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Research Paper

Designing an Improved Stochastic Planning Model for Supply Chain Considering Maintenance and Operations (MRO) in Rahiab Sanat Sepahan Engineering Technical Company

Sayyed Mohammad Reza Davoodi[1*], Amir Hortamani[2], Nafiseh Bakhtiary Dastgerdi[3]
[1]Assistant professor, Department of Management, Dehaghan Branch,Islamic Azad University
[2]Assistant Professor, Department of Economic, Dehaghan Branch, Islamic Azad University , Dehaghan, Iran
[3]Master of Industrial Management, Production and Operational Orientation, Amin Institute of Higher Education, Foolad Shahr, Isfahan
*Email of Corresponding Author: smrdavoodi@ut.ac.ir
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Abstract
The science of maintenance and the active life of the equipment is becoming increasingly important and is defined as a subset of asset management. This necessitates the design and development of a maintenance planning model for the supply chain. This research in the production and distribution program of the spare parts supply chain system, according to the specific and definite order and demand program of users in periods, leads to cost reduction and achieving economic goals in the production unit. In order to achieve this goal, some limitations for model equilibrium and justifying the answers obtained from the model solution are presented, in which we have achieved the optimal answer using the genetic algorithm method in MATLAB software. The present study is descriptive in terms of method and nature and applied in terms of purpose. This research has been done in terms of cross-sectional time and in six time periods and has no specific period. Data were collected through interviews and information available in the production unit of Rahyab Sanat Sepahan Company. According to the functions, the goal of minimizing system costs includes minimizing production, storage, and distribution costs, as well as reducing the difference between actual production time and nominal production capacity in the target function has been investigated. Reality can help make acceptable decisions despite various fluctuations in production lines, distribution centers, and transportation costs.

Keywords
Probability Density Function, Spare Parts, Supply Chain Design, Maintenance-Repair-Operation

1. Introduction

In recent years, major and continuous changes in market demand, demand, and development of a dynamic business environment have caused the issue of designing stable and responsive supply chain networks to be considered by industries and researchers.

On the other hand, the issue of choosing a supplier is an important and strategic decision in the supply chain, and choosing the right set of suppliers to work with is very important for the success of industries [1].

An in-house supply chain provides organizations with the resources and processes that produce products and services and deliver them to the end customer [2]. Supplier management is a strategic approach to managing supplier integration. Which includes the development of two strategic suppliers [3]. The integrated design and implementation of the supply chain with the response strategy create capabilities in the network, which include responding to a wide range of demands, the ability to provide a wide range of products. , Response to demand Short delivery time, meeting high service level, and managing supply and demand uncertainty [4].

Improve the ability of product chain features to control threat factors and break down potential problems is a success factor for new companies, so achieving a minimum acceptable to the cost manager and customer satisfaction with services and achieving a minimum time for repairs and maintenance, as well as increasing profits by reducing The costs of purchasing spare parts and reducing the cost of warehousing these parts and not losing the goods market [5].

2. Theoretical Foundations

Managers found that producing quality goods was not enough. Providing products with the customer's desired doctrine (when, where, how) and their desired quality and cost poses a new challenge for manufacturing organizations.

Under such circumstances, organizations realized that these changes were not enough to manage their organization for a long time. To the customer, they participated. With such an attitude, the supply chain theory emerged. The supply chain is a relatively stable group of businesses that are involved in a series of production, distribution, and distribution activities required to provide to the end customer [6]. In traditional manufacturing companies, post-production goods were stored in warehouses and elsewhere. This supply chain is complex [2].

Langenberg et al. suggested that the production supply chain network optimizes network flow and improves the level of customer service by minimizing costs and maximizing resource utilization, demand cycle completion rate, and facility capacity[7].

3. Literature review

Tavana et al. developed an integrated three-stage maintenance scheduling model for unrelated parallel machines with aging effect and multi-maintenance activities to provide a general interpretation [8].

Wibowo et al. concluded that MRO service providers adopt more flexible strategies such as finding departmental resources Services and demand fulfillment for customers tend to different demand requirements at the service level. Numerical results show that the approximate method is very accurate, and leads to a significant reduction in costs [9]. Rajesh and Ravi developed a model entitled Supplier Selection in a Resistant Supply Chain Analysis Approach Supply that can be considered as unavoidable resources for modern supply chains [10]. Yova et al. studied the single machine that plans the problem where the goal is to minimize unique workload [11]. Zhu and Zhou, in a study entitled Machine scheduling with deteriorating and resource-dependent maintenance activity states that with deteriorating and resource-dependent activity on a single machine that the repair period is assumed to coincide with the start [12]. Busstra and Vandongen examined key nodes in operations Train service [13]. Giri and Sharma presented a model in which closed-loop members include raw material suppliers, manufacturers, retailers, and product collectors [14].

Many researchers have considered the design or implementation of models to improve the supply chain. Rahmani et al. reviewed the development of a comprehensive model of data envelopment analysis to determine the best supplier with inaccurate data and weight constraints [5]. Taherkhani and Tavakoli Moghaddam, by examining the development of a two-purpose quadrilateral supply chain model and using the STEM method presented a model that provides a quadrilateral supply chain model including suppliers, manufacturers, distributors, and retailers[15]. Azimian et al. expressed strategic products in the Institute of Submarine Science and Technology [16]. Yousefinejad and Neyshabouri, performed a critical path analysis of limited resources based on discrete event simulation and group optimization of components [17]. The effects of key factors in the success of the Chai supply chain on the strategic performance of electronics companies in Iran were investigated in another study [18]. Aghajani et al. in their research examined and measured the elasticity of the supply chain using fuzzy logic [19]. Agha Ahmadi and Mahoutchi investigated the number and location of distribution centers, retailers assigned to distribution centers, and determining the inventory control policy of distribution centers in conditions of demand uncertainty [20]. Hosseini and Shekhi explained the strategic role of supply chain management operations. They considered the improvement of the company's performance [6]. Arab and Davoodi described a distribution system that is intended to be closer to reality despite the intermediate warehouses. This project has a great impact on determining the rate of product returns in production planning as well as finance, and forecasting demand and product return to optimize planning. This study guides the company in reducing costs and time, and this has been one of the main goals of the company in distribution system planning [21].

Based on research conducted by other researchers, most of the methods have been cost optimization and decision making in terms of relative reliability or the implementation of a supply chain model. Multiple choices are considered that increase the flexibility of the model, and its objective function is random (probabilistic). Using that production unit can operate in one of the levels of warehousing costs and the second can lead to more reliable decisions. Supply chain reliability is related to the probability that the product flow from production centers and supply to the points of demand is not less than the total demand.

4. Research methodology

Research Method: In the present study, an approach is adopted that provides the performance of spare parts supply chain (MRO) multi-period and multi-product performance. In this model, they are defined as a random variable and a multiple-choice variable, respectively. The objective functions are to optimize the production, storage, and distribution costs in the supply chain operation. The parameters and variables of this decision are production, inventory, and product transportation. According to the objective function, there are restrictions for the supply chain of spare parts. The most important of them is to meet the needs of customers in every period and everything that is produced reaches the customers. The existence of factory warehouses is at the end of the zero production period. This constraint is called a multi-choice constraint. The supply chain design is a spare part. Since this model considers randomness and uncertainty in the production and warehousing of spare parts at the same time, it is an innovation in such models. With the answer da, It is optimal to get this model.

In the model under consideration, it is assumed that type i spare parts are required by users or end users. End users can purchase this type i spare parts from n spare parts distribution center and each distribution center sells all types of spare parts. Each type of spare part is produced by a separate workshop or factory. Therefore, there are i factories for the production of spare parts. Each factory has its warehouse where the parts are sent after production and the distributors, by visiting the factory warehouse, supply their spare parts.

Each spare part has its own cost and production time. Accumulation of the product in the warehouse of factories or distribution centers each has its own storage cost. Sending the product from the factory warehouse to the distribution centers and from the distribution centers to the end users also has transportation costs.

End-user demand for some time (for example, each period can be one month) is clear and constant. The amount of user demand m in the field of spare goods is indicated by i. Therefore, each factory must have a production plan for each period and produce several spare goods. The following symbols are used to indicate the above:

5. Data analysis and results

Index

Type of spare parts: $i = 1, 2, \ldots, I$

Factory number: $j = 1, 2, \ldots, J = I$

Distribution Centers: $n = 1, 2, \ldots, N$

The number of end users: $m = 1, 2, \ldots, M$

Parameters

α_{it} :A binary variable that indicates whether or not factory j produces at time t;

β_{it} :Number of spare parts of type i produced in period t;

γ_{ijt}: Inventory of part i at factory location j in period t;

μ_{int} :Inventory of parcel i in the warehouse of the distribution center n in period t;

T^{1}_{int} :"Number of pieces i transferred from factory j to distribution center n in period t;

T^{2}_{inmt} :The number of pieces i transferred from the distribution center n to user m in period t;

C^{setup}_{ijt} :The cost of preparing factory j to produce part i in period t;

C^{prod}_{ijt} :Factory production cost j to produce part i in period t;

C^{stor}_{ji} :Storage cost of unit i in factory j;

C^{stor}_{in} :The cost of warehousing a unit i in the distribution center n;

$C^{upstor}_{j} = \{C^{upstor(1)}_{j}, C^{upstor(2)}_{j}, \ldots, C^{upstor(h_j)}_{j}\}$:Factory High Warehousing Limits j (The factory can budget one of the mentioned cost levels for the maximum cost of its warehousing system)

T_i^{prod} :Time required to produce a unit i;

T_j^{setup} :Factory preparation time j;

d_{imt}^{demand} :User demand matrix in periods;

C_{ijn}^{trans} :The cost of transferring a unit of part i from the factory warehouse j to the distribution center n;

C_{nm}^{trans} :The cost of transferring a unit from a distribution center n to user m;

The time required to prepare the factory and produce the product in each period is theoretically a certain amount. But in reality, the time available for production in each period is a random variable

$C_{it}^{prod\ time}$:Random variable represents the time available to produce a fragment i in period t that has a probability density $f\,(C_{it}^{prod\ time})$ function.

Therefore, production must be done in such a way that the difference between real-time and available is minimized.

As one of the objective functions in the supply chain system should be minimized in which the coefficient of determination of the importance of the closeness of the time difference in different production periods. The purpose is to determine the production and distribution program in the spare parts supply chain system according to the specific and definite order and demand program of users in periods. Therefore, in order to determine this strategy, in addition to minimizing the difference between real and available time, other costs related to warehousing (related to factory and distribution center) and transportation (from the factory to the distribution center and from distribution center to customer) Must be optimized. For this purpose, the objective function is optimized.

5.1 Mathematical composition of the stochastic planning design problem

The objective function

(1)
$$\begin{aligned} Min\ & \sum_{i=1}^{I}\sum_{t=1}^{T} C_{it}^{setup}\alpha_{it} + C_{it}^{prod}\beta_{it} + \sum_{i=1}^{I}\sum_{t=1}^{T} C_{i}^{stor}\gamma_{it} \\ & \sum_{i=1}^{I}\sum_{n=1}^{N}\sum_{t=1}^{T} C_{in}^{tran}T_{int}^{1} + \sum_{i=1}^{I}\sum_{n=1}^{N}\sum_{m=1}^{M}\sum_{t=1}^{T} C_{nm}^{tran}T_{inmt}^{2} + \\ & E\,(\sum_{t=1}^{T} p_t \sum_{i=1}^{I}\left|C_{it}^{prod\ time} - (T_i^{setup}\alpha_{it} + T_i^{prod}\beta_{it})\right|) \end{aligned}$$

(2) $C_i^{stor} \le C_j^{upstor} = \{C_j^{upstor(1)}, C_j^{upstor(2)}, \ldots, C_j^{upstor(h_j)}\}$

(3) $\forall i,t : \beta_{it} - L\alpha_{it} \le 0$

(4) $\forall i,t : \gamma_{it} = \gamma_{i,t-1} + \beta_{it} - \sum_{n=1}^{N} T_{int}^{1}$

(5) $\forall n,t : \mu_{int} = \mu_{int-1} + \sum_{i=1}^{I} T_{int}^{1} - \sum_{m=1}^{M} T_{inmt}^{2}$

(6) $\forall i,m,t:\ M_{imt}^{demand} = \sum_{n=1}^{N} T_{inmt}^{2}$

(7) $\forall i:\ \sum_{t=1}^{T} \beta_{it} = \sum_{n=1}^{N}\sum_{m=1}^{M}\sum_{t=1}^{T} T_{inmt}^{2}$

(8) $\forall i:\ \sum_{n=1}^{N}\sum_{t=1}^{T} T_{ijnt}^{1} = \sum_{n=1}^{N}\sum_{m=1}^{M}\sum_{t=1}^{T} T_{inmt}^{2}$

(9) $\forall i,t:\alpha_{it} \in \{0,1\}, \beta_{it} \geq 0, \beta_{it} \in Z$

(10)
$$E(\sum_{t=1}^{T} p_t \sum_{i=1}^{I} \left| C_{it}^{prod\ time} - (T_i^{setup}\alpha_{it} + T_i^{prod}\beta_{it}) \right|) = \sum_{t=1}^{T} p_t \sum_{i=1}^{I} \int_0^{\infty} \left| C_t^{prod\ time} - (T_i^{setup}\alpha_{it} + T_i^{prod}\beta_{it}) \right| f(C_t^{prod\ time}) dC_t^{prod\ time}$$

(11) $(x_0, y_0), \ldots, (x_j, y_j), \ldots, (x_k, y_k)$

(12) $L(x) := \sum_{j=0}^{k} y_j \ell_j(x)$

(13)
$$\ell_j(x) := \prod_{\substack{0\le m\le k \\ m\neq j}} \frac{x - x_m}{x_j - x_m} = \frac{(x - x_0)}{(x_j - x_0)} \cdots \frac{(x - x_{j-1})}{(x_j - x_{j-1})} \frac{(x - x_{j+1})}{(x_j - x_{j+1})} \cdots \frac{(x - x_k)}{(x_j - x_k)},$$

(14) $f(v_j) = C_j^{upstor(r+1)}$

(15)
$$P_{h_j-1}(v_j) = \sum_{r=0}^{h_j-1} C_j^{upstor(r+1)} . \prod_{\substack{k=0 \\ k\neq r}}^{h_j-1} \frac{v_j - k}{r - k}, j = 1, 2, ..., J$$

In equation 1, the objective function shows that minimizing overall costs includes start-up costs, production costs, storage, and distribution costs (transportation and relocation). In the second part, the objective function is to reduce the difference between actual production and nominal capacity. It is called a multi-choice constraint. Equation 3 states that production takes place in period t if the factory is selected and in which L is a large positive number. Equation 4 Adjusts the inventory of factories in terms of the remainder of the previous period, new production, and delivery of goods to distribution centers. 5 Adjusting the inventory of distribution centers according to the remainder of the previous period, receiving goods from factories, and sending goods to end users. In equation 6, the needs of customers in each period are met. In equation 7, everything produced is delivered to the customers and the existence of the factory warehouse is at the end of the zero production period. Equation 8 shows the flow of goods entering and leaving the distribution center in all periods. Equation 9 is the range of variables in the model. Equation 10 to 15 describes the optimization techniques in the year. Equation 10 states that to calculate the objective function, it is related to minimizing the time available to production. Equation 11 uses the Lagrange interpolation method to deal with the multiple-choice constraints mentioned in the model. The Lagrange interpolation polynomial method seeks to find one or more sentences of degree k. Equation 13 is used for linearization. Equation 15 shows polynomials according to Lagrange.

The system under consideration includes four end users, three distribution centers, and two factories, each of which produces a specific and different spare part, therefore:

J=I=2

M=4

N=3

Applicant users are both spare parts and in the six-time periods, each period is one month, have a demand table as follows. In this model, the time required to produce each piece is 4 hours and the time required to set up both factories is 2 hours. Then the parts will be sent to the distribution centers and finally, the end users will get these parts from the distribution center.

Table 1. End users demand for two pieces

	Month1	Month2	Month3	Month4	Month5	Month6
User1/part1	40	32	45	10	32	10
User2/part1	20	12	21	12	45	12
User3/part1	120	15	48	45	15	40
User4/part1	120	58	10	35	14	5
User1/part2	5	12	10	62	84	42
User2/part2	70	35	12	15	52	12
User3/part2	25	48	42	10	10	8
User4/part2	25	10	43	10	8	25

The time required to make each piece (A) is 4 hours and piece (B) is 3 hours. The time required to set up both factories is 2 hours. Setup costs and production costs for two products are presented in Table 2.

Table 2. Establishment and production costs

	Part1	Part2
Setup/T=1	100	110
Setup/T=2	120	130
Setup/T=3	110	120
Setup/T=4	120	140
Setup/T=5	110	120
Setup/T=6	100	110
production/T=1	40	50
production /T=2	50	60
production /T=3	50	60
production /T=4	70	80
production /T=5	50	60
production /T=6	40	50

Warehousing costs in factories and distribution centers according to the type of spare parts are presented in Table 3.

Table 3. Warehousing costs

Storage cost	Part1	Part2
Manufacture1	40	50
Manufacture2	40	50
Distribution center1	50	60
Distribution center2	60	65
Distribution center3	50	70

Warehousing costs in each time period for each factory can be a maximum of one of the following values:

$$C_1^{upstor} \in \{1000,1200\}$$

$$C_2^{upstor} \in \{1100,1300\}$$

Shipping costs for a production unit from distribution centers to users in Table 4 are:

Table 4. Shipping costs for a production unit from distribution centers to users

Transfer cost	User1	User2	User3	User4
Distribution1	30	35	45	50
Distribution2	45	40	55	40
Distribution3	40	40	20	45

Shipping costs for a production unit from factories to distribution centers are given in Table 5.

Table 5. Shipping costs for a production unit from factories to the distribution center

Transfer cost	User1	User2	User3	User4
Distribution1	30	35	45	50
Distribution2	45	40	55	40
Distribution3	40	40	20	45

We also assume that the time distribution function available for production in any period of the normal distribution with mean and standard deviation parameters, where

$\mu_t = 27 \quad t = 1, 2, ..., 6$

$\sigma_t = 1.15 \quad t = 1, 2, ..., 6$

The value $p_t = 1$ was also considered for all periods. To optimize the model, the genetic algorithm was used for the linear constraints in the MATLAB optimization toolbox. The characteristics of the genetic algorithm used are as shown in Table 6.

Table 6. Genetic algorithm parameters

Input parameter	**quantity**
number of people	500
The number of repetitions	100
Probability of intersection	0.9
Probability of mutation	0.05

At the end of the optimization process of the spare parts supply chain model, the following results were obtained in the field of production and distribution program.
In the final answer the values:

$v_1 = 1$

$v_2 = 2$

These values in the multi-choice constraint mean choosing the maximum warehousing cost for factories so that the maximum cost for factory number one is 1000 and for factory number two is 1300. Finally, the total system cost (the value of the optimal objective function) was calculated to be 152800. Tables 7 and 8 show the activity or inactivity of each factory and the amount of production in each period.

Table 7. Activity or inactivity of each factory in each period

$\alpha_{11}=1 \quad \alpha_{12}=1 \quad \alpha_{13}=0 \quad \alpha_{14}=1 \quad \alpha_{15}=1 \quad \alpha_{16}=0$

$\alpha_{21}=1 \quad \alpha_{12}=1 \quad \alpha_{23}=1 \quad \alpha_{24}=1 \quad \alpha_{25}=1 \quad \alpha_{26}=1$

Table 8. Production of each factory in each period

$\beta_{11}=450 \quad \beta_{12}=10 \quad \beta_{13}=0 \quad \beta_{14}=100 \quad \beta_{15}=150 \quad \beta_{16}=0$

$\beta_{21}=250 \quad \beta_{12}=120 \quad \beta_{23}=140 \quad \beta_{24}=120 \quad \beta_{25}=150 \quad \beta_{26}=87$

For example, it means the production of 120 spare parts of the second type by factory number two in the fourth period. In Table 9, the rest of the optimal variables of the model will be mentioned, which due to their high volume, only non-zero variables will be expressed.

Table 9 - The number of goods transferred from factories to distribution centers

$T^1_{111}=300 \quad T^1_{112}=100 \quad T^1_{223}=110 \quad T^1_{114}=75 \quad T^1_{115}=100 \quad T^1_{116}=45$

$T^1_{121}=100 \quad T^1_{132}=060 \quad T^1_{233}=12 \quad T^1_{134}=10 \quad T^1_{125}=020 \quad T^1_{216}=87$

$T^1_{131}=050 \quad T^1_{212}=100 \quad T^1_{214}=60 \quad T^1_{215}=100$

$T^1_{211}=150 \quad T^1_{222}=050 \quad T^1_{224}=30 \quad T^1_{225}=30$

$T^1_{231}=050 \quad T^1_{234}=15$

For example, it means sending $T^1_{134}=10$ spare parts of the first type from the first factory to the third distribution center in the fourth period.

Tables 10, 11, and 12 indicate the inventory of each factory, the number of goods transferred from the distribution center to end users, and the inventory of the distribution center in each period and after sending the goods to customers, respectively.

Table 10. The inventory of each factory in each time period

	Month1	Month2	Month3	Month4	Month5	Month6
Manufacture1/part1	42	34	47	11	34	11
Manufacture2/part1	21	13	21	13	47	13
Manufacture1/part2	5	13	11	65	88	44
Manufacture2/part2	73	37	13	16	55	13
Ending inventory	0	0	0	0	0	0

Finally, the inventory at the end of the factory period is equal to zero.

Table 11. The number of goods transferred from the distribution center to end users

$T^2_{1111}=040$	$T^2_{1112}=32$	$T^2_{1113}=45$	$T^2_{1114}=10$	$T^2_{1115}=32$	$T^2_{1116}=10$
$T^2_{1131}=120$	$T^2_{1142}=58$	$T^2_{1143}=05$	$T^2_{1124}=12$	$T^2_{1125}=45$	$T^2_{1126}=12$
$T^2_{1141}=120$	$T^2_{1222}=12$	$T^2_{1223}=20$	$T^2_{1144}=35$	$T^2_{1135}=15$	$T^2_{1136}=40$
$T^2_{1221}=020$	$T^2_{2112}=12$	$T^2_{1343}=07$	$T^2_{1234}=32$	$T^2_{1245}=14$	$T^2_{1246}=05$
$T^2_{2111}=005$	$T^2_{2122}=35$	$T^2_{2113}=12$	$T^2_{1444}=10$	$T^2_{2115}=10$	$T^2_{2116}=42$
$T^2_{2121}=070$	$T^2_{2232}=48$	$T^2_{2133}=42$	$T^2_{1334}=13$	$T^2_{2155}=84$	$T^2_{2126}=12$
$T^2_{2131}=025$	$T^2_{2242}=10$	$T^2_{2143}=43$	$T^2_{2114}=62$	$T^2_{2225}=10$	$T^2_{2136}=08$
$T^2_{2331}=025$		$T^2_{2323}=12$	$T^2_{2144}=35$	$T^2_{2235}=21$	$T^2_{2146}=45$
			$T^2_{2224}=15$	$T^2_{2435}=20$	
				$T^2_{2445}=10$	

As an example, $T^2_{1144}=35$ it shows that the distribution center number one has sent 35 first type goods to the number one user in the fourth period.

$T^2_{1144}=35$

$\mu_{111}=40$	$\mu_{112}=50$	$\mu_{113}=52$	$\mu_{114}=08$	$\mu_{115}=16$	$\mu_{226}=1$
$\mu_{212}=80$	$\mu_{122}=03$	$\mu_{123}=32$	$\mu_{134}=04$	$\mu_{125}=06$	
$\mu_{211}=50$	$\mu_{132}=60$	$\mu_{133}=07$	$\mu_{214}=08$	$\mu_{225}=01$	
$\mu_{231}=05$	$\mu_{212}=03$	$\mu_{213}=15$	$\mu_{224}=05$		
		$\mu_{234}=18$			

As an example, $\mu_{214}=08$ it shows that in the fourth period and for the first distributor, the number of inventory of the second part is equal to 8.

6. Conclusion

In the present study, the performance of the spare parts supply chain (maintenance, repair, operation) is multi-period and multi-product. First, the general framework of performance was stated. Users estimate demand based on equipment data sets. Demand information is first sent to distribution centers and then to manufacturers. Distribution centers are provided by manufacturers and distribute products among users (customers). In the studied model, it was assumed that type i is a spare part required by users or end users. End users can purchase this type i spare parts from n spare parts distribution center and each distribution center sells all types of spare parts. Each spare part has its own cost and production time. Product storage in factories or distribution centers each has its storage costs. Sending the product from the factory warehouse to the distribution centers and distribution centers to the end users also has transportation costs. Randomness and uncertainty in the production and storage of spare parts are considered in this model, which are defined as random variables and multi-option variables in mathematical programming, respectively. Also, the time required to prepare the factory and produce the product in each period is a certain amount. But in reality, the time available for production in each period is a random variable, so production must be done in such a way as to minimize the difference between real-time and available time.

For this purpose, the expected value of this difference will be minimized. In other words, $p_{t=1}$ quantity should be minimized as one of the objective functions in the supply chain system, in which p_t the coefficient of determination is the importance of the closeness of the time difference in different production cycles. The purpose of this research is to optimize and minimize overall costs such as production, storage, and distribution costs in supply chain performance. The parameters and variables of this production decision are the inventory during the transportation of the product. According to the objective function, constraints and constraints are considered for the spare parts supply chain model. Another limitation is that Factory I can choose one of the warehousing cost levels (upper bound), this constraint is called a multiple-choice constraint. It should be noted that the limiting parameter exists as a multivariate variable in the model that the multivariate set can be adapted to, thus improving the stochastic planning model for spare parts supply chain design. Since this model takes into account randomness and uncertainty in the production and storage of spare parts at the same time, the optimal supply chain design obtained by responding (solving) this model would be a more logical and logical action. In practice, this decision-making model can select a corresponding distribution for random variables based on the operational situation. Also, they can adjust the dimensions of the multiple variables required. Lagrange method of MATLAB software can be used to solve optimization problems and programming model of nonlinear integers. Using the results and meanings obtained from the analysis of parameters performed by experts and management, the optimal value can be achieved.

Maintenance and repair is a set of different activities that are used to maintain parts, equipment, and safeguard assets and assets. In order to prevent accidents in the event of equipment failure and interruptions in the production process or the process of operation of related equipment. From a scientific point of view, improving partial planning is one of the reasons for project management. It can lead to a significant increase in the profitability of organizations. Using a special maintenance system of an organization can play a significant role in reducing the cost of the final product. But the effects are not limited to cost, in the speed of product or service delivery throughout the supply chain, product quality, reliability, the agility of the organization, and such factors will also have their effects. Today, industries are dealing with customers whose satisfaction is very difficult due to the highly competitive environment. Each of them will be a place of reflection. Therefore, we can understand the important and influential role of various maintenance and repair strategies on the business of the enterprise. Maintenance is an integral part of the production that can affect these competing priorities. The objectives of this study are important because these factors have not been addressed specifically. Optimization in production has always been one of the issues that have been considered by researchers. In the present study, the problem of reducing costs in production is raised. Therefore, a genetic algorithm has been used to obtain the optimal value. The problem is to reduce production costs in the workshop were type i parts are produced. The type i spare parts are procured from n spare parts distribution centers and each distribution center sells all types of parts. Therefore i There is a factory for the production of spare parts. Despite the different variables and the objective function, which is in random form, a few quantitative constraints have been used, which has increased the flexibility of the model. The obtained results were compared with the reality in Rahyab Sanat Sepahan Engineering Technical Company as much as possible and we came to the conclusion that the model has provided good outputs compared to reality and can despite the various fluctuations in the production line, distribution centers, costs Shipping can be an acceptable decision. After completing the process of optimizing the supply chain model of spare parts in the field of production and distribution program and reviewing the production of each factory, we reached the inactivity of some factories in each period.

6. References

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