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Design Supply Chain Management Networks by New Risk Passive Defense Model and solved it by Heuristic Algorithm Case Study: Warehouse and Retail ETKA Organization

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Abstract

Supply chain network design is important structures to get competition's profits and minimizing costs, Considered to physical flows, information flows and money flows. In this article we want to combine allocation-location model with Risk passive defense model for minimizing single objective. We design two-phase for heuristic algorithm include of construction and improvement phase that in the construction phase we use of two sub phase such as searching and waiting and in the other phase as waiting and comparison. The purpose of this article is to present a heuristic approach for minimizing costs and an integrated information communication through three layers such as major store, minor stores and customers. We propose new model based on SLMRP model and Risk Passive Defense model according to customers request and we affected customers request using Paired comparisons by AHP in model. the results of article are determine to assign minor stores to major store, the end we solve this model by using heuristic method and comparison it model with 2-opt and heuristic.

Keywords: Risk Passive Defense, Supply chain management, SLMRP, AHP, 2-opt.

Introduction

Process product Flow is in components supply chain includes of fund flow, information flow and product flow. The important goal in supply chain has become improving customer service by concerned with multi-service, selection best supplier, and manufacturing and logistic.

Supply chain network design decisions are by nature costly and difficult to reverse, and their impact spans a long horizon time when design decisions are affected, any of the parameters of the problem costs, demands, distances and lead time may change drastically[1].

Industries always face the several challenges of trying to resolve their facility location and task allocation decisions under demand uncertaintainty and from a global viewpoint, Supply chain by solving can be included of[2]: i. How to find the optimal location, given a set of location options and a given set of customers? ii. How to design the best distribution for marketplace?

The problem of facility location and allocation customers that design distribution system with covering approach. Model formulation based on mathematical complexity and solution found very difficult and affected on solution performance[3]. ETKA Organization often faced the new challenge about how to resolve their problem that problem involves how to decision allocation-location minor store to major store that arrive to minimizing cost and maximizing profit, in result the ETKA Org. will be best decision that in article will decide how to answer problems and determine road plan by considering with facility coordinate, transportation costs and open facility costs, etc.

The other problem in many industries same like EKA Org. is Trying to arrive the an integrated through components supply chain, An integrated is the cause of Incompatibility because supply chain management has two horizon plan that first horizon plan is for strategic decision and second horizon plan is tactical plan. Controlling Integration in supply chain is the one of the challenge, that decision maker always tries to solve it problem[4].

In article, we decide to find solve for an integrated ETKA Org. by considered to product flow and related through major store, minor store and customer that get minimizing costs and maximizing profit. They Developed model for solving complex Supply chain management. Complexity in integrated supply chain management caused of researcher try develops and improved their model[4]. We developed SLMRP model with Risk passive defense, We designed questionnaire to who people made decision about between 3 to 5 people that decision which is one minor store allocation to major store by considered with probability passive defense and costs passive defense for each allocation, we considered parameters of risk passive defense include of: i. Camouflage (α_1), ii. Cover (α_2), iii. Secrecy (α_3), iv. Dispersal (α_4), v. Establish safety structure and maintenance (α_5), vi. Protection documentary and personality (α_6), vii.

Installation firefighting system (α_7), viii. Centralizing avoid[5] (α_8).

Location phase and allocation phase are sub Supply chain management and that's have hardly problem in the other hand are NP-Hard problem, that could solve it by heuristic o meta-heuristic algorithm.

Literature Review: A supply chain is dynamic and it involves the constant flow of information, product and funds between stages, a typical supply chain may involve a variety of stages these supply chain stages include: i. Customer, ii. Retailer, iii. Warehouse/distribution, iv. Manufacturing, v. supplier.

In this article we just survey three stages involves Customers, Retailers and Warehouse or Customers, minor store and major store.

The objective of every supply chain should be maximized the overall value generated[6]. Supply chain often defines with some characterized for integrated process that the important characterized included of suppliers, manufacturers, distributors, and retailers that considering by simultaneously characterized and the following factors: i. acquire raw materials, ii. convert these raw materials into specified final products, and iii. deliver these final products to retailers[7].

A deterministic mixed integer non-linear mathematical programming model based on economic order quantity (EOQ) techniques[8].

Developed a multi-objective and solved it by mixed integer programming model (MOIPM), The model has multiple period and multi- objective that some objective were type of maximize and the other were type of minimize[9]. Their goals were found the best potential location. They used of MOPIM cause it can handling multiple conflicting objectives such as the minimization of cost, traffic accessibility, and maximization local incentives.

Proposed sites from supply chain perspectives using the analytic hierarchical process (AHP) that involves re-location of a combined manufacturing and distribution (warehousing) facility[9]. They didn't use any mathematical model for problem they used of scoring method for decision.

In real-word, exist many parameters for each models in the other hand supply chain management is the most important in field management that shows the decision tools to researcher and one of the challenge in industries that to remain in competitive should be minimizing costs and improve customer services, in result if the researcher determine parameters to exact it's just good for academic research, but many researcher found the parameters has uncertain and should be stochastically. Proposed model based on fuzzy parameters the first step developing a decision support system; the second step performs the procurement of raw material and the third step surveyed distribution and how to sell[10]. Two parameters were uncertainty involved of customer demands and supply of material; they solved it by fuzzy sets.

Surveyed logistic network problem and formulated based on mixed integer linear programming model, the end they solved it by Meta - heuristic method and solved it by genetic algorithm[11].

Proposed multi objective supply chain management network include of costs, service level, supplier, etc objective they proposed a new approach that solved it by genetic algorithm and comparative it by Pareto-optimal solutions[12].

Developed a dynamic programming model that they want to catch an optimal that combined of transportation models with multi-period planning horizon[13]. Then formulated as an optimal discrete time stochastic control problem where cost is quadratic and dynamic that solved it by dynamic programming algorithm and used of shadow price.

Proposed multi objective supply chain model based on fuzzy set theory and solved it by two-phase fuzzy linear programming considered by degree of satisfaction of each objective[14].

Problem Formulation: We combined SLMRP model with new risk passive defense model, this combined model composed two objective functions. Both of them objective function are type of cost and we should be minimizing it.

Risk passive defense has a one constraint such as budge constraint, three parameters and four indexes, we converted multi-objective function to single-objective function and defined affect coefficient risk passive defense in objective function is Gamma between zeros to one depended on decision making.

Model is zero-one integer non-linear programming. We comparative SLMRP model and SLMRP-RPD model in table 1.

Table-1
SLMRP and SLMRP-RPD Comparative

Definition	SLMRP	SLMRP-RPD
Model Typical	INLP zero-one	INLP zero-one
Software	C++	Matlab
solution	Lagrangian, lower bound, upper bound, branch and cut and Algorithm	Two-phase Heuristic algorithm such as: construction and waiting in first phase and waiting and improved in second phase
Risk passive defense	no	yes
Difficulty	NP-Hard	NP-Hard

We use the following notation problem from SLMRP model: Indexes: i. I: retailer (minor store), the number of minor store that we'll allocation to major store. ii. J: potential facility site(major store or Warehouse), iii. S: scenario.

Parameters: Demand: i. μ_{is} : average daily demand at retailer i in scenario s, for i ϵ I, s ϵ S, ii. σ^2_{is} : variance of daily demand at retailer i in scenario s, for i ϵ I, s ϵ S.

Costs: i. d_{ijs} : per-unit cost to ship from DC j to retailer i in scenario s, for i ϵ I, j ϵ J, s ϵ S, ii. f_j : fixed cost per year of opening DC j, for j ϵ J, iii. F_j : fixed cost per order placed to the supplier by DC j, for j ϵ J, iv. g_j : fixed cost per shipment from the supplier to DC j, for j ϵ J, v. a_j : per-unit cost to ship from the supplier to DC j, for j ϵ J, vi. h : inventory holding cost per unit per year.

Probability: i. q_s : probability that scenario s occurs, for s ϵ S

Weights: i. β : weight factor associated with transportation cost (β>=0), ii. Ө : weight factor associated with inventory cost (Ө >=0).

Service parameters: i. L_j : lead time in days from the supplier to DC j, for j ϵ J, ii. α : desired probability of not stocking out at a DC during a retailer lead-time, iii. Z_α : standard normal deviate such that P(Z<= Zα)=α, iv. χ : number of working days per year.

Risk Passive Defense Parameters: i. α_{ijsk} : Coefficient RPD means as we'll decide Kth factor RPD from minor store i allocate to major store j in scenario s, ii. C_{ijsk} : Costs RPD means as we'll decide Kth factor RPD from minor store i allocate to major store j in scenario s, iii. B_k : Budget constraint when we'll decide assignment Kth factor RPD.

Decision variables

- $X_j = \begin{cases} 1 & \text{if DC open } j \in J, \\ 0 & \text{otherwise,} \end{cases}$
- $Y_{ijs} = \begin{cases} 1 & \text{if retailer } i \in I \text{ served by DC } j \in J \text{ in scenario } s \in S; \\ 0 & \text{otherwise.} \end{cases}$

Formulation:

$$\text{Min gamma} \times \sum_i \sum_j \sum_s \sum_k \alpha_{ijsk} C_{ijsk}\, y_{ijs} + \sum_{s\in S} \sum_{j\in J} q_s (f_j X_j + \sum_{i\in I} \hat{d}_{ijs} Y_{ijs} + K_j \sqrt{\sum_{i\in I} \mu_{is} Y_{ijs}} + \theta \sqrt{\sum_{i\in I} L_j \sigma^2_{is} Y_{ijs}})$$

S.t

$$\sum_{j\in J} Y_{ijs} = 1, \forall i \in I, \forall s \in S. \quad (1)$$

$$Y_{ijs} \le X_j, \forall i \in I, \forall s \in S, \forall j \in J. \quad (2)$$

$$\sum_i \alpha_{ijsk} . C_{ijsk} . Y_{ijsk} \le B_k \quad (3)$$

$$X_j \in \{0,1\}, \forall j \in J \quad (4)$$

$$Y_{ijs} \in \{0,1\}, \forall i \in I, \forall s \in S, \forall j \in J. \quad (5)$$

$$J = 1, \dots, m$$
$$S = 1, \dots, l$$
$$K = 1, \dots, z$$

The objective function is single objective function and we'll decided minimizing, constraint (1) is each retailer (minor sore) must receive each product from just one DC (major store) in constraint (2) is, retailer mustn't receive any product from a DC that has not been opened in constraint (3) say decision making how to get expand for each factor risk passive defense by considering with allocation minor store to major store. In constraint (4, 5) says the decision variables are zero or one.

Methodology

We define new approach for scenario in model so we identify three package buying by considered with Purchasing power and design questionnaire for each customer in three shift in the store and use of Expert Choice software converted qualify data to quantity data thus determined each critical such as: Price, Quality, Packing, Easy access and Availability in questionnaire and score of critical put in scenarios, in the end we assumption for three scenario we have three score constant.

We defined for Risk Passive Defense two matrixes, each matrix should be run for Kth factor and there scenario, the matrix is below:

$$\text{Matrix 1.} \begin{pmatrix} \alpha_{11} & \cdots & \alpha_{1i} \\ \vdots & \ddots & \vdots \\ \alpha_{j1} & \cdots & \alpha_{ji} \end{pmatrix}_{ji} \text{ And } \text{Matrix 2.} \begin{pmatrix} c_{11} & \cdots & c_{1i} \\ \vdots & \ddots & \vdots \\ c_{j1} & \cdots & c_{ji} \end{pmatrix}_{ji}$$

$$\text{Matrix 3.} \begin{pmatrix} \alpha_{11} & \cdots & \alpha_{1i} \\ \vdots & \ddots & \vdots \\ \alpha_{j1} & \cdots & \alpha_{ji} \end{pmatrix}_{ji} . \begin{pmatrix} c_{11} & \cdots & c_{1i} \\ \vdots & \ddots & \vdots \\ c_{j1} & \cdots & c_{ji} \end{pmatrix}_{ji}$$

Matrix 1: Says decision making must for each scenario and Kth factor assignment score between zero and one by considering with their experimental by this assumption which one minor store is allocation to major store.

Matrix 2: Says decision making for each scenario and Kth factors how much could be pay it by considering with which one minor store is allocation to major store.

Matrix 3: Says we should be Scalar multiplication two matrix and put it in model, and we say the matrix 3 is coefficient risk passive defense.

We assumption parameters in table 2 are stochastic and they defined with uniform distribution.

Table-2

Parameter	Distribution Uniform
Θ	U(a,b)
h	U(a,b)
α	U(a,b)
F	U(a,b)
f	U(a,b)
a	U(a,b)
g	U(a,b)
B	U(a,b)

Result and Discussion

Heuristic Algorithm: In the first step we defined a new Pseudo Code for run the model, our Pseudo Code is illustrated in matrix 4. Our Pseudo Code include of row and column that the rows are minor stores or retailers and the columns are major stores or distribution center we assumption by considering with first and two constraint should be each sum of row must one and each columns can be every number.

matrix 4. $\begin{pmatrix} 1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & 1 \end{pmatrix}_{ij}$

Our algorithm decomposed two phase include of construction phase and improving phase we defined two phase other for each phase for example in construction phase combined of two phase same as searching phase in row and waiting phase and the other phase combined of waiting phase and improved phase, so in the first phase by considering with produce random numbers around the number one in each row and swap zero by one in the waiting phase we defined waiting factor that we assumption this factor is uniform distribution between ten and fifteen, Respectively responsibility are produce neighbor search and kept the better result than each neighbor, in the second phase we have two phase that in first phase we defined searching phase in column and for wo phase defined a list of code that we avoid of repeat codes and the other phase we found the best result between each run model. We illustrated our algorithm in figure 1.

We defined two other factors for control algorithm such as waiting factor and number of run. We assumption parameters and typical of distribution in table 3.

Table-3

Parameters	Distribution
θ	U(0.9,0.98)
h	U(1500,2000)
α	U(0.9,0.98)
gamma	0.5
q1	0.3024
q2	0.5052
q3	0.1924
B	U(0.5,0.5)
Waiting factor	U(10,15)

All of the details this article exists in project[15].

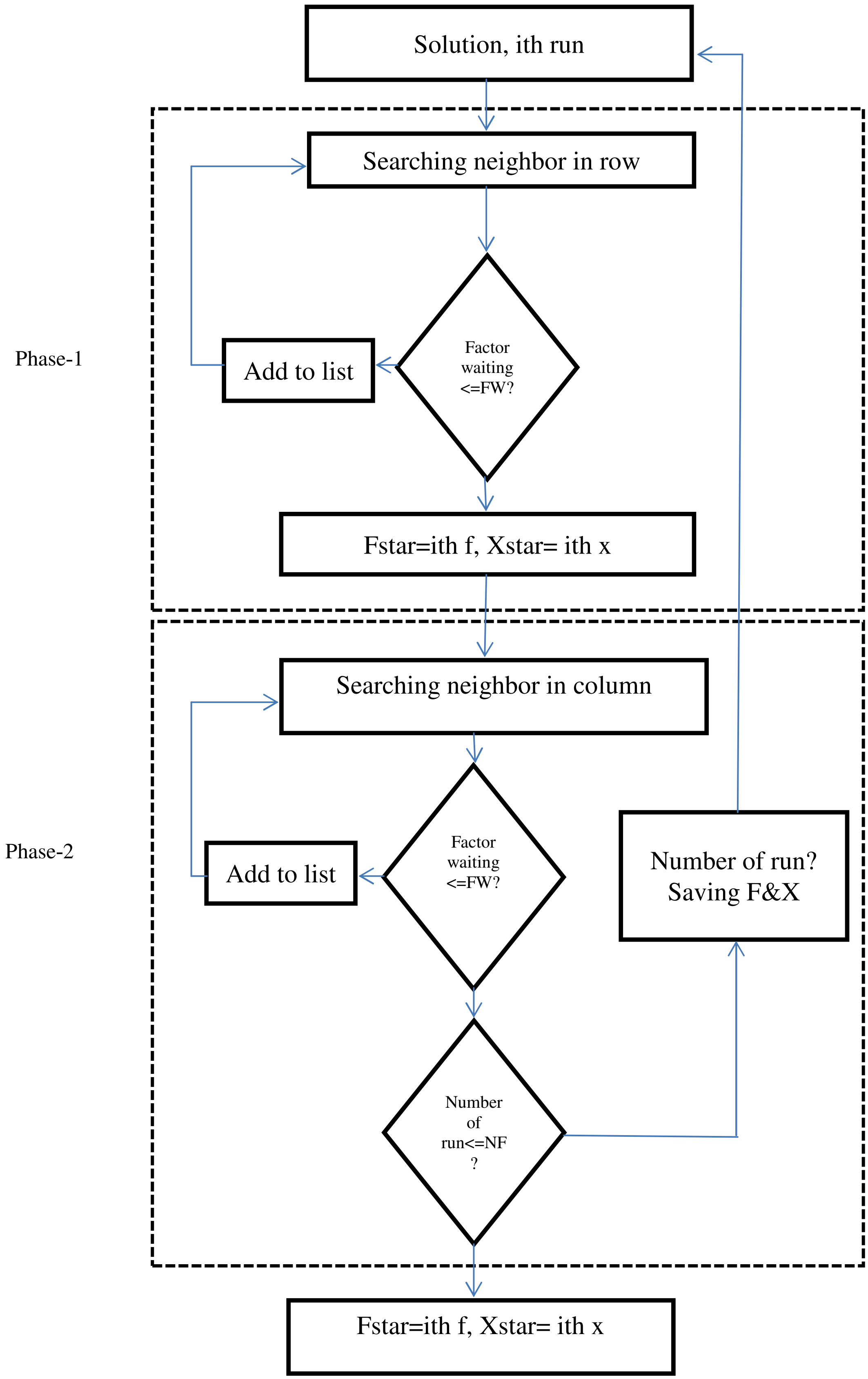
We run this problem with 2.67 GHz CPU, 4 G ram and OS 64 bit. We produce four problems that in each problem has a number of major store and minor store and solved it by our algorithm and comparative it by 2-opt algorithm, the important of result are time and value of objective and their details are in table 4. (Time based on second and value of objective based on 10,000,000,000 Rial).

For example in first row we see two values of objective and time, that we just comparative it two model because the other rows we didn't have any result in 2-opt. thus we can know which one is better by considering with time and value of objective minimize.

In figure 2 we arrived to local optimization and algorithm has a little moved in upper and lower, but in figure 3 moved between upper and lower bound was randomly and high movement.

Table-4

N.	(DC, Retailer)	Definition	2-opt	SLMRP-RPD
1	(12,50)	Value of objective	1.1979	1.0138
2	(12,50)	Time	101.57	88.95
3	(15,55)	Value of objective	---	1.0314
4	(15,55)	Time	---	1328.21
5	(18,60)	Value of objective	---	1.1187
6	(18,60)	Time	---	1460.98
7	(20,65)	Value of objective	---	1.2296
8	(20,65)	Time	---	1591.73


Solution, ith run
Searching neighbor in row
Phase-1
Add to list
Factor waiting <=FW?
Fstar=ith f, Xstar= ith x
Searching neighbor in column
Phase-2
Add to list
Factor waiting <=FW?
Number of run? Saving F&X
Number of run<=NF ?
Fstar=ith f, Xstar= ith x

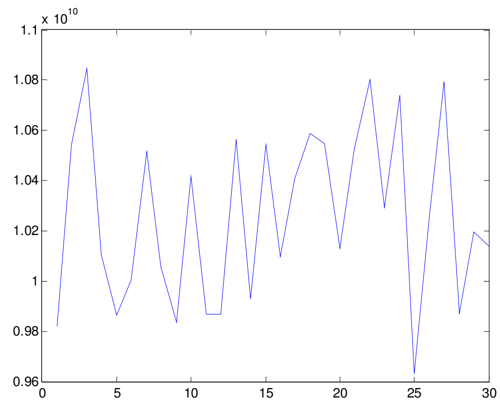


Figure-2
SLMRP-RPD duration 30 times repeat (12, 50)

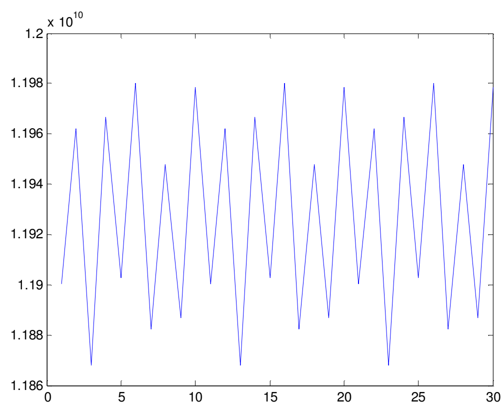


Figure-3
2-opt duration 30 times repeat (12, 50)

Conclusion

In this paper we proposed a new model base on combined SLMRP and Risk Passive Defense (RPD) and we solved it by a heuristic algorithm and comparative it by 2-opt algorithm. we define three scenario by considering with customer request and define four critical that was important for customers and converted it qualify data to quantity data by Expert Choice software, thus allocation minor store to major store. The output of model are: an integrated through DC, Retailer and customer by considering with product process and minimizing costs of ETKA Org. this model could solve it by tabu search and simulated annealing and could define new pseudo code for better result. The disadvantage of our model is ignoring budget constraint and has not the other algorithm for comparative it by our algorithm.

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References

1. Lawrence V.S. Mark S.D. and Chung P.T., The Stochastic Location With Risk Pooling (SLMRP), *Operation Research,* **179,** 1221-1338 **(2007)**

2. Kung J.W. and Makond B.L., Location and allocation in two-echelon supply chain with stochastic demand- A genetic- algorithm based solution, *Expert systems with applications*, **38**, 6125-6131 **(2011)**

3. Klose A. and D.A., Facility location models for distribution system design, *European Journal of Operational Research,* **162**, 4–29 **(2005)**

4. Narasimhan R. and Mahapatra S., Decision models in global supply chain management, *Industrial Marketing Management,* **33**, 21–27 **(2004)**

5. Esfandiari M., Camouflage, Cover and secrecy, *Emmam Hossein University*, **(2012)**

6. Chopra S.P. and Meindl P., Supply Chain Management: Strategy, *Planning and Operation,Prentic Hall, Third Edition*, **(2007)**

7. Benita M.B., Supply chain design and analysis: Models and methods, *Int. J. Production Economics*, **55**, 281-294 **(1998)**

8. Cohen M.A. and Lee H.L., Resource deployment analysis of global manufacturing and distribiutation networks, *Journal of Manufacturing and Operations Management*, **2**, 81-104 **(1989)**

9. Min H. and M.E., The relocation of a hybrid manufacturing/distribution facility from supply chain perspective: A case study, Omega, **27(1)**, 75-85 **(1999)**

10. Petrovic D. and Petrovic R., Modeling and simulation of a supply chain in an uncertain environment, *European Journal of Operational Research*, **109**, 299-309 **(1998)**

11. Syarif A.Y. and Gen M., Study on multi-stage logistic chain network: a spanning tree-based genetic algorithm approach, *Computers & Industrial Engineering,* **43**, 299-314 **(2002)**

12. Altiparmak F., Gen M., Lin L. and Paksoy T., A genetic algorithm approach for multi-objective optimization of supply chain networks, *Computers and Industrial Engineering,* **51,** 196–215 **(2006)**

13. Midler J.L., A stochastic multiperiod multimode transportation model, *Transportation Science*, **3,** 8-29 **(1969)**

14. Bashiri M. and Hosseininezhad S.J., A fuzzy group decision support system for multifacility location problems, *International journal Advance Manufacturing Technology,* **42**, 533-543 **(2009)**

15. Ebadati M. and Aghaei M., Design supply chain networks ETKA Org. and proposed multi-objective and multi-

critical based on AHP and GP, *Elite Research science and technology ETKA,* **(2012)**

16. Mangang P.N., Health Beliefs and Perception of Well being among the Lois of Thanga in Manipur, India, *Research Journal of Recent Sciences*, **1(4)**, 46-52 **(2012)**

17. Nwajei G.E., Okwagi P., Nwajei R.I. and Obi-Iyeke G.E., Analytical Assessment of Trace Elements in Soils, Tomato Leaves and Fruits in the Vicinity of Paint Industry, Nigeria, *Research Journal of Recent Sciences*, **1(4)**, 22-26 **(2012)**

18. Amanchi N.R. and Mohd M.H., Ecophysiological and cytopathological impact of delfin insecticide (Bacillus thuringiensis) to a unicellular ciliate protozoan, Euplotes patella, *Research Journal of Recent Sciences*, **1(4)**, 64-67 **(2012)**

19. Rathore Kanishka Raj, Dhawankar Aditi and Gungun, Environmental Impact Assessment (EIA) For Bus Based Rapid Transit System (BRTS) Bhopal, MP, India, *Research Journal of Recent Sciences*, **1(ISC-2011),** 166-171 **(2012)**