The use of total optimized model of logistic distribution in condition of one-producer and several distribution warehouse, based on creating balance producer and minimizing the total cost of carrying in logistic system

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ABSTRACT

In this article based on case study in shelter assembly shop in Sanaye Felezi Iran Co, with the use of "Stop -Watch" method, the cycle time of every conveyance operation to each workstation of the assembly lines is measured then the standard time of every conveyance cycle, the ideal rate of conveyance, the velocity of conveyance in each minute, are calculated. Then, with the use of linear programming technique, decrease the total expected cost of conveyance. In the next stage, by using the Hungarian allocation technique, for each line of assembly shop, lifter and the operator was allocated and in the next stage classifying the raw materials transportation paths from warehouses to assembly shop to determination the best transportation path by use of 'technique for order preference by similarity to ideal solution' (TOPSIS). Finally, usage of production distribution model to optimum distribution of productions in Sanaye Felezi Iran Co.

Introduction

These days, daily increasing of competitive conditions in markets, customer services and essential progress in information technology and communication industries caused to satisfying the customers in appropriate quality of product or service, low price in comparison to other competitive and on time delivery of product or service, has the essential role in remaining of organizations at markets and getting the market's proportion. For this reason the concept of supplying chain management is posed during these two decades.

Logistic balance issue is an assurance for being equal of loading operation times and transferring a loading or unloading considering to production rate which is result of ideal transferring rate. Ideal transferring rate is converted to the transferring time of each part which is named such as balance index or balance time or cycle time.

Balancing the logistic operation is caused to allocating the optimum required operators in logistic process, determining the optimum transferring time, and decreasing the total expected cost of transferring operation of materials and other stuff during the building stream. Finally, this is caused to increasing the velocity of supplying parts according to the production plan and non-stopping in the production process and rapid respond to the receiving requests. In this research we are looking for considering that weather balancing logistic through the application of suitable blend of the number of the human resources and transferring instruments in assembly shop, could be useful in improving the costs of transferring or not? And if this claim will be true, in which different parts of logistic, exclusive of internal logistic, with the use of logistic balance, could be used.

Production distribution is very important process after the logistic balancing. production distribution should be done with optimum cost and optimum time and optimum supply quality status.

Much research has been done in this issue, some of which that: with the aim of developing a phase multi-purposed model for equalizing the use of transportation machines in logistic system, have considered this issue (Ghazanfari, khalili-dizaj, 2004). Was choosing as case study with the purpose of decreasing the transportation costs in iran khodro Company (Asghari, Aghdasi, 2004). Have presented a model for determining the order point and optimizing the size of order considering the transportation costs (Teimouri, Ghiyami, 2004). Have presented some models for integrating the total logistic cost in supplying chain management (Ghazanfari, Seyed Hosseini, 2004). Have practiced to the development of a model for optimizing the total cost of logistic distribution in conditions of a producer and some distributed warehouses in supplying chain management (Ghazanfari, Seyed Hosseini, 2004). by presenting a mathematical Mosel, have practiced to lowering the transportation costs and existence in a production company which the production have been done in some stages and considering the limitation of time for producing a part till requested time to transportation (Watanabe and et.al, 1994).

The main reasons for doing this research are:

1) Reduce transportation total expected costs of raw materials to assembly lines.

2) Developing a consistent and coordinated transportation program with production plan.

3) Smoothing transportation operations throughout the assembly saloon.

4) Determination and optimum allocation of transportation operators and their lift trucks to each assembly line.

5) Make an optimum schedule for proper usage of transportation operators and their lift trucks.

6) Make an optimum production distribution plan.

Literature Review
Supply Chain
Supplying chain consists of material stream, money and information between supplier's network, transportation, producer, distribution network and final customer (Javid, 2004).

Logistics
The keyword "logistic" has been used in the U.S.A military forces for more than one century and gradually has been accepted by the other military forces of English language countries. In the recent decades this is also developed in trade market and civil industrial. Logistic has originally come from a Greek work "logistics" and it means science of computation and skill in computerizing. Antoine Henry Jomini had the first systematic try to definition this word with low accordance and connected to the other war elements. He was a French commentator and war writer. He defined the logistic in his book 'the brief art of war" in 1838 like this: logistic is the scientism art of militaries movement. Based on his definition, the logistic apparently consists of all supporting and moving activities of militaries such as, planning (Henry Jomini, 1838).

Logistic balancing
Logistic balancing issue is an assurance for being equal of loading operation times and transferring a loading or unloading considering to production rate which is result of ideal transferring rate. Ideal transferring rate is converted to the transferring time of each part which is named such as balance index or balance time or cycle time.

Balancing the logistic operation is caused to allocating the optimum required operators in logistic process, determining the optimum transferring time, and decreasing the total expected cost of transferring operation of materials and other stuff during the building stream. Finally, this is caused to increasing the velocity of supplying parts according to the production plan and non-stopping in the production process and rapid respond to the receiving requests (Javid, 2004).

Research Methodology

Figure 1: Research Practical Model
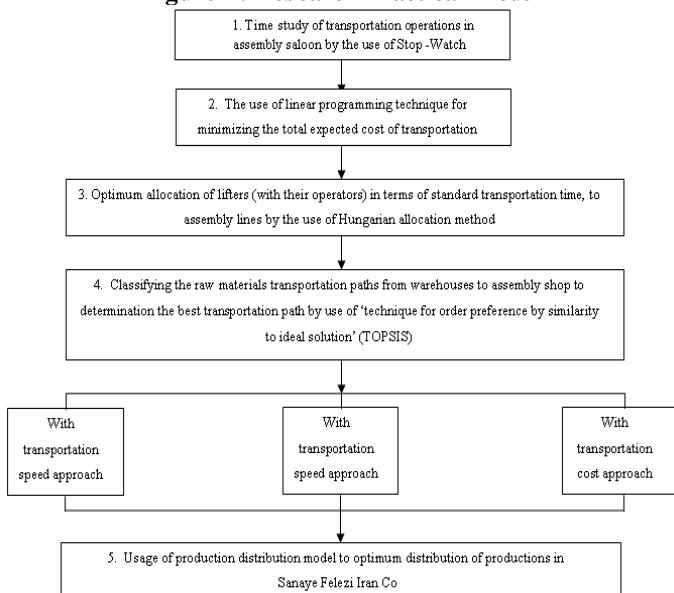
The use of linear programming technique for minimizing the total expected cost of transportation

This objective function has two limitations which the first one is related to the managers of Sanaye Feleziye Iran Co, to the transportation velocity (logistic) and raising the number of transportation process to over 250 boxes per hour according to the production plan of 2 bodies per hour.

$$Min\ Z = 263.18X_1 + 178.52X_2 + 173X_3 + 213.48X_4$$
$$s.t:$$
$$X_1 + X_2 + X_3 + X_4 = 250$$
$$25 \leq X_1 \leq 40$$
$$30 \leq X_2 \leq 60$$
$$80 \leq X_3 \leq 120$$
$$70 \leq X_4 \leq 100$$
$$X_i \geq 0\ ;\ i = 1,2,....,4$$

Optimum allocation of lifters (with their operators) in terms of standard transportation time, to assembly departments by the use of Hungarian allocation method

Table 1. Transportation process implementation time by each lifters in each department (minute)

D	C	B	A	Department / Lifer
3.1	2.9	2.5	2.8	1
2.5	2.8	2.6	2.9	2
3	3.2	2.9	2.7	3
2.9	2.6	3.3	2.8	4

Table1 shows that transportation time of any lifters (with their operators) in each of assembly departments. The information in this table is used for optimum allocation of any lifters (with their operators).

Classifying the raw materials transportation paths from warehouses to assembly shop to determination the best transportation path by use of 'technique for order preference by similarity to ideal solution' (TOPSIS)

In this step of research, the main aim is determination the best raw materials transportation path by each lifter (with their operators) from warehouses to assembly departments in assembly shop. This mean, three indexes considered: transportation distance, supply quality status and the average of transportation time.

Table 2: The initial decision making table to determination the best transportation path

The average of transportation time (minute)	Supply Quality Status	Distance (meter)	Index / Alternative
4	Very good	53	Transportation path: 1
2.5	suitable	76	Transportation path: 2
3	good	43	Transportation path: 3

Table2 shows that the initial decision making table to determination the best transportation path to classifying the raw materials transportation paths from warehouses to assembly shop.

At this stage of the research for Qualitative values into quantitative, bipolar scale space method has been used.

The steps of this section are:

a. Determination the decision making matrix

$$\begin{bmatrix} 53 & 9 & 4 \\ 76 & 5 & 2.5 \\ 43 & 7 & 3 \end{bmatrix} = A$$

b. Determination the weighted matrix by using of entropy technique

b.1. Determination the P matrix:

$$P = \begin{bmatrix} 0.31 & 0.43 & 0.42 \\ 0.44 & 0.24 & 0.26 \\ 0.25 & 0.33 & 0.31 \end{bmatrix}$$

b.2. Determination the Ej matrix:

$$Ej = \begin{bmatrix} 0.971 & 0.971 & 0.974 \end{bmatrix}$$

b.3. Determination the Éj matrix:

$$Éj = 1\text{- } Ej = \begin{bmatrix} 0.029 & 0.029 & 0.026 \end{bmatrix}$$

b.4. Determination the Éj matrix:

$$Wj = Éj \div \Sigma\, Éj$$

$$Wj = \begin{bmatrix} 0.345 & 0.345 & 0.31 \end{bmatrix}$$

c. Determination the D matrix

$$D = \left[d_{ij}\right]_{m \times n}, \qquad d_{ij} = \frac{a_{ij}}{\sqrt{\sum_{i=1}^{m} a_{ij}^2}}$$

$$D = \begin{bmatrix} 0.511 & 0.722 & 0.715 \\ 0.747 & 0.845 & 0.447 \\ 0.423 & 0.567 & 0.536 \end{bmatrix}$$

d. Determination the V matrix

$$W_{n \times n} = W, \quad V = D \times W_{n \times n}$$

$$\begin{bmatrix} 0.345 & 0 & 0 \\ 0 & 0.345 & 0 \\ 0 & 0 & 0.31 \end{bmatrix} \begin{bmatrix} 0.511 & 0.722 & 0.715 \\ 0.747 & 0.845 & 0.447 \\ 0.423 & 0.567 & 0.536 \end{bmatrix} = V$$

$$\begin{bmatrix} 0.176 & 0.25 & 0.221 \\ 0.257 & 0.291 & 0.138 \\ 0.146 & 0.195 & 0.166 \end{bmatrix} = V$$

e. Determination the positive ideal options (A^+) and the negative ideal options (A^-):

$$\{\max \square V_{ij} \mid j \in J),\, (Min\ V_{ij} \mid j \in J')] \ i = "1,2,\dots,m"\} = {}^+A$$

$$\{V_1^+, V_2^+, \dots, V_n^+\} =$$

$$\{(Min\ V_{ij} \dashv \mid j \in J),\, (Max\ V_{ij} \mid j \in J' \mid i = "1,2,\dots,m"\} = \bar{A}$$

$$\{V_1^-, V_2^-, \dots, V_n^-\} =$$

$$\{0.146,\ 0.291, 0.138\} = \{Min\ V_{i1},\, Max\ V_{i2},\, Min\ V_{13}\} = {}^+A$$

$$\{0.257,\ 0.195, 0.221\} = \{Max\ V_{i1},\, Min\ V_{i2},\, Max\ V_{13}\} = A^-$$

f. Determination the amounts of d_i^+ and d_i^- by using the Euclidean method

$$1, 2\dots n = i \ , \quad \sqrt{\sum_{j=1}^{n} \left(V_{ij} - V_j^+\right)^2} = d_i^+$$

$$1, 2\dots n = i \ , \quad \sqrt{\sum_{j=1}^{n} \left(V_{ij} - V_j^-\right)^2} = d_i^-$$

$$d_1^+ = \sqrt{(0.175 - 0.146)^2 + (0.25 - 0.291)^2 + (0.221 - 0.138)^2} = 0.096$$

$$d_2^+ = \sqrt{(0.257 - 0.146)^2 + (0.291 - 0.291)^2 + (0.138 - 0.138)^2} = 0.111$$

$$d_3^+ = \sqrt{(0.146 - 0.146)^2 + (0.195 - 0.291)^2 + (0.166 - 0.138)^2} = 0.1$$

$$d_1^- = \sqrt{(0.175 - 0.257)^2 + (0.25 - 0.195)^2 + (0.221 - 0.221)^2} = 0.0986$$

$$d_2^- = \sqrt{(0.257 - 0.257)^2 + (0.291 - 0.195)^2 + (0.138 - 0.221)^2} = 0.1268$$

$$d_3^- = \sqrt{(0.146 - 0.257)^2 + (0.195 - 0.195)^2 + (0.166 - 0.221)^2} = 0.1236$$

g. Determination the amounts of cl_i^+:

$$cl_i^+ = \frac{d_i^-}{d_i^+ + d_i^-}, \ 1 \le cl_i^+ \le 1, i = 1, 2, \dots, m$$

$$cl_1^+ = \frac{d_1^-}{d_1^+ + d_1^-} = \frac{0.0986}{0.0969 + 0.0986} = 0.504$$

$$cl_2^+ = \frac{d_2^-}{d_2^+ + d_2^-} = \frac{0.1286}{0.111 + 0.1286} = 0.536$$

$$cl_3^+ = \frac{d_3^-}{d_3^+ + d_3^-} = \frac{0.1236}{0.1 + 0.1236} = 0.552$$

Usage of production distribution model to optimum distribution of productions in Sanaye Felezi Iran Co:

In this step of research, the main aim is determination the optimum plan to distribution of productions from production maintenance warehouses to retailer for sending to customers. To implementation of this step, using of linear planning to minimize the distribution total expected cost. This model will be resolved by Win Qsb software.

Table 3. Volume required for retailers according to warehouse i and product j (Yijk)

Retailers need from warehouse 2		Retailers need from warehouse 1		
Retailers need (Retailer 2) K2	Retailers need (Retailer 1) k1	Retailers need (Retailer 2) K2	Retailers need (Retailer 1) k1	Production
10	10	10	10	Shelter (type 1) (j1)
15	10	10	15	Shelter (type 2) (j2)

Table 4. Volume required for retailers according to warehouse i and product j

Warehouse \ Product	warehouse 1	warehouse 2
Shelter (type 1) (j1)	10+10 = 20	10+10 = 20
Shelter (type 2) (j2)	15+10 = 25	10+15 = 25

Table 5. Transportation cost and maintenance cost (million Taman), product j by Transportation path R and transportation vehicle M

warehouse 1				warehouse 2					
j2		j1		j2		j1		Transportation Path	
M2	M1	M2	M1	M2	M1	M2	M1		
1	2	1	3	1	1	2	2	Transportation Cost	R1
1	1	1	1	1	1	1	1	Maintenance Cost	

Table 6. Maintenance cost (million Taman) of product j in warehouse i (Cij)

Warehouse / Product	warehouse 1	warehouse 2
Shelter (type 1) (j1)	4	5
Shelter (type 2) (j2)	3	3

Table7. Capacity (area) of warehouses and productions

$$\square''(m''\square^{r''}2'')$$

	warehouse 1	warehouse 2	Shelter (type 1)	Shelter (type 2)
Capacity (area) $\square''(m''\square^{r''}2'')$	350	350	10	6

Table 8. Capacity (area) of warehouses and productions

$$\square''(m''\square^{r''}2'')$$

Types of transportation vehicles	Vehicle 1 (M1)	Vehicle 2 (M2)
Capacity (area) $\square''(m''\square^{r''}2'')$	120	90

Make a production distribution model to optimum distribution of productions in Sanaye Felezi Iran Co:

In this model, the main aim is minimize of distribution total expected cost of productions.

The parameter X_{ijmr} shows that: number of productions j from warehouse i by transportation vehicle M and transportation path R:

$$Min\ Z = 6X_{1111} + 6X_{1121} + 4X_{1211} + 4X_{1221} + 8X_{2111} + 6X_{2121} + 5X_{2211} + 4X_{2221}$$

$$s.t:$$

$$\begin{cases} 10X_{1111} + 10X_{1121} + 6X_{1211} + 6X_{1221} \le 350 \\ 10X_{2111} + 10X_{2121} + 6X_{2211} + 6X_{2221} \le 350 \\ X_{1111} + X_{1121} \le 20 \end{cases}$$

$$\begin{cases} X_{1211} + X_{1221} \le 25 \\ X_{2111} + X_{2121} \le 20 \\ X_{2211} + X_{2221} \le 25 \\ 10X_{1111} \le 120 \\ 10X_{1121} \le 90 \\ 6X_{1211} \le 120 \end{cases}$$

$$\begin{cases} 6X_{1221} \le 90 \\ 10X_{2111} \le 120 \\ 10X_{2121} \le 90 \\ 6X_{2211} \le 120 \\ 6X_{2221} \le 90 \end{cases}$$

$$X_{ijmr} \ge 0\ ;\ i = 1,2,....,4$$

Results and Discussion

Determining and analyzing the results with the use of linear programming method for lowering the total expected cost

Table 9. The optimum number of production in any production department (Xi)

Department	(Xi*)
1	X1=25
2	X2=35
3	X3=120
4	X4=70

Table 9 shows that the optimum number of pallets that should be transport from warehouse to departments (Xi).

The results described:

a. The optimum number of pallets that should be transport from warehouse to department 1, is: 25

b. The optimum number of pallets that should be transport from warehouse to department 2, is: 35

c. The optimum number of pallets that should be transport from warehouse to department 3, is: 120

d. The optimum number of pallets that should be transport from warehouse to department 4, is: 70

e. The optimum total expected cost for transportation is: 48531.3(Taman per hour)

Determining and analyzing the results of optimum allocating of lifters (with operators) to the assembly shop with the use of Hungarian allocation method as for transportation time of each lifters in each departments

Table 10: The finally table to optimum allocation of production operators to each department by Hungarian method

Department / Lifter	1	2	3	4
1	0.3	0	0.4	0.6
2	0.4	0.1	0.3	0
3	0	0.2	0.5	0.3
4	0.2	0.5	0	0.3

Table 10 shows that the finally table to optimum allocation of lifters to each department by Hungarian method. Table 11 shows that the optimum allocation of lifters to each department based on the measured time (min) for transportation in a transportation cycle.

Table 11: the optimum allocation of production operators to each work station

Lifter	Department
1	1
2	2
3	3
4	4

Based on the finally result for optimum allocation of production operators to each work station by Hungarian method, the optimum total expected time for production is: 10.3 (min)

Determination the best transportation route, classifying material transportation routes from warehouses to assembly shop by using Topsis technique

Table 12: The finally table of classifying the transportation routes

Classifying	Alternative
third	Route: 1
second	Route: 2
first	Route: 3

Based on table 12:

a. The optimum raw materials transportation route is: 3

b. Transportation distance is: 43 meter

c. Supply Quality Status is: good

d. The average of transportation time is: 3 minutes

Determination the best transportation route, classifying material transportation routes from warehouses to assembly shop by using Topsis technique

Table 13: The optimum productions distribution

warehouse 1		warehouse 2		Transportation Path	
j2	j1	j1	j1		
12	14	18	15	Transportation Cost	R1
13	6	7	5	Maintenance Cost	

Based on table 13:

a. Number of production distribution type of (J1) from warehouse (1) and transportation path (R1) by transportation vehicle (M1) is: 15

b. Number of production distribution type of (J1) from warehouse (1) and transportation path (R1) by transportation vehicle (M2) is: 5

c. Number of production distribution type of (J2) from warehouse (1) and transportation path (R1) by transportation vehicle (M1) is: 18

d. Number of production distribution type of (J2) from warehouse (1) and transportation path (R1) by transportation vehicle (M2) is: 7

e. Number of production distribution type of (J1) from warehouse (2) and transportation path (R1) by transportation vehicle (M1) is: 14

f. Number of production distribution type of (J1) from warehouse (2) and transportation path (R1) by transportation vehicle (M2) is: 6

g. Number of production distribution type of (J2) from warehouse (2) and transportation path (R1) by transportation vehicle (M2) is: 13

Conclusion and suggestion

According to the results of doing this research, the role of creating the balance in logistic system and optimum production distribution plan is a vital affair for every production or service organization. In fact the determining an accurate program for implementation of transportation process and feeding of assembly departments according to the changing in production plan and as for bill of materials in each workstations, is an important competitive advantage for every organization.

According to the obtained results from balancing and distributing plan of shelter assembly shop, the decreasing of costs in transportation total expected in parts transportation in order to feeding of assembly line and in distribution of final products for caucusing will be observed.

Because of variety of variations, it is not possible to control the total variations that mean that some impressive variations on the result of research are out of control. So, it is suggested that the related researches in this filed should be done by all impressive variations.

As for the logistic and logistic balance and its relating to the costs is a new issue in Iranian organizations, so in considering of its indexes and in organizations and filed study, this research has been faced with the previous researches limitations. Also it is suggested that research in this field should be done by impressive various indexes in logistic and different organizations.

As for the difference between applied parts in the final product and various solid of them and various sizes in batches of each parts and also the various size of boxes, only the main applied parts in the final product have been considered and analyzed. So, it is suggested that the related researches should be done with the regards of all parts as for various solid and size and their importance in the final product.

As for various transportation machines, in this study, just the main tools for transportation, which is called lifter, have been analyzed and considered. So, we suggest that the related research in this field, with regards of the total transportation tools or machined such as trailers, tows and AGVS (lifter without drivers), should be done.

References:

1. Ghazanfari, mehdi and khalili dizaj-Mahrokh in 2004, with the aim of developing a phase multi-purposed model for equalizing the use of transportation machines in logistic system, have considered this issue.

2. Asgari, Nasrin and Aghdasi, Mohammad (2004) also was choosing as case study with the purpose of decreasing the transportation costs in Iran Khodro Company.

3. Teimouri, Ebrahim and Ghiyami Yousef (2004) also have presented a model for determining the order point and optimizing the size of order considering the transportation costs.

4. Ghazanfari, Hossein and seyed Hosseini seyed Mohammad (2004) have presented some models for integrating the total logistic cost in supplying chain management.

5. Ghazanfari, Hossein and Hosseini, seyed Mohammad (2004), have practiced to the development of a model for optimizing the total cost of logistic distribution in conditions of a producer and some distributed warehouses in supplying chain management.

6. Watanabe and et.al (1994) by presenting a mathematical Mosel, have practiced to lowering the transportation costs and existence in a production company which the production have been done in some stages and considering the limitation of time for producing a part till requested time to transportation.

7. Nozick and turnquist (2000), as for theory of integrating process, transportation cost and facilities cost and existence, have presented a mathematical model and for considering the performance of the presented model, they have opted a car making factory as a case study.

8. Dasci and cetter (2001) have presented a model for supplying-distribution system based on application of continuous function in order to presenting the distribution cost and customer request.

9. Nishazaki (2001) and et.al also modeled this matter as a phase modeling. In this study the purpose function is for decreasing the cost of transportation, travel time and the number of vehicle.

10. Bamol and winod (1993), have done the first prompts for determining the transportation vehicle in an alone product more which could be a model of decreasing the existence and transportation cost.

11. Constable and reyolds(1975) have developed a theoretical model for developing the costs of transportation and return of order. These models determine the reclaim of existence point, amount of order and choose a transportation vehicle which lowers the existence and transportation cost, continuously.