek and Wikarek.

In 2013, Zeng, Hu and Huang studied the transportation mode distribution of multimodal transportation in automotive logistics [12]. They focused on the transport mode allocation problem with road, railway and waterway modes with commodity car. In this model, the route and demand are fixed, transportation cost and time, the mode of transportation capacity constraints are considered in the case study of China. They also studied on transfer time, additional storage cost, penalty cost, inventory cost waiting time in the model like Liansheng and Jiazhen but wider.

Lewis, Rosholdt and Wikinson [7] presented a comprehensive transportation network which explore the unique capabilities of large-scale, high-speed computing equipment in evaluating large complex transportation schemes. They suggested clearly many category of data input for a multimodal transportation model which helps in multimodal transportation analysis and modeling.

A planning model for multi-mode transportation system operations was presented by Nihan and Morlok in 1976 [5]. The model in the article is optimal network operations model which is a transportation planning model in transport policy-making. Beside the network between modes, they studied on vehicle flow network and person flow network. The model objective is also to minimize the cost but they considered a lot of complicated types of constraints that are not mentioned in the two articles above including demand-supply relationship, policy, accessibility, social state, profit, budget constraints etc. These constraints are very realistic but it is difficult to measure the exact data which relates to social state or policy etc...

Crainic and Rousseau in 1986 [9] presented a general modeling framework for the service network design problem for multimode multicommodity freight transportation base on network optimization model which could assist tactical strategic planning process. Decomposition and column generation principles are used to solve the problem with means of an algorithm.

3. THE CASE STUDY

This section introduces the real case study of an automobile manufacturer outbound logistics that this model bases on. This model makes a lot of assumption to simplify the real case constraints and later the project would be studied further than the model this paper presents to satisfy the real-time case.

As mentioned, the model in this paper attempt to apply to a real case study of a Vietnam automobile manufacturer outbound logistics. This company uses multimodal transportation with road and sea modes, and they have problem with the high outbound transportation cost, for each unit of product, the transport cost takes place 4% which is very high. The aim of this paper is to create a model that provide the company a better decision support, the model should be close to the real case, the real constraints as much as it could.

In the company case, with the road mode, the products (cars/trucks) are put in a larger delivery truck to be delivered, they have four different types of delivery trucks with different capacities. But due to the type of the product here are car and truck, some products are allowed to be delivered by themselves directly to customers, no need delivery truck, and to some products, a truck product may also carry another car product to deliver both at the same time without delivery truck. The sea mode is simpler but to mention, the company containerized the products then put them on the ships, normally each 40 ft container can have two cars or trucks, but some products can carry other product as mentioned above, so a container may have 2-4 products inside. The companies owns two delivery ships with different capacities. In the previous studied model, the parameters to tell the differences between modes are transport unit capacity, the transport cost and time of each mode. With this case of the company, there can be basically eight different modes of transport: two modes for two different ships, fours modes for four different delivery trucks, two modes for drive-alone product and one-carry-one product.

The company uses sea mode and they want that depending on the demand quantity and time, the delivery better be carried out directly from port to customers without being through distributors so the cost of distributor and transport can be saved. Therefore, delivery network in this paper includes finished goods warehouse at manufacturer, ports/port storages, distribution centers/distributors and customers/ showrooms/ agencies. The outbound delivery network can be described in Fig 1, this network bases on the information provided by company.

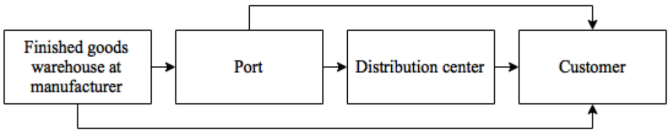
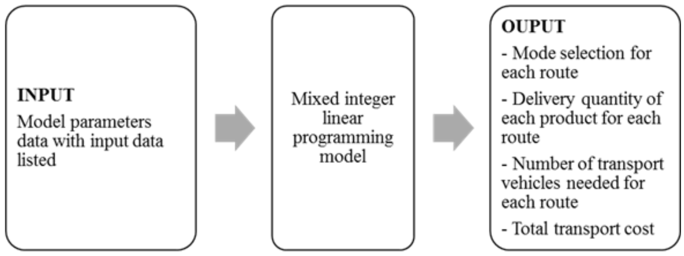


Fig1. The outbound logistics network of the case study

4. MATHEMATICAL MODEL



Symbol	Description
Index	
i	Warehouse/Finished goods warehouse at manufacturer (i=1..I)
j	Port (j=1..J)
k	Distributor/Distribution center (k=1..K)
s	Customer (Showroom and agency) (s=1..S)
p	Product (p=1..P)
m	Mode (m=1..M)
Parameters	
O_{ip}	Output of product p from manufacturer stored at warehouse i
D_{sp}	Demand of product p at customer s
DL_{sp}	Required time from customer s to complete delivery of product p

CP_j	Max capacity of port j
PT_j	Time preparing shipment at port j
CD_k	Max capacity of distributor k
DCT_k	Time preparing shipment at distributor k
CM_m	Capacity of transport vehicle of mode m
NM_m	Number of transport vehicles of mode m
B_{pm}	Equals 1 if product p can be carried by mode m
$T1_{ijm}$	Time to deliver by mode m from warehouse i to port j
$T2_{ism}$	Time to deliver by mode m from warehouse i to customer s
$T3_{jsm}$	Time to deliver by mode m from port j to customer s
$T4_{jkm}$	Time to deliver by mode m from port j to distributor k
$T5_{ksm}$	Time to deliver by mode m from distributor k to customer s
$A1_{ijm}$	Equals 1 if mode m can be used to deliver from warehouse i to port j, equals 0 otherwise
$A2_{ism}$	Equals 1 if mode m can be used to deliver from warehouse i to customer s, equals 0 otherwise
$A3_{jsm}$	Equals 1 if mode m can be used to deliver from port j to customer s, equals 0 otherwise
$A4_{jkm}$	Equals 1 if mode m can be used to deliver from port j to distributor k, equals 0 otherwise
$A5_{ksm}$	Equals 1 if mode m can be used to deliver from distributor k to customer s, equals 0 otherwise
$C1_{ijpm}$	Transport cost of delivering product p by mode m from warehouse i to port j
$C2_{ispm}$	Transport cost of delivering product p by mode m from warehouse i to customer s
$C3_{jspm}$	Transport cost of delivering product p by mode m from port j to customer s
$C4_{jkpm}$	Transport cost of delivering product p by mode m from port j to distributor k
$C5_{kspm}$	Transport cost of delivering product p by mode m from distributor k to customer s
Decision variables	
$X1_{ijpm}$	Quantity of product p delivered by mode m from warehouse i to port j
$X2_{ispm}$	Quantity of product p delivered by mode m from warehouse i to customer s
$X3_{jspm}$	Quantity of product p delivered by mode m from port j to customer s
$X4_{jkpm}$	Quantity of product p delivered by mode m from port j to distributor k
$X5_{kspm}$	Quantity of product p delivered by mode m from distributor k to customer s
$Y1_{ijm}$	Equals 1 if mode m is used to deliver from warehouse i to port j
$Y2_{ism}$	Equals 1 if mode m is used to deliver from warehouse i to customer s
$Y3_{jsm}$	Equals 1 if mode m is used to deliver from port j to customer s
$Y4_{jkm}$	Equals 1 if mode m is used to deliver from port j to distributor k
$Y5_{ksm}$	Equals 1 if mode m is used to deliver from distributor k to customer s
$Z1_{ijm}$	Number of transport vehicles needed using mode m from warehouse i to port j
$Z2_{ism}$	Number of transport vehicles needed using mode m from warehouse i to customer s
$Z3_{jsm}$	Number of transport vehicles needed using mode m from port j to customer s
$Z4_{jkm}$	Number of transport vehicles needed using mode m from port j to distributor k
$Z5_{ksm}$	Number of transport vehicles needed using mode m from distributor k to customer s
M	Large number

$$Minimize \quad Z1 = \sum_{i}^{I}\sum_{j}^{J}\sum_{p}^{P}\sum_{m}^{M} C1_{ijpm} * X1_{ijpm} + \sum_{i}^{I}\sum_{s}^{S}\sum_{p}^{P}\sum_{m}^{M} C2_{ispm} * X2_{ispm} + \sum_{j}^{J}\sum_{s}^{S}\sum_{p}^{P}\sum_{m}^{M} C3_{jspm} * X3_{jspm} + \sum_{j}^{J}\sum_{k}^{K}\sum_{p}^{P}\sum_{m}^{M} C4_{jkpm} * X4_{jkpm} + \sum_{k}^{K}\sum_{s}^{S}\sum_{p}^{P}\sum_{m}^{M} C5_{kspm} * X5_{kspm} + \sum_{i}^{I}\sum_{j}^{J}\sum_{m}^{M} Z1_{ijm} + \sum_{i}^{I}\sum_{s}^{S}\sum_{m}^{M} Z2_{ism} + \sum_{j}^{J}\sum_{s}^{S}\sum_{m}^{M} Z3_{jsm} + \sum_{j}^{J}\sum_{k}^{K}\sum_{m}^{M} Z4_{jkm} + \sum_{k}^{K}\sum_{s}^{S}\sum_{m}^{M} Z5_{ksm} \quad (1)$$

Subject to:

$$\sum_{j=1}^{J}\sum_{m=1}^{M} X1_{ijpm} + \sum_{s=1}^{S}\sum_{m=1}^{M} X2_{ispm} \le O_{ip} \quad for \ i \in I, p \in P \quad (2)$$

$$\sum_{j=1}^{J}\sum_{m=1}^{M} X3_{jspm} + \sum_{k=1}^{K}\sum_{m=1}^{M} X5_{kspm} + \sum_{i=1}^{I}\sum_{m=1}^{M} X2_{ispm} \ge D_{sp} \quad for \ s \in S, p \in P \quad (3)$$

$$\sum_{i=1}^{I}\sum_{m=1}^{M} X1_{ijpm} = \sum_{s=1}^{S}\sum_{m=1}^{M} X3_{jspm} + \sum_{k=1}^{K}\sum_{m=1}^{M} X4_{jkpm} \quad for \ j \in J, p \in P \quad (4)$$

$$\sum_{j=1}^{J}\sum_{m=1}^{M} X4_{jkpm} = \sum_{s=1}^{S}\sum_{m=1}^{M} X5_{kspm} \quad for \ k \in K, p \in P \quad (5)$$

$$\sum_{i=1}^{I}\sum_{p=1}^{P}\sum_{m=1}^{M} X1_{ijpm} \le CP_j \quad for \ j \in J \quad (6)$$

$$\sum_{j=1}^{J}\sum_{p=1}^{P}\sum_{m=1}^{M} X4_{jkpm} \le CD_k \quad for \ k \in K \quad (7)$$

$$Y1_{ijm} * T1_{ijm} + Y1_{ijm} * PT_j + Y3_{jsm} * T3_{jsm} \le DL_{sp} \quad for \ i \in I, j \in J, s \in S, m \in M, p \in P \quad (8)$$

$$Y1_{ijm} * T1_{ijm} + Y1_{ijm} * PT_j + Y4_{jkm} * T4_{jkm} + Y4_{jkm} * DCT_k + Y5_{ksm} * T5_{ksm} \le DL_{sp} \quad for \ i \in I, j \in J, s \in S, k \in K, m \in M, p \in P \quad (9)$$

$$Y2_{ism} * T2_{ism} \le DL_{sp} \quad for \ i \in I, s \in S, m \in M, p \in P \quad (10)$$

$$B_{pm} * A1_{ijm} * Z1_{ijm} * CM_m \ge X1_{ijpm} \quad for \ i \in I, j \in J, m \in M, p \in P \quad (11)$$

$$B_{pm} * A2_{ism} * Z2_{ism} * CM_m \ge X2_{ispm} \quad for \ i \in I, s \in S, m \in M, p \in P \quad (12)$$

$$B_{pm} * A3_{jsm} * Z3_{jsm} * CM_m \ge X3_{jspm} \quad for \ j \in J, s \in S, m \in M, p \in P \quad (13)$$

$$B_{pm} * A4_{jkm} * Z4_{jkm} * CM_m \ge X4_{jkpm} \quad for \ j \in J, k \in K, m \in M, p \in P \quad (14)$$

$$B_{pm} * A5_{ksm} * Z5_{ksm} * CM_m \ge X5_{kspm} \quad for \ k \in K, s \in S, m \in M, p \in P \quad (15)$$

$$\sum_{i=1}^{I}\sum_{j=1}^{J} Z1_{ijm} + \sum_{i=1}^{I}\sum_{s=1}^{S} Z2_{ism} + \sum_{j=1}^{J}\sum_{s=1}^{S} Z3_{jsm} + \sum_{j=1}^{J}\sum_{k=1}^{K} Z4_{jkm} + \sum_{k=1}^{K}\sum_{s=1}^{S} Z5_{ksm} \le NM_m \quad for \ m \in M \quad (16)$$

$$\sum_{p \in \{1,2,4,5,7\}}\sum_{m=8} X1_{ijpm} \ge \sum_{p \in \{9..14\}}\sum_{m=8} X1_{ijpm} \quad for \ i \in I, j \in J \quad (17)$$

$$\sum_{p \in \{1,2,4,5,7\}}\sum_{m=8} X2_{ispm} \ge \sum_{p \in \{9..14\}}\sum_{m=8} X2_{ispm} \quad for \ i \in I, s \in S \quad (18)$$

$$\sum_{p \in \{1,2,4,5,7\}}\sum_{m=8} X3_{jspm} \ge \sum_{p \in \{9..14\}}\sum_{m=8} X3_{jspm} \quad for \ j \in J, s \in S \quad (19)$$

$$\sum_{p \in \{1,2,4,5,7\}}\sum_{m=8} X4_{jkpm} \ge \sum_{p \in \{9..14\}}\sum_{m=8} X4_{jkpm} \quad for \ j \in J, k \in K \quad (20)$$

$$\sum_{p \in \{1,2,4,5,7\}}\sum_{m=8} X5_{kspm} \ge \sum_{p \in \{9..14\}}\sum_{m=8} X5_{kspm} \quad for \ k \in K, s \in S \quad (21)$$

$$Z1_{ijm} \le M * Y1_{ijm} \quad for \ i \in I, j \in J, m \in M \quad (22)$$

$$Z2_{ism} \le M * Y2_{ism} \quad for \ i \in I, s \in S, m \in M \quad (23)$$

$$Z3_{jsm} \le M * Y3_{jsm} \quad for \ j \in J, s \in S, m \in M \quad (24)$$

$$Z4_{jkm} \le M * Y4_{jkm} \quad for \ j \in J, k \in K, m \in M \quad (25)$$

$$Z5_{ksm} \leq M * Y5_{ksm} \quad for \ k \in K, s \in S, m \in M \quad (26)$$

$$X1_{ijpm}, X2_{ispm}, X3_{jspm}, X4_{jkpm}, X5_{kspm} \geq 0 \ for \ i \in I, j \in J, k \in K, s \in S, p \in P, m \in M \quad (27)$$

$$Z1_{ijm}, Z2_{ism}, Z3_{jsm}, Z4_{jkm}, Z5_{ksm} \geq 0 \ for \ i \in I, j \in J, k \in K, s \in S, m \in M \quad (28)$$

$$Z1_{ijm}, Z2_{ism}, Z3_{jsm}, Z4_{jkm}, Z5_{ksm} \ are \ integers \ for \ i \in I, j \in J, k \in K, s \in S, m \in M \quad (29)$$

$$Y1_{ijm}, Y2_{ism}, Y3_{jsm}, Y4_{jkm}, Y5_{ksm} \in \{0,1\} \ for \ i \in I, j \in J, k \in K, s \in S, m \in M \quad (30)$$

The objective function (1) defines the total transportation cost including labor cost, fuel cost, road tax and product insurance and total the number of used vehicles. Constraint (2) ensures that total delivering quantity from warehouse does not exceed the production capacity at manufacturer. Constraint (3) specifies that total delivering quantity from port/distributor/warehouse to customers should satisfy or may exceed the customer demand. Constraint (4) and (5) balances the delivering quantity goes through port and distributors. Constraint (6) and (7) ensure that the delivering quantity from warehouse to port does not exceed the port storage capacity and delivering quantity from port to distributor does not exceed the distributor capacity. Constraint (8), (9), (10) cover the total transport time between locations does not exceed the required time to complete shipment of customer. Constraint (11) to (15) guarantee the delivering quantity does not exceed the capacity of transport unit of mode. Constraint (16) defines the delivering with available transport. Constraint (17) to (21) set a specific characteristic of mode one-carry-one that any product in set of product 1, 2, 4, 5, 7 can carry any product in set of product 9...14. Constraints (22) to (26) set values of decision variables base on binary variables. Constraint (27) to constraint (30) arise from the nature of the model.

5. METHOD

The model was run with CPLEX. The IBM ILOG CPLEX Optimizer is an optimization software package and a very powerful tool helps creating and solving mathematical optimization model. [] CPLEX can solve integer programming, very large linear programming problems using primal or dual variants of the simplex method or the barrier interior point method, convex and non-convex quadratic programming problems, and convex quadratically constrained problems. The CPLEX Optimizer has a modeling layer called Concert providing interfaces to C++, C# and Java languages. It is very useful that CPLEX provides connector to Microsoft Excel. The language of CPLEX is different from other software but when getting used to it, it can be found that CPLEX is very convenient. IBM also has a forum of IBM developers where CPLEX experts and users can interact and discuss on any problems arising from CPLEX. The model was implemented by coding the mathematical model in CPLEX language with full objective function, constraints, parameters etc. There are three main parts of coding which are code for pulling data from excel in matrix form (this model has more than two dimensions matrix and excel does not support more than two dimensions matrix display), code for mathematical model and code for display result data to excel. The model can be saved in text file using any text editor.

6. COMPUTATIONAL EXAMPLE

A one week data set for multimodal transport planning of the company with 14 products, 8 modes, 1 finished good warehouse, 3 distributors, 2 port warehouses and 140 customers was inputted to find optimal solution of the model. The company current available resources are used with no outsource. The cost optimization model was implemented in the CPLEX environment. The total transportation cost result from the model comparing to the estimated current transportation cost at the company, is 13% better.

The computational time in total to reach optimal solution is 3 minutes 44 seconds and 70 ticks. The results do not violate the constraints. Due to the large size of result, a small part of computational result is discussed:

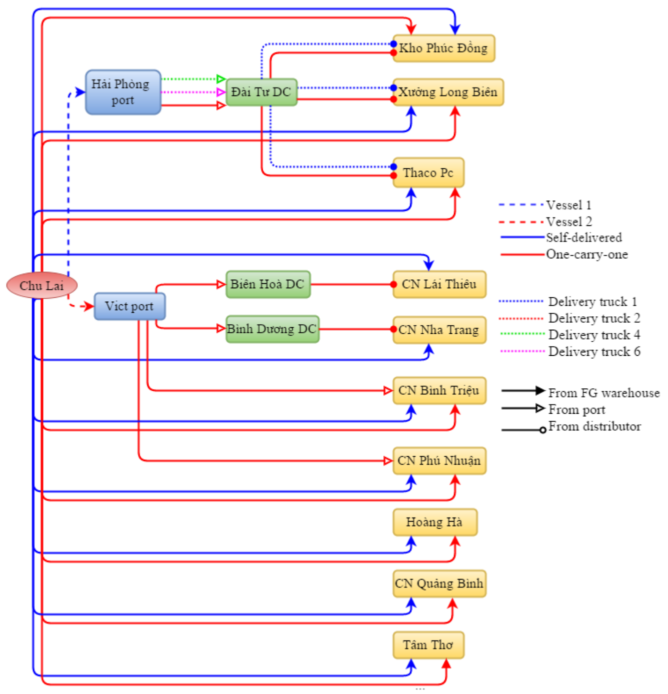


Fig 2: Example of mode selection network

Mode	From FG warehouse	To Port	No. of vehicles needed	Product	Quantity (unit)
Ship1	Chu Lai	Hải Phòng	1	Product 1	46
Ship1	Chu Lai	Hải Phòng		Product 2	21
Ship1	Chu Lai	Hải Phòng		Product 9	55
Ship1	Chu Lai	Hải Phòng		Product 10	61
Ship1	Chu Lai	Hải Phòng		Product 11	29
Ship1	Chu Lai	Hải Phòng		Product 12	28
Ship1	Chu Lai	Hải Phòng		Product 13	34
Ship1	Chu Lai	Hải Phòng		Product 14	26

Table 1: An example of the result

From the network and result table example, it can be described that one vessel type 1 is used for the route Chu Lai - Hai Phong port to transport 46 units of product 1, 21 units of product 2, 55 units of product 9, 61 units of product 10, 29 units of product 11, 28 units of product 12, 34 units of product 13 and 26 units of product 14. It is similar to other results.

Generally, base on the output of decision variables, one can make decision from tactical level which included mode of transport, the need for different means of transport. The value of decision variables Z1... Z5 determines the number of transport units needed for the route and X1… X5 determines the delivery quantity of each product in the route. In practical, this thesis presents an applicable method on planning for multimodal transportation and it can be used as a part of the transportation planning of the company planning department.

7. CONCLUSION

In this paper, Mixed Integer Linear Programming is applied to find optimal solution on multimodal transportation planning. Working on the case study, the research is more practical, knowledge in supply chain management, logistics and transportation is expanded and the model in the thesis can be implemented with real-time data. The presented transportation cost optimized model and its computational result can be used as a part of the transportation planning which supports in decision making from tactical level on the mode of transport, the need for different means of transport and with the delivery quantity, at the same time satisfying customer requirement in quantity and time.

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