International Journal of Pure and Applied Mathematics
Volume 118 No. 20 2018, 155-161
ISSN: 1311-8080 (printed version); ISSN: 1314-3395 (on-line version)
url: http://www.ijpam.eu
Special Issue

ANALYSIS OF GREEN SUPPLY CHAIN INVENTORY MANAGEMENT FOR WAREHOUSE WITH ENVIRONMENTAL COLLABORATION AND SUSTAINABILITY PERFORMANCE USING GENETIC ALGORITHM

[1]Ajay Singh Yadav, [2]Monika Johri, [3]Jitendra Singh, [4]Sanjeev Uppal
[1]Department of Mathematics, [2,3]Department of Computer Science & Engineering
[4]Department of Electrical & Electrons Engineering
[1,2,3,4]SRM University, Delhi-NCR Campus
[1]ajay29011984@gmail.com, [2]monika.j@ncr.srmuniv.ac.in, [3]jitendra.s@ncr.srmuniv.ac.in,
[4]sanjeev.u@ncr.srmuniv.ac.in[4]

Abstract: We propose given to the topic of Green Supply Chain inventory management for warehouse with environmental concerns a technique based on genetic algorithm to optimize inventory in the whole Green supply chain. We focus on to specifically determine the dynamic nature of the excess stock level and shortage level required for inventory optimization in the Green supply chain such that the total Green Supply Chain inventory management for warehouse with environmental concerns cost is minimized. The complexity of the problem increases when more products and multiple agents are involved in Green Supply Chain inventory management for warehouse with environmental concerns process that has been resolved in this work. Here, we are proposing an optimization methodology that utilizes the Genetic Algorithm, one of the best optimization algorithms, to overcome the impasse in maintaining the optimal stock levels at each member of the Green Supply Chain inventory management for warehouse with environmental concerns. We apply our method on four member of Green Supply Chain inventory management for warehouse studied model for optimization.

Keywords: Green Supply Chain, Inventory management, Refinement of feedstock production, warehouse, distribution centres, industrial sales, environmental collaboration and Genetic Algorithm

1. Introduction

Green Supply chain management using environmental collaboration and sustainability performance can be defined as "Green Supply chain management using environmental collaboration and sustainability performance can is the coordination of production, inventory, location and transportation among the participants in a Green Supply chain management using environmental collaboration and sustainability performance can to achieve the best mix of responsiveness and efficiency for the market being served."

After a literature review it is realized that there are some flaws in the earlier researches. In the area of integrated inventory models, above-mentioned situations are rarely put together with Green Supply chain management using environmental collaboration and sustainability performance can. On the other hand, minimization of the cost attracts the attention of few researchers in recent years for the inventory models, but they only considered one side of the supply chain, which is either the buyer or the vendor side. As it is mentioned earlier, nowadays integration of entities is really essential in order to be successful in the competitive market in a Green Supply chain management using environmental collaboration and sustainability performance can. Unfortunately, the researchers who studied the market changes did not concern about this key issue of the supply chain management.

Based on all researches and shortcomings mentioned above, this thesis incorporates the integrated inventory model under with products experiencing continuous cost decrease for a successful Green Supply chain management using environmental collaboration and sustainability performance can of technology-related industries.

2. Genetic Algorithms

The principles of Genetic Algorithms (GA) and the mathematical framework underlying it were developed in the late 1960s (Holland, 1962, Kristinson and Dumont, 1992; Koppen et al., 2006). GA is normally discussed in the context of Evolutionary Computing (EC). The core methodologies of EC are Genetic Algorithms (GA), Evolutionary Programming (EP), Evolution Strategies (ES) and Genetic Programming (GP) (Oduguwa et al., 2005). In GA, attempt is made to model the processes underlying population genetic theory by using random search. GAs uses the survival-

of-the-fittest strategy, where stronger individuals in a population have a higher chance of creating an offspring. To achieve this, the current input (population) is used to create a new and better population based on specified constraints. The inputs are normally represented as string and they model chromosome in human genetics. In materials engineering, for example, the input string will represent some properties of materials that are of interest.

One iteration of the algorithm is referred to as a generation. The basic GA is very generic and there are many aspects that can be implemented differently according to the problem (for instance, representation of solution or chromosomes, type of encoding, selection strategy, type of crossover and mutation operators, etc.) in practice, GA are implemented by having arrays of bits or characters to represent the chromosomes. The individuals in the population then go through a process of simulated evolution. Simple bit manipulation operations allow the implementation of crossover, mutation and other operations. The number of bits for every gene (parameter) and the decimal range in which they decode are usually the same but preclude the utilization of a different number of bits or range.

3. Literature Review

Narmadha at. al. (2010) proposed Multi-Product Inventory Optimization using Uniform Crossover Genetic Algorithm. Radhakrishnan et. al. (2009) gives a inventory optimization in Supply Chain Management using Genetic Algorithm. Singh and Kumar (2011) gives a inventory optimization in Efficient Supply Chain Management. Priya and Iyakutti (2011) proposed Web based Multi Product Inventory Optimization using Genetic Algorithm. Thakur and Desai (2013) a study inventory Analysis Using Genetic Algorithm In Supply Chain Management. Khalifehzadeh et. al. (2015) presented a four-echelon supply chain network design with shortage: Mathematical modelling and solution methods. Kannan et. al. (2010) Discuss a genetic algorithm approach for solving a closed loop supply chain model: A case of battery recycling. Jawahar and Balaji (2009) Proposed A genetic algorithm for the two-stage supply chain distribution problem associated with a fixed charge. Zhang et. al. (2013) presented A modified multi-criterion optimization genetic algorithm for order distribution in collaborative supply chain. Che and Chiang (2010) proposed A modified Pareto genetic algorithm for multi-objective build-to-order supply chain planning with product assembly. Yimer and Demirli (2010) Presented A genetic approach to two-phase optimization of dynamic supply chain scheduling. Wang, et. al. (2011) Proposed Location and allocation decisions in a two-echelon supply chain with stochastic demand – A genetic-algorithm based solution. Humphreys, et. al. (2009) presented Reducing the negative effects of sales promotions in supply chains using genetic algorithms. Sherman et. al. (2010) gives a production modelling with genetic algorithms for a stationary pre-cast supply chain. Ramkumar, et. al. (2011) proposed Erratum to "A genetic algorithm approach for solving a closed loop supply chain model: A case of battery recycling". Ye et. al. (2010) Proposed Some improvements on adaptive genetic algorithms for reliability-related applications. Guchhait et. al. (2010) presented Multi-item inventory model of breakable items with stock-dependent demand under stock and time dependent breakability rate. Changdar et. al. (2015) gives an improved genetic algorithm based approach to solve constrained knapsack problem in fuzzy environment. Sourirajan et. al. (2009) presented A genetic algorithm for a single product network design model with lead time and safety stock considerations. Jiang et. al. (2015) gives Joint optimization of preventive maintenance and inventory policies for multi-unit systems subject to deteriorating spare part inventory. Dey et. al. (2008) proposed Two storage inventory problem with dynamic demand and interval valued lead-time over finite time horizon under inflation and time-value of money. Jawahar and Balaji (2012) proposed A genetic algorithm based heuristic to the multi-period fixed charge distribution problem. Pasandideh et. al. (2010) gives a parameter-tuned genetic algorithm for multi-product economic production quantity model with space constraint, discrete delivery orders and shortages. Yadav et. al. (2016) proposed a cooperative Two-Warehouse Inventory Model for Deteriorating Items with Variable Holding Cost, Time-Dependent Demand and Shortages. Consider a similar model, Two Warehouse Inventory Model with Ramp Type Demand and Partial Backordering for Weibull Distribution Deterioration. put forward a model, A two-storage model for deteriorating items with holding cost under inflation and Genetic Algorithms. Singh et. al. (2016) proposed a Two-Warehouse Model for Deteriorating Items with Holding Cost under Particle Swarm Optimization. Consider a similar model, A Two-Warehouse Model for Deteriorating Items with Holding Cost under Inflation and Soft Computing Techniques. Yadav et. al. (2016) analyzed a Multi Objective Optimization for Electronic Component Inventory Model & Deteriorating Items with Two-warehouse using Genetic Algorithm. Sharma et. al. (2016) focused an Optimal Ordering Policy for Non-Instantaneous Deteriorating Items with Conditionally Permissible Delay In Payment Under Two Storage Management. Yadav et. al. (2016) analyzed a Analysis of Genetic Algorithm and Particle Swarm Optimization for warehouse with Supply Chain management in Inventory control.

4. Genetic Algorithms Based Green Supply Chain Inventory Management Using Environmental Collaboration Optimization Analysis

The proposed method uses the Genetic Algorithm to study the stock level that needs essential Green Supply chain inventory management using environmental collaboration and sustainability performance. This is the pre-requisite idea that will make any kind of inventory control effective. For this purpose, we are using Evolutionary algorithms method as assistance. In practice, the Green Supply chain inventory management using environmental collaboration and sustainability performance supply chain is of length m, means having m number of members in Green Supply chain inventory management using environmental collaboration and sustainability performance such as Extraction of raw material, Refinement of feedstock production, warehouse, distribution centers, industrial sales, and Product packaging disposal so on. Here, for instance we are going to use a four stage Green Supply chain inventory management using environmental collaboration and sustainability performance that is illustrated in the figure 1. Our exemplary Green Supply chain inventory management using environmental collaboration and sustainability performance consists of a Refinement of feedstock production, warehouse, distribution centers and industrial sales.

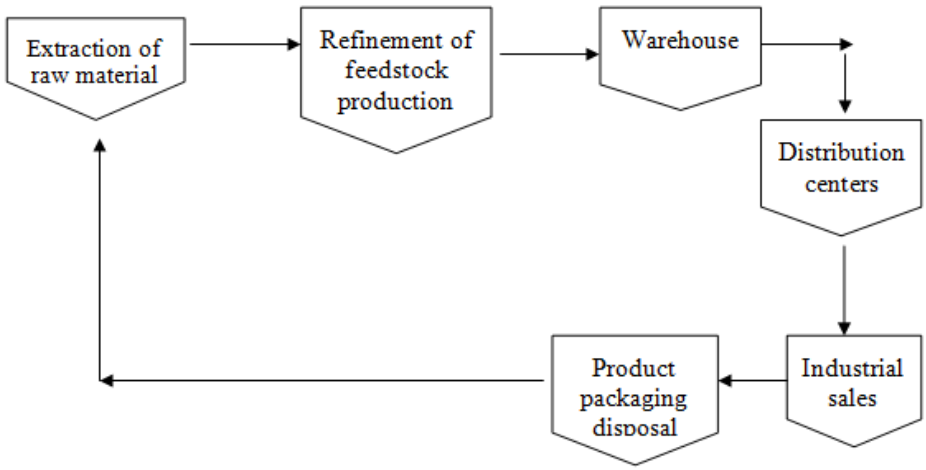

Figure 1. Four member Green Supply chain inventory management using environmental collaboration

In the Green Supply chain inventory management using environmental collaboration and sustainability performance we are illustrated, the Extraction of raw material is the massive stock holding area where the stocks are Storage. The Refinement of feedstock production is the massive stock holding area where the stocks are manufactured as per the requirement of the warehouse. Then the warehouse will take care of the stock to be supplied for the distribution center. From the distribution center, the stocks will be moved to the corresponding industrial sales and the stocks will be moved to the corresponding Product packaging disposal. As earlier discussed, the responsibility of our approach is to predict an optimum stock level by using the past records and so that by using the predicted stock level there will be no excess amount of stocks and also there is less means for any shortage. Hence it can be asserted that our approach eventually gives the amount of stock levels that needs to be held in the four members of the Green Supply chain inventory management using environmental collaboration and sustainability performance consists of a Refinement of feedstock production, warehouse, distribution centers and industrial sales. In our proposed methodology, we are Evolutionary algorithms using genetic algorithm for finding the optimal value.

Which depicts the steps applied for the optimization analysis. Initially, the amount of stock levels that are in excess and the amount of stocks in shortage in the different Green Supply chain inventory management using environmental collaboration and sustainability performance contributors are represented by zero or non-zero values. Zero refers that the contributor needs no inventory control while the non-zero data requires the inventory control. The non-zero data states both the excess amount of stocks as well as shortage amount. The excess amount is given as positive value and the shortage amount is mentioned as negative value.

The first process needs to do is the clustering that clusters the stock levels that are either in excess or in shortage and the stock levels that are neither in excess nor in shortage separately. This is done simply by clustering the zero and non-zero values. For this

purpose we are using, the efficient Evolutionary algorithms.

After the process of Evolutionary algorithms method using Genetic Algorithm is performed, the work starts its proceedings on Genetic algorithm, the heart of our work. For the Evolutionary algorithms using Genetic Algorithm, instead of generating an initial population having chromosomes of random value, a random chromosome is generated in each time of the iteration for further operation.

Genetic Algorithm

When compared to other evolutionary algorithms one of the most important GA feature is its focus on fixed length character strings although variable length strings and other structures have been used.

Step 1: Start:-"Randomly generate population of n chromosomes as per population size."

Step 2: Fitness:-"Evaluate the fitness f(y) of each chromosome y in the population"

Step 3: New population:-"Create new population by repeating following steps until the new population is complete."

a) Selection: - "Select two parent chromosomes from a population."

b) Crossover: - "With a crossover probability, crossover the parents to form a new offspring. If no crossover was performed, offspring is the exact copy of parents."

c) Mutation: - "With a mutation probability, mutate new offspring at each locus."

d) Accepting: - "Place new offspring in the new population."

Step 4: Replace: - "Use new generated population for a future run of the algorithm."

Step 5: Test: - "If the end condition is satisfied, stop, and return the best solution in current population."

Step 6: Loop: - "Go to step 2".

Step 7: Stop: - "Stop when the fittest value is obtained."

We are using those basic steps for finding the optimal resources for an organization in Medium range prospective using MATLAB software package

5. Results And Discussions

The proposed approach for the inventory optimization in green supply chain management with two-warehouses based on genetic algorithm is analyzed with the help of MATLAB. The stock levels for the three different four members of the Green Supply Chain inventory management for warehouse with environmental collaboration and sustainability performance using Genetic Algorithm, Refinement of feedstock production, warehouse, distribution centres and industrial sales are generated using the MATLAB script and this generated data set is used for evaluating the performance of the genetic algorithm. Some sample set of data used in the implementation is given in Table I. Some 11 sets of data are given in the Table I and these are assumed as the records of the past period.

Table 1. A Sample of Data Sets Having Stock Levels of the Members of Supply Chain

Refinement of feedstock production	Warehouse	Distribution Centres	Industrial Sales
-258	367	235	-657
-124	-456	587	458
-231	214	-546	258
200	-106	358	-369
521	504	-591	-257
-564	705	-508	654
100	-547	409	478
365	-852	-607	-587
-201	-158	-147	698
301	169	157	146

In the database tabulated in Table II, the fields are related with the stock levels of particular products that were held by the respective four members of the Green Supply Chain inventory management for warehouse with environmental collaboration and sustainability performance using Genetic Algorithm network. Similarly, different sets of stock levels are held by the database. As per the proposed analysis based on Genetic Algorithm, a random initial chromosome is generated as follows.

Table 2. Initial Random Inventory Generated For the Genetic Algorithm Based Analysis

Refinement of feedstock production	Warehouse	Distribution Centres	Industrial Sales
300	-167	215	-647

In this manner two different random chromosomes are generated and they will be subjected to genetic operations like Selection, Crossover and Mutation. An iteration involving all these processes was carried out so as to obtain the best chromosome. For the chosen iteration value of 200, hundred numbers of iterative steps will be performed. The best chromosome obtained as result is depicted in the Table III.

Table 3. The final best chromosome obtained after the 200 iterations

Refinement of feedstock production	Warehouse	Distribution Centres	Industrial Sales
400	-317	-435	637

The organization can decide about the quantum of iterations for running the simulation to arrive at the optimal solution. As long as minimization of the fitness function is still possible, then the iteration continues till such a time that no improvement in the fitness function value is noticeable. After a certain number of iterations, if the fitness function value is not improving from the previous iterations, then this is an indication that the fitness function value is stabilizing and the algorithm has converged towards optimal solution. This inference is useful for deciding the number of iterations for running the Genetic Algorithms simulation as well as this may be used as the stopping criteria for the algorithm. For greater accuracy, the number of iterations should be sufficiently increased and run on the most frequently updated large database of past records.

6. Conclusion

Green Supply Chain inventory management for warehouse with environmental collaboration and sustainability performance using Genetic Algorithm is a significant component of Green Supply Chain inventory management. The novel and proficient approach based on genetic algorithm to optimize inventory in Green Supply Chain inventory management for warehouse with environmental collaboration. we also focus on to specifically determine the complexity in predicting the optimal stock levels and shortage level required for inventory optimization in the Green Supply Chain inventory management for warehouse with environmental collaboration such that the total Green Supply Chain inventory management cost is minimized .we apply our methods on three stage Green Supply Chain inventory management for warehouse with environmental collaboration studied model for optimization. The proposed method was implemented and its performance was evaluated using MATLAB.

References

[1] Changdar, C., Mahapatra, G.S., and Pal, R.K. (2015) An improved genetic algorithm based approach to solve constrained knapsack problem in fuzzy environment Expert Systems with Applications, Volume 42, Issue 4, Pages 2276-2286.

[2] Che, Z.H. and Chiang, C.J. (2010) A modified Pareto genetic algorithm for multi-objective build-to-order supply chain planning with product assembly Advances in Engineering Software, Volume 41, Issues 7–8, Pages 1011-1022.

[3] Jawahar, N. and Balaji, A.N. (2009) A genetic algorithm for the two-stage supply chain distribution problem associated with a fixed charge European Journal of Operational Research, Volume 194, Issue 2, Pages 496-537.

[4] Jawahar, N. and Balaji, A.N. (2012) a genetic algorithm based heuristic to the multi-period fixed charge distribution problem Applied Soft Computing, Volume 12, Issue 2, Pages 682-699.

[5] Jiang, Y., Chen, M. and Zhou, D. (2015) Joint optimization of preventive maintenance and inventory policies for multi-unit systems subject to deteriorating spare part inventory Journal of Manufacturing Systems, Volume 35, Pages 191-205.

[6] Kannan, G., Sasikumar, P. and Devika, K. (2010) A genetic algorithm approach for solving a closed loop supply chain model: A case of battery recycling Applied Mathematical Modelling, Volume 34, Issue 3, Pages 655-670.

[7] Narmadha, S., Selladurai, V. and Sathish, G. (2010) Multi-Product Inventory Optimization using Uniform Crossover Genetic Algorithm International Journal of Computer Science and Information Security,Vol. 7, No. 1.

[8] Radhakrishnan, P., Prasad, V.M. and Gopalan, M.R. (2009) Inventory Optimization in Supply Chain Management using Genetic Algorithm International Journal of Computer Science and Network Security, Vol.9 No.1.

[9] Ramkumar, N., Subramanian, P., Narendran, T.T. and Ganesh, K. (2011) Erratum to "A genetic algorithm approach for solving a closed loop supply chain model: A case of battery recycling" Applied Mathematical Modelling, Volume 35, Issue 12, Pages 5921-5932.

[10] Sharma, S., Yadav, A.S. and Swami, A. (2016) An Optimal Ordering Policy For Non-Instantaneous Deteriorating Items With Conditionally Permissible Delay In Payment Under Two Storage Management International Journal of Computer Applications Volume 140 –No.4.

[11] Singh, R.K., Yadav, A.S. and Swami, A. (2016) A Two-Warehouse Model for Deteriorating Items with Holding Cost under Particle Swarm Optimization International Journal of Advanced Engineering, Management and Science (IJAEMS) Volume -2, Issue-6.

[12] Singh, R.K., Yadav, A.S. and Swami, A. (2016) A Two-Warehouse Model for Deteriorating Items with Holding Cost under Inflation and Soft Computing Techniques International Journal of

Advanced Engineering, Management and Science (IJAEMS) Volume -2, Issue-6.

[13] Singh, S.R. and Kumar, T (2011). Inventory Optimization in Efficient Supply Chain Management International Journal of Computer Applications in Engineering Sciences Vol. 1 Issue 4.

[14] Thakur, L and Desai, A.A. Inventory Analysis Using Genetic Algorithm In Supply Chain Management International Journal of Engineering Research & Technology (IJERT) Vol. 2 Issue 7.

[15] Wang, K.J., Makond, B. and Liu, S.Y. (2011) Location and allocation decisions in a two-echelon supply chain with stochastic demand – A genetic-algorithm based solution Expert Systems with Applications, Volume 38, Issue 5, Pages 6125-6131.

[16] Yadav, A.S., Mishra, R., Kumar, S. and Yadav, S. (2016) Multi Objective Optimization for Electronic Component Inventory Model & Deteriorating Items with Two-warehouse using Genetic Algorithm International Journal of Control Theory and applications, Volume 9 No.2.

[17] Yadav, A.S., Sharma, P. and Swami, A. (2016) Analysis of Genetic Algorithm and Particle Swarm Optimization for warehouse with Supply Chain management in Inventory control International Journal of Computer Applications Volume 145 –No.5.

[18] Yadav, A.S., Sharma, S. and Swami, A. (2017) A Fuzzy Based Two-Warehouse Inventory Model For Non instantaneous Deteriorating Items With Conditionally Permissible Delay In Payment International Journal Of Control Theory And Applications, Volume 10 No.11.

[19] Yadav, A.S., Swami, A. and Singh, R.K. (2016) A two-storage model for deteriorating items with holding cost under inflation and Genetic Algorithms International Journal of Advanced Engineering, Management and Science (IJAEMS) Volume -2, Issue-4.

[20] Yadav, A.S., Swami, A., Kumar, S. and Singh, R.K. (2016) Two-Warehouse Inventory Model for Deteriorating Items with Variable Holding Cost, Time-Dependent Demand and Shortages IOSR Journal of Mathematics (IOSR-JM) Volume 12, Issue 2 Ver. IV.

[21] Yadav, A.S., Tyagi, B., Sharma, S. and Swami, A., (2016) Two Warehouse Inventory Model with Ramp Type Demand and Partial Backordering for Weibull Distribution Deterioration International Journal of Computer Applications Volume 140 –No.4.

[22] Yimer, A.D. and Demirli, K. (2010) A genetic approach to two-phase optimization of dynamic supply chain scheduling Computers & Industrial Engineering, Volume 58, Issue 3, Pages 411-422.

[23] Zhang, H., Deng, Y., Chan, F.T.S. and Zhang, X. (2013) A modified multi-criterion optimization genetic algorithm for order distribution in collaborative supply chain Applied Mathematical Modelling, Volume 37, Issues 14–15, Pages 7855-7864.

[24] T. Padmapriya and V.Saminadan, “Improving Performance of Downlink LTE-Advanced Networks Using Advanced Networks Using Advanced feedback Mechanisms and SINR Model”, International Conference on Emerging Technology (ICET), vol.7, no.1, pp: 93, March 2014.

[25] S.V.Manikanthan and K.srividhya "An Android based secure access control using ARM and cloud computing", Published in: Electronics and Communication Systems (ICECS), 2015 2nd International Conference on 26-27 Feb. 2015,Publisher:IEEE,DOI:10.1109/ECS.2015.7124833.

[26] Rajesh, M., and J. M. Gnanasekar. "An optimized congestion control and error management system for OCCEM." International Journal of Advanced Research in IT and Engineering 4.4 (2015): 1-10.