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ASSEMBLY AND DISASSEMBLY HALLS SUPPLIED BY LOGISTICS NETWORK

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Abstract
Nowadays both manufacturing and assembly companies have dealed with reducing costs while continuously overseeing the improvement of the quality so that they require accuracy, reliability and high standard quality from their suppliers. With a properly formed logistics network this reliability and accuracy can be provided. Besides this, however, an online computer-aided network should be built up to provide the fluent communication between the members of the logistics network.
Keywords
Logistics network, assembly and disassembly halls, efficiency improvement, cooperation, communication system.

1. PROBLEM STATEMENTS

Due to the not properly organized material supply whole assembly lines can stop causing high costs and overstepping of the deadline. The lack of material can originate in the lack of information, which can occur both in the client company and the supplier company. In assembly companies the required quantity of the material frequently fluctuate which lead to capacity problems (i.e. not to fill the orders). These problems are the consequences of the instable economic and market conditions of supplier companies. They can't supply not only the proper quantity and quality of parts but they can't meet the requirements of assembly lines within an adequate time. This information and capacity problems can be solved by establishing a logistics network and computer network between the members in order to provide the principles of the cooperation. This online connection comes into being through a central database. The other problem is to join the assembly companies and the companies manufacturing raw materials, semi-finished goods or parts.

2. APPLICATION AREA

As managing with cost in a realistic way is becoming more and more significant logistics get a more and more important role in the economy of the company. Logistics forms the activities of the companies into a closed system and integrates the purchasing of raw materials, semi-finished goods and parts, distribution and recycling processes of the finished products into one complex chain. A developed

cooperation form is creating network, which can provide numerous advantages for its members:

- multiplication of resources,
- reducing and sharing costs,
- more complex services,
- higher and more reliable incomings,
- cheaper purchasing,
- more intensive communication,
- getting more information for the market environment,
- faster innovation.

So, the network can operate as a complex company also providing numerous advantages for companies who have resort to its services:

- more accuracy transit times,
- more reliable transit quantities,
- providing continuous material supply,
- improvement of the quality,
- meeting the requirements comprehensively with help of the online connection.

The basis of the network cooperation is the confidence between the members. Due to the internet accessing the information is easier than before, so people have much more possibilities for being in communication and the geographical barriers of the information flow have ceased. For the sake of feasibility and operability of the network, first the aim of the network should be determined. Many industries have the possibility to forming network but now we will involve in companies offering or requiring logistics services.

3. RESEARCH COURSE

During the resource course a logistics network have been revealed to solve these problems mentioned above. Firstly the potential members of the network, the possible (hierarchical) connection and the material and information flow between them should have been worked out and then the structure of the network should have been determined. The potential members of the network are as follows:

1. Logistics center (LC) – having management and organizational tasks,
2. Logistics service companies (LSC) – providing logistics services like transportation, storage, letting of 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.

Among these elements we have to emphasize those which influence directly the reliability of the continuous material supply. The material and information flow between these elements can be seen it the following figure (Fig.1.)

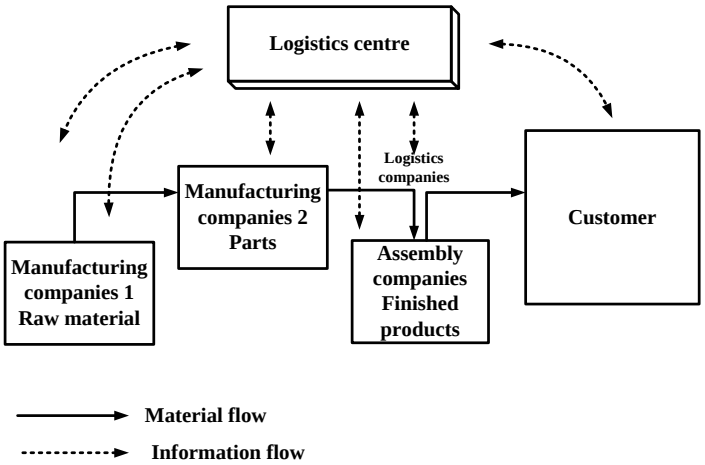

Fig.1. Connection between the logistics centre and the manufacturing and assembly companies

The direction of the information flow can be seen very well in this figure that is the logistics centre gets all of the information, so it can take its decisions with great reliability and accuracy knowing the requirements of both the clients and the suppliers. This is the reason why a central database should be created through which the communication can be possible. The database has to meet serious security regulations so that incompetent people couldn't reach it. This database will contain static data (for example: the name, address or management of the company, etc.) and dynamic data (for example: scope of activities, resources, capacity, etc.), which can serve a reliable basis to the LC in taking its decisions. Decision making process can be seen in Fig. 2.

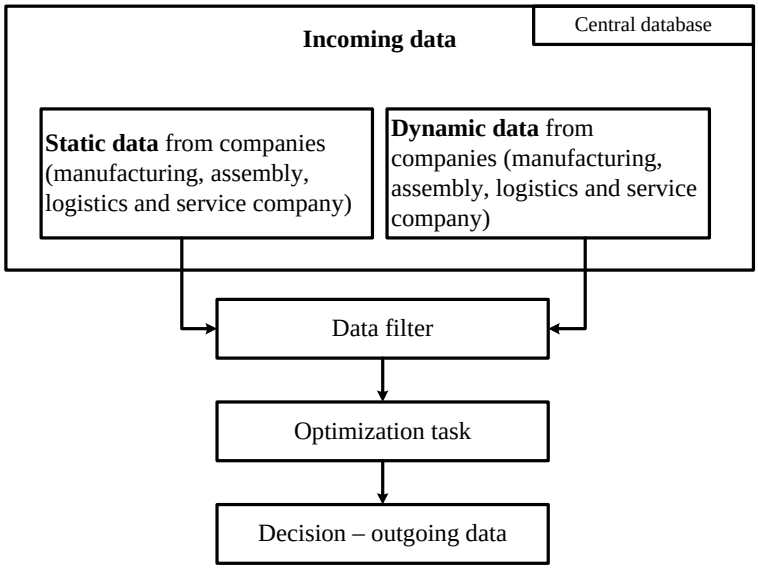

Fig. 2. The decision making process using data from the central database

The database have been built up according to the principles of hierarchic data model, in which information is stored from companies (i.e. the manufactured raw materials, semi-finished goods or parts, manufacturing capacity, quality of the products, storage capacity, types of means of transport, other services). In connection with the material supply of assembly halls questions are emerged as follows:

- which companies can manufacture the required raw materials, semi-finished goods or parts,

- what is the price and the quality of the products being manufactured by them,
- how far are the manufacturing companies from the client's company,
- what is the capacity of these companies,
- are there any company being able to produce the whole amount of the required products,
- if there aren't any company being able to produce the whole amount of the required products, which group of companies can provide it,
- which logistics company or group of companies can transport the required quantity at the lowest price.

Selection is done according to the following factors taken into account:

• Price of the product (Euro/item)

$P_{tx} \rightarrow$ min

$P_{tx} \rightarrow p_{tx}$ (index without dimension)

• Quality of the product (ppm number)

$Q_{tx} \rightarrow$ min

$Q_{tx} \rightarrow q_{tx}$ (index without dimension)

• Distance between companies being able to produce the required products

$D_t \rightarrow$ min

$D_t \rightarrow d_t$ (index without dimension)

• Manufacturing capacity of companies being able to produce the required product

1. able to produce the whole required quantity (yes or no)?
2. what is the effective capacity of the company (piece/day)?

1, $b_{tx} = 0$, where $c_{xt} < c_{xr}$ – able to produce the required quantity

$b_{tx} = 1$, where $c_{xt} >= c_{xr}$ – not able to produce the required quantity

where

c_{xt} – capacity of t. manufacturing company from x. product

c_{xr} – quantity of the product ordered by the customer

2, what is the effective capacity of the companies (item/day)

$C_x = [c_{xt}]$

These steps must be done for the sake of comparability, because the factors having different dimensions can take into account simultaneously. Now selecting the supplier means joint the supply (products) and the demand (requirements of the customers) not join a company with another, so we can speak about joining:

- 1 product - 1 customer
- 1 product - several customers
- several products – 1 customer (can be divided into 1 product – 1 customer)
- several product s– several customers (can be divided 1 product – several customer)

Henceforth we will involve only in the 1 product – 1 customer problem which solution process is as follows:

1. Forming the capacity (C_x) and the distance matrix (D_x)

$C_x = [c_{xt}]$ $D_x = [d_{xt}]$

2. Reducing the capacity matrix according to this condition

$$\frac{c_{xt}}{c_{xr}} \geq 1 \quad (1)$$

$C'_x = [c_{xi}]$ – companies being able to produce the whole required quantity.

According to this the distance matrix also should be reduced: $D'_x = [d_{xi}]$

3. Forming the matrix of transportation costs (K'_x), which are proportional to the distance between the supplier and the customer.

$$K'_x = [k_{xi}], \quad \text{ahol} \quad k_{xi} = d_{xi} * p$$

p = constant

4. Forming the comparison matrix (A'_x)

$$A'_x = [a_{xi}],$$

where

$$a_{xi} = k_{xi} * (p_{xi} + q_{xi}) \tag{2}$$

5. Selection the optimal solution according to the following:

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

In the previous case, we examine companies having sufficient capacity, but we also have to examine companies having insufficient capacities i.e. whether we don't get a better solution if the demand is satisfied by not one but two or three, etc. companies. So the final solution is gotten by choosing the minimal among the best solutions:

Table 1. Selecting the optimal company or group of companies

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

After the selection of the company or the group of companies which will manufacture the required products for the assembly halls the logistics company should be selected as well. The aim is to reduce logistics costs, the two main components of it are the transportation cost and the storage cost. However these cost components have influence into each other, if the stock is reduced the frequency of the transportation will increase. The task is to transport λ quantity from one place to another (company or storage). Factors influencing the transportation cost:

- length of the transportation distance,
- way of transport,
- type and number of means of transports,
- idle capacity,
- waiting time,
- transportation capacity.

Parameters about the services of the logistics companies are stored in the central database from which information (for example way of transport (water-, air-, and railway transport), number and capacity of vehicles $\left(\frac{Pallet}{Vehicle}\right)$, number of restart places, etc.) can be gotten easily. To get the best logistic company for a given task, a base matrix must be created containing the transportation cost between companies in case of each logistic company.

$$K_x^s = \left[k_{xij}^{sf} \right]$$

k_{xij}^{sf} - transportation cost between i. and j. company in case of f. logistics company and x. products. The transportation cost refers to the best track in any case

in this matrix. The operational cost of vehicles, up and down loading cost and the cost of waiting time exist in each logistics company, so only the transportation distance and the way of transportation influence the transportation cost. Transportation cost depends on several factors, but in this case I take into account only the distance and the way of transportation.

$$k_{xij}^{sf} = \min_{i,\, j=1,\ldots,m} \left\{ d_{xij}^{\varepsilon} * m_x^s \right\} \tag{4}$$

d_{xij}^{ε} - the ε. line between i. and j. company

m_x^s - the way of transportation in case of the shortest transportation line

The best solution is chosen by selecting the minimal, as the nest formula shows:

$$\min_{f=1,..,o} \left\{ k_{xij}^{sf} \right\} \tag{5}$$

In these calculations the reliability of the results depends in a great extent on the reliability and accuracy of the data.

4. METHODS USED

For solving these problems optimization methods were used to select the best company for a given supplier task. For setting up the central database the hierarchic data model was chosen among the database modeling methods.

5. STATUS

In the current stage of the resource course only comprehensive aspects are taken into account in the examination process of supplier and logistics companies. Parameters must convert into values having no dimension in order to be comparable.

6. RESULTS

A mathematic model was worked out which able to give the most suitable company or group of companies for a given supplier task taking into account different factors (price, quality, capacity and distance (cost of transportation)).

7. FURTHER RESEARCH

In the next stage of the research we want to specify the factors in order to get better solution.

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