VIRTUAL LOGISTICS NETWORK FOR SUPPORTING THE SUPPLIER SELECTION

Katalin Buczkó, Béla Illés

University of Miskolc

Abstract: Companies are going to become more and more dependent on their suppliers, so an unfavourable supplier could cause unfavourable consequence. With a logistics network this reliability and accuracy can be increased considerably. However, an online computer-aided network should be constructed to provide continouos communication among the network members. Undecent information flow might cause problem with the suppliers and, as a result missed material delivery. Another task of teh logistic network is involved in matching the assembly and supplying companies regarding the mutual requirements as well. In this paper we will give a theoretical solution to this problem. We have worked out an optimization process that consider several factors (like price, quality, capacity and cost) so as to select the best manufacturing company for a given task.

Keywords: Virtual logistics, logistics network, supplier selection

1. Virtual logistic network

The network itself is an integrated business model for logistics management. It covers the flow of goods from suppliers through manufacturing and distribution chain to the end consumer. The virtual arrangement create a network of suppliers, manufacturers and administrative services to accomplish specific objectives, such as flexibility and reliability.

Therefore, the objectives of the network is the overall fulfillment of consumers' expectations. Within the traditional supplier/client relationship, various strategies can be considered such as:

- *Quality*: Supplier is needed to please customers'claims with considering the overall expectations.
- *Cost*: Customer chooses the best supplier from the point of the expected quality with the cheapest price.
- *Delivery*: is to contract specified issues of the contracted product, its accurately agreed quantities and the due date of delivery. Safety stock is necessary so that delivery delays be avoided.
- *Flexibility*: Customer is continuously monitoring the suppliers' market. If supplier's contracted transporter deliver too expensive, customer should change it.
- *Relationship between the companies* in a logistic network: within the range of products on the scales from the raw material to the standardized end product, customer provide the steps of developing and further processing.
- Customer provide the outsourcing of manufacturing, unit-parts and semi-finished products moreover control the quality at the event of takeover.

Therefore, it is necessary to work out a logistic network, which is capable to treat the above listed problems. Firstly we are to check the potential members of the network, then the hierarchical connections among its parts, afterwards the material and information flow, in the end - the overall network. The network include the logistic and information elements from the offer's market to the customers'. The network itself will make possible the mutual connection between customers, network partners and suppliers.

Elements of the network are the followings:
1. Logistics center (LC) – having management and organizational tasks,
2. Logistics service companies (LSC) – providing logistics services like transportation, storing, means of transportation,
3. Manufacturing companies (MC) – manufacturing raw materials, semi-finished goods or parts,
4. Assembly companies (AC) – producing finished products,
5. Services companies (SC) – providing services (not logistics services),
6. Innovation centre (IC) – performing researches (like universities),
7. local governments, chambers of commerce (LG) – can influence the operation of the network.

We should emphasize those elements from the above, which directly influence the reliability of continuous material supply. Although several logistic centres are possible to gain the membership in the logistic network, a central management is necessary which coordinate the material and information flow.
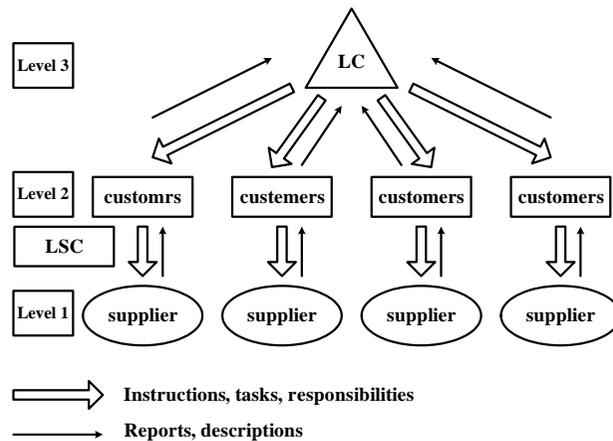

Figure 1. Information flow of a logistic centre

In Figure 1. you can follow the direction of the information flow according to which the information will get to the logistic centre that is capable to make decisions with high reliability and accuracy, because all the information regarding the customers and suppliers is available. To forward the current information to the logistic centre central database is to set up so that a communication line should be operated. This database include statical data - name of the company, seat of the company, dynamic data like the company activities, available resources, capacities providing reliable service for decision making to the LC.

2. Logistic optimization

Each decision involves the analysis of possible future events (costs, outcomes, markets etc.) furthermore involves the choice of competing alternatives. To make a decision is to make a choice. Each decision involves the analysis of available inforrnation and ultimately the selection of a choice among alternatives with varying degrees of uncertainty. High quality decisions do not always mean that they are the optimal ones. If we regard the material supply of one company we can meet several questions to consider. E. g:

- Which company is capable to manufacture the product (raw material, semi-finished goods, parts)?
- How much is to pay for an agreed quality?
- How far is the supplier?
- What is the capacity?
- Is there a company that is capable to produce the expected amount on its own?
- If not - which companies can do that in cooperation?

At the moment logistic optimization means an ultimate possibility for companies for a considerable cost reduction. Companies have made huge strides in automatizing processes. Collecting data in the field of logistics is neither simple, nor cheap but with the help of optimizing costs can be reduced by 10-40%.

3. Making decision

To choose the best supplier we can have 3 choices: '
1. *New task situation*: To choose a new supplier so as to deliver a new product, in this case the highest risk is to calculate with
2. *Modified rebuy*: New product is to deliver by an existing supplier.(As this supplier proved reliability, risk is not so high than in 1)
3. *Straight rebuy* Reviewing momentary supplying activities. To review if they ~need to replace. Risk is the lowest related to the above two.

Before all other steps 4 decision making steps are to understand:
1. What are the objectives to achieve? To discuss the problem that is to solve.
2. Defining the criteria - Criteria depend on the problem see above in step 1.
3. Pre-qualifying suitable suppliers: It means a detailed examination of acceptable (and not all) current suppliers. Their examination is going in more than one steps so that to reduce the existing number of suppliers
4. Making the final choice: Final decision can be made according to a multiply method the simplest of which is the so called „linear weight method ".The ultimate weight is for that . element which has the ultimate importance. Weight factors are summarized, therefore one number belongs to each supplier. The choice fall onto that one who achieves the highest value.

These steps are to do for comparability, because participating factors have different dimensions.
Choice can be made according to the criteria listed below:
1. Which company can produce the given product?
2. How much does the product cost[Euro/unit]?
3. Quality of the delivered product (e.g.: size: ppm - in chemistry)
4. How far is the supplier from the customer?

5. Capacity of each company
   - Can they produce the ordered quantity? (yes/no)
   - Effective capacity (amount/day).

Considering the above points a list can be compiled for each case with that company on the head which ultimately please the expected criteria. After this a comparison matrix is to generate (column matrix) one element of which on its total includes all influencing factor.

To take the work more transparent, this paper deals only with the case that regards one customer and one product. (One customer would like to find one product.)

One element of this comparison matrix is obtained using the following formula:

$$a_{xi} = k_{xi} \cdot (p_{xi} + q_{xi}) \tag{1}$$

where
  $i=1,\ldots k;$ – companies possess sufficient capacity,
  a_{xi} – total comparison index of company "i" having sufficient capacity in product x, according to which the decision can be made
  k_{xi} – transportation costs between the company "i" and the customer

$$k_{xi} = d_{xi} \cdot p \tag{2}$$

where
  d_{xi} – distance between the company "i" and the customer,
  $p =$ constant
  p_{xi} – price index of the company "i",
  q_{xi} – quality index of the company "i",

So, the optimal solution can be chosen by choosing the minimal number:

$$\min_{1 \leq i < k} \{a_{xi}\} \tag{3}$$

In the previous case we examine only those companies that have sufficient capacity to deliver the ordered amount on their own, but we also have to examine companies as well; when more than one company deliver whether a better result could be achieved. Final decision is to make after examining all the above cases.

Table 1. Choosing the best transporter acc. to the summarized results

Way of satisfying the demand	Best solutions
One company satisfies the whole ordered quantity	$\min_{1 \leq i < k} \{a_{xi}\}$
Two companies satisfy the ordered quantity	$\min_{1 \leq \delta < s} \{a_{x\delta}\}$
Three companies satisfy the ordered quantity	$\min_{1 \leq \varepsilon < r} \{a_{x\varepsilon}\}$
…	…

Not only choosing the transporter, but to choose each member of the network will be decisive so you need to calculate and conclude the best partner companies thoroughly, first of all to consider the customers' claim.

4. Summary

To solve the emerging problems, authors find it important to show and compare how to use various optimizing methods so that specialists choose the best company for a given delivery. To set up database, authors choose the hierarchic data model. At present status of research authors considered only a general view. Parameters were to convert to parameters without dimension so as to result good comprehensibility. Authors worked out a mathematical model that is capable to choose that transporter (company or group of companies) who is most suitable to carry out a given delivery considering the influencing factors - price, quality, capacity, distance, delivery cost. In following steps of this research authors want to describe the influencing factors in a more specific way. Finally, we find necessary to remark that with all of our steps will regard to please the customers' claim.

References

[1] CSELÉNYI, J., TÓTH, T.: **Mathematical model for optimisation of a product assembly system integrated by logistics and operating in a network like way** WESIC 2001. Workshop on European Scientific and Industrial Collaboration. University of Twente. Published by Drubbel Institute for Mechatronics. Proc.

[2] MIKE P. CLARKE: **Virtual logistics: An introduction and overview of the concepts** International Journal of Physical Distribution 1998/28/7 ISSN:0960-0035, pp.486-507.

[3] DÁVID RŐMER: **The various form of purchasing in the partnership strategies** Department of Building Machines, Material Handling Machines and Plant Logistic Faculty of Transportation Engineering Budapest University of Technology and Economics Nov. 27. 2002

[4] A. GUNASEKARAN, E. W. T. NGAI: **Virtual supply-chain management** Production Planning & Control, Vol. 15, No. 6, September 2004, ISSN 0953-7287, pp. 584-595

[5] DON RATLIFF: **10 rules for logistics optimization** White Paper, 2003 Velant Inc.

[6] SZEGEDI ZOLTÁN: **Logisztika menedzsereknek**, Kossuth kiadó, Budapest, 1999., 15-28.

[7] HORVÁTH GYULA: **Lineáris programozás a gyakorlatban**, A Budapesti Műszaki Egyetem mérnöki továbbképző Intézete előadássorozatból: 5030, Budapest, 1981.