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Article

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MANAGEMENT | RESEARCH ARTICLE

Furniture industry management by applying SCM

Majid Azizi[1*] and Mehdi Faezipour[1]

Abstract: The purpose of this study is to use supply chain management in a wood furniture company and find its effect on the management indices of that company. The supply chain is a complex system consisting three or more commercial units which directly include at least one connected product procedure, financial service, and/or information from one source to a customer. In fact, in every company and factory, a cycle is carried out from raw material producing stage to product delivery to final customer. To be more precise, this cycle itself includes different rings such as provider, producer, and customer. Actually, in creating present procedures, time factor should be reduced to satisfy the customer more. In this study, data connected to a wood furniture company were provided through supply chain management model. Likewise, optimized program was offered using GAMS programming software. Considering the acquired results, the use of this model can revolutionize the wood furniture industry of Iran, regarding competitive features. As a result, it develops the aforementioned industry.

Subjects: Business, Management & Accounting; Mathematical Modeling; Supply Chain Management

Keywords: supply chain management; supplier; limitation; optimized; customer; model

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Additional information is available at the end of the article

1. Introduction

Supply chain management (SCM) is one of the new scientific and applied issues which has caused management development in the present century, industrially and commercially. As a matter of

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Majid Azizi received his MSc degree in wood and paper sciences and industries from the University of Tehran in 1993. Subsequently, he obtained his PhD in management of wood and paper industries from University of Tehran in 2002. Presently, he is working as a professor at the Department of wood and paper sciences and industries, University of Tehran, Iran. Azizi's research areas include Analytic Hierarchy Process, Analytic Network Process, Multi-Criteria Decision-Making, Forecasting, Industrial Management, and Wood Products Marketing.

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PUBLIC INTEREST STATEMENT

This perspective article describes using supply chain management in Iran's furniture factory and its effect on management criteria of the company. Managers of the furniture industry should establish a proper relation with suppliers and consumers as well as obtain favorite results regarding benefit, satisfaction of the customers, financial risk, and volume of production. Understanding these relations can improve the situation of the factory in the market and development planning in the future.

fact, increasing competitiveness and a try to reach organization continuity, since located in technology era and development in IT, have necessitated organizations for continuing their existence to consider customer satisfaction as their first priority. Regarding this, price reduction, timely transportation, and high-quality products can be considered as customers' needs and interests. SCM is an attitude which satisfies all these needs not only by just being stuck to customers' final products, but also by other higher suppliers. In other words, this process covers other suppliers too. Obviously, this supply to meet a customer's need is called supply chain. This attitude can be applied in different functional parts of an organization like strategic planning, production planning, supply control, transportation planning, location, setting, etc. SCM, specifically, introduces supply chain or it is a network of organizations where they produce value through connecting higher levels to lower ones in processes and activities involved and offering products and services to the final customer. In general, a tool of supply includes some legally separated organizations which are connected to one another by material, information, and financial currents. Unquestionably, this organization can be the one that produces units and composes units and final products. Even the suppliers of provision and distribution (logistic) services and customer himself can be included in this process. Basically, a network does not focus just on a chain in a trend. Moreover, it focuses on a complex convergent and divergent network which includes many different orders of the customer which should be met in parallel with each other.

1.1. Model introduction

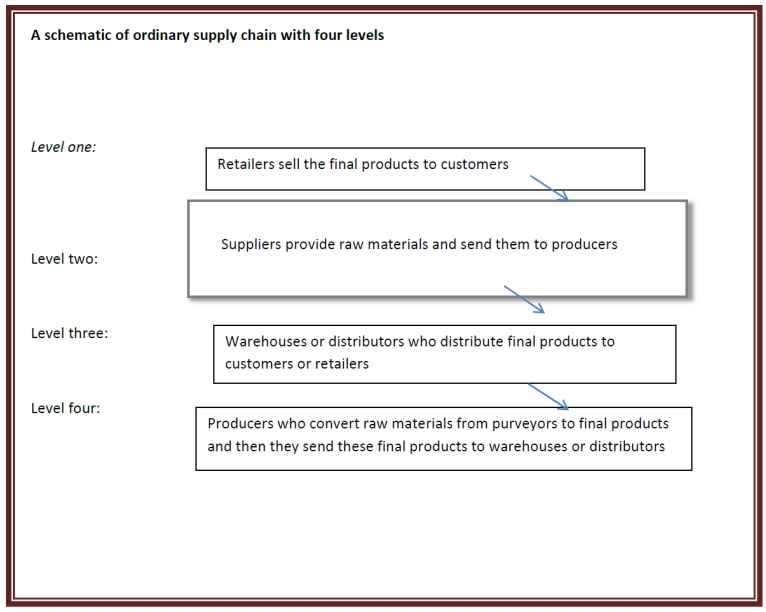
Designing and managing a supply chain is one of the most important programming activities of an organization in the field of production. A supply chain is a network which consists of purveyor, producing units, warehouses, and distributors who are organized to offer raw materials and its conversion to final products and also its distribution among the customers.

1.2. Consider an ordinary supply chain with four levels

The first level of this chain is customers or retailers in which the final products are sold to the customers.

The second level is warehouses or distributors who distribute final products to the customers or retailers through different ways of transportation. The third level is producers who convert raw materials from purveyors to final products and then they send these final products to warehouses or distributors through different methods of transportation. A warehouse of raw material should be considered by every producer in order to realize the model better. In addition, each producer can produce various products in every series. However, they should tolerate fixed cost and expenditure of relevant systems establishment related to the new product. Basically, the production rate of every producer in every series is lower or equal to the maximum production capacity of that producer. Moreover, this maximum capacity should not be lower than a minimum amount and more than a maximum amount.

The fourth level which has been considered as a discussable level in supply chain in this proposal model, in fact, which consists of suppliers. Then, suppliers provide raw materials and send them to producers through different ways of transportation. In this model, providers' benefit has not been taken into consideration in regard to maximizing supply chain's benefit. Basically, in this model, the aim is to design a general structure of supply chain net. This supply chain is planned for a specific period of time. Places of the customer and provider groups include problem's entries, as well as there are existing potential places for providers and distributors. Furthermore, whether providers and distributors are created or not as well as production capacity and warehouse, distributors and producers are initially determined.



1.3. Arjan Company

Wood art Arjan Co. is one of the greatest wood industrial companies which is active in the field of designing and products manufacturing, services, and interior designing. This company cooperates with various providers for providing its required raw materials. Also, this company manufactures a variety of products.

On the other hand, the company is in relation to different distributors and also produces a wide range of products. This relation results in the selling of the company's various products. On the whole, it can be said that this company is located in a complete supply chain which consists of high levels (providers) and low levels (customers). So, it can be a good case to study in this regard.

The suppliers of Arjan Company include a group of local and foreign suppliers who provide various kinds of raw material for the company. Also, the company has a modern and decent production line which can produce different products. Arjan company's products include various kinds of wood services used at home. Not only are they beautiful, but also they are applied and give comfort and satisfaction. Most component parts of these products are of MDF along with different thicknesses. In addition, it consists of various metal and plastic parts.

1.4. Aim of the study

The use of supply chain management (SCM) in factories and furniture industries results in providing suitable raw materials from suitable provider, decreasing production expenditure, and increasing customers' satisfaction rate. Therefore, this industry can experience a considerable development. All in all, the general goal of this study is to utilize supply chain net in wood art Arjan Co. and as a result to improve the management factors of the factory.

In this regard, we consider the following special aims: to maximize benefit, to maximize customers' satisfaction, to minimize financial risk and investment, and to maximize flexibility in the volume of producing as well as storing.

1.5. Hypothesis of study

The usage of SCM can lead to improvement and promotion of competitive indices of wood art Arjan Co. including amount of raw materials' purchase from providers, the amount of stock at the end of the period, customers' satisfaction, and finally promoting benefits of the company.

1.6. Review of the related literature

Akbari Jokar and Sheikh Sajadiyeh (2005) created a composite model through offering three subdivisions of production, distribution, and supply as components of a composite model and also defined and identified joint agents and relationship among these subdivisions. Ahmadi (2005) studied e-commerce models in SCM of car manufacturing industries. Etebari, Pouresfandiani, and Khalaj (2005) paid attention to SCM as one of the main needs of big organizations such as Iran Khodro (a car manufacturing Co.). Chehrsoughi, Degordi, and Heidari (2005) offered a model to determine the number of orders for each component of the chain in unspecified conditions of final customer as well as delivery times. Modarres (2005) compared companies using e-commerce with the other companies and came to the conclusion that companies using e-commerce differ a lot in function and the amount of benefitting from their income-earning methods indicates the efficiency of SCM. Moazez, Modarres, and Sabouri (2005) offered a new model in supply chain. Also, they omitted or minimized the defects of the model through analyzing previous models and recognizing their weak points so, "the authors suggest a model that they call perfect model." Apostolou, Sakkas, and Mentzas (2004) studied big and valid corporations being active in the furniture industry internationally and came to the conclusion that most of them tend to use new technologies to develop a new measure; they transferred a part of their shares through the Internet to their customers. Also, they have displayed information of their products on the Internet for their customers. As a result, it has created a high level of satisfaction among customers and a commitment for the company itself. Vlosky, Westbrook, and Poku (2002) analyzed and studied wood products' producers in the western part of America and concluded that using the net can be a launch pad for business and wood industries. Moreover, statistically 61% participants had a website, 18% used the Internet to sell their products, and 10% are going to use the Internet in the future. Wahba and Al Etr (2003) studied the furniture industry in Egypt. In fact, considering the speed of developing furniture in the world and comparing traditional methods in Egypt's furniture industry, they came to the conclusion that they can promote the industry through a suitable model. Brown, Graves, and Honczarenko (1987) offered a one-cycle model in the form of composite integer to determine where every product should be produced, which product should be produced by which machine and which part, and finally from where these products should be sent. Also, this model minimized the production cost and distribution for new products. Cohen and Lee (1989), in order to design an international supply chain and determine the quality of material current, offered a model in the form of integer which was nonlinear and composite. The objective function of this model was to maximize benefit and included expenditures such as maintenance, production, distribution, transportation, and customs. Butler (2003) offered a multi-level and multi-cycle model in the form of composite integer. This model determined which equipment of production is used in every cycle. Also, it determined how products are moving from producers to distributors and then to customers. Alonso-Ayuso, Escudero, Garín, Ortuño, and Pérez (2003) offered a possible composite integer in which the price of the raw material and product's sales price, demand, and production costs were considered as indefinite parameters.

2. Materials and methods

In this study, to create a relevant mathematical model, we considered wood art Arjan Co. Data concerning the relevant model are very expansive and also were collected from managers of the company.

2.1. Model and its characteristics

The case is explainable as follow:

2.1.1. Definite data

- General information of the case: number of cycles, number of kinds of raw material, and number of types of products.

- Information on production: required amounts of each type of raw material to produce each unit of each kind of final product and minimum and maximum capacities of production of each producer.
- Information on transportation: Length of delivery and maximum capacity of transportation for every method of transport.
- Information on capacity of producers' raw material warehouse and distributors' final products' warehouse.
- Expenditure parameters: cost of buying raw material, fixed costs of giving orders, fixed and changing cost of producing products, cost of making warehouses and new product lines, cost of unemployment, cost of maintenance of raw material warehouses for producers and warehouse of products for distributors, and transportation costs.
- Information on economic parameters: beat-up value of raw material and value of products and each element of supply chain at the end of analysis.
- Sales data: price of every product in different series and to different customers.

2.1.2. Possible Data

- Gas price changing factor in every series (effective on transportation cost).
- Interest rate and inflation rate in different periods.
- Maximum amount of supply for every one of the suppliers in every period.
- Every customer's request for each product in every period is offered as an entry according to this probable data in the form of discontinuous scenarios with definite probability of occurrence to the model. In this case, these probable parameters are accessible in the form of definite distributions (e.g. normal distribution); we can convert it to discontinuous amounts with definite probability through Mont Carlo Sampling.

2.1.3. Decision-making Variables

- To determine the general structure of the supply chain network (variables of first phase): number, place, and producers' and distributors' capacities.
- To determine which provider we should purchase from in every period.
- To determine the production plan of each producer (what products and how much production).
- To determine materials' transportation process all over the supply chain network in every level.
- To determine sales' level of each product to each customer in every period.
- To determine the stock level of warehouses in every period for every producer and distributor.
- To determine all expenditures.

2.1.4. Model characteristics

This model has added some new dimensions which are explained as follow:

(1) To consider distributors of manufactured products as a level and a discussed part in supply chain.

Because providers play an important role in supply chain, despite previous models, this model considers providers both as a level and discussed part in supply chain.

(2) To consider economical parameters like profit rate, inflation rate, and installments value in decision-making.

In order to be applicable, inflation rate and money value during the time in revenue and expenditures are considered in this model. In all societies, including developed and developing ones, the rate of inflation may stand in low level but never reaches zero. Given that this model is a multi-cycle one, and is presented in strategic and long lasting level, it needs high investment. The significance of inflation and money value consideration would be cleared completely. This subject could be considered using the present concept of net value. In this model, raw materials' installment value products, producers, and distributors at the end of estimation period are considered after deducting amortization of all periods.

Considering supply amount as a source of unreliability. Another failure that is observed in former models is that the only source of unreliability had been just demand and indecisiveness and supply has not been considered in them.

(3) To consider transportation expenditures as a source of uncertainty.

In order to be applicable, in this proposed model, not only demand, amount of supply, and inflation rate but also transportation expenditures are considered imprecisely. It's clear that transportation expenditures are highly dependent on fuel price (gasoline and gas oil) and because fuel price has an unstable nature, the same nature is observed in transportation prices. In this model, coefficient of increasing fuel price is considered.

(4) To consider customer satisfaction using the concept of meeting commitments against all customer groups.

In previous probable multi-purpose models, the action of not providing demand was fined or completion rate was used as a criterion to evaluate customer satisfaction. Completion rate is a common criterion to estimate servicing to customer and reveals the percentage of orders that are met in no time and its aim is to maximize the percentage of met demands between customers in that special period of customer's demand. Instead, in this proposed model, maximizing the percentage of met demand in that period of customer's demand for each group in all markets is considered to achieve customer satisfaction. In other words, satisfaction of all customers is considered in this model and all answers in which there is one customer with unprovided demand are forbidden, and it's exactly the concept of commitment providing for all groups of customers.

(5) To consider financial risk as one of the aim functions:

One of the aim functions in this model is decreasing financial risk. In previous models, the concept of risk has not been considered; instead, in this proposed model, financial risk is explained as the possibility of decreasing the profit from a desired level and using different events, we get to problem answer in which the possibility (financial risk) is minimized.

(6) To consider flexibility in raw materials' warehouse of producers. In addition to considering flexibility in product warehouse of distributors and capacity of manufactures, flexibility in raw material warehouse of producers is considered as one of the aims of this multi-purpose model. Volume flexibility of warehouse is explained as the difference of the average amount of the production to the maximum capacity of production.

2.2. Model introduction

j	total amount of raw materials
i	total amount of productions
s	total providers
p	total of producers
d	total of distributors
I	total of customers
t	total of periods
m	All the ways of transportation
a	all the contemporaneous events

2.2.1. Expenditure parameters

S_{ilt}	sales price of each unit of product i to customer l in period t.
B_i	installments value of each unit of production i at the end of period
K_{ta}	fuel price increase coefficient in period t based on a event
C^1_{jst}	purchase price of each unit of j raw material from s provider in t period
C^{01}_{jst}	ordering fixed expenditure to buy each unit of raw material j from provider s in period t
C^2_{ipt}	production expenditure of each unit of product i in producer p in period t
C^{02}_{ipt}	production-fixed expenditure of each unit of product i in producer p in period (term) t
A_j	installments value of each unit of raw material j at the end of periods
T^1_{jspm}	transportation expenditure of each unit of raw materials j from supplier s to producer p by the way of transportation m
T^2_{ipdm}	transportation expenditure of each unit of product i from producer p to distributor d by transportation way m
T^3_{idlm}	transportation expenditure of each unit of product i from distributor d to customer l by transportation way m
B^1_p	minimum fixed expenditure for producer p
BU^1_p	fixed expenditure against expansion of raw material's ware fare capacity for producer p for a shared unit of raw material
BU^2_p	fixed expenditure against expansion of producer's producing capacity for a shared unit of product
B^3_d	minimum fixed expenditure for distributor d
BU^3_d	fixed expenditure against expansion of distributor's ware fare capacity for a shared unit of product
S^1_p	percentage of producer's amortization p during all periods
S^2_d	percentage of distributor's amortization d during all periods
C^{h1}_{jpt}	maintenance expenditure of each unit of raw material j in producer p in period t
C^{h2}_{idt}	maintenance expenditure of each unit of product i in distributor d in period t

2.2.2. Parameters related to limitations

T_1	number of products,
T	number of all periods,
θ_{ta}	inflation rate in period t in event a
IR_{ta}	profit rate in period t in event a
H	minimum accepted profit to consider financial risk equal to zero

W_1 the weight of importance in flexibility in producer's raw material ware fare

W_2 the weight of importance in flexibility in producers

W_3 the weight of importance in flexibility in distributor's products' ware fare

K_p^1 maximum capacity in producer's raw material ware fare p based on shared unit of raw material

LK_p^1 minimum capacity in producer's raw material ware fare p based on shared unit of first material

K_p^2 maximum produce capacity for producer p based shared unit of product

LK_p^2 minimum produce capacity for producer p based on shared unit of product

K_d^3 maximum capacity in distributor's products' ware fare d based on shared unit of product

LK_d^3 minimum capacity in distributor's products' ware fare d based on shared unit of product

E_{ji} needed amount of raw material j to produce a unit of product i

S_{jsta} to predict maximum amount of supply for supplier s for raw material j in period t in event a

D_{ilta} to predict the amount of customers' demand l for product i in period t in event a

A_j^1 conversion coefficient of raw material j to production standard

A_i^2 conversion coefficient of product i to production standard

TC_{spm}^1 maximum capacity of raw material transportation from supplier s to distributor p by transportation way m based on shared unit of raw material

TC_{pdm}^2 maximum capacity of product transportation from producer p to distributor d by transportation way m based on shared unit of product

TC_{dlm}^3 maximum capacity of product transportation from distributor d to customer l by transporting way m based on shared unit of product

L_{spm}^1 duration of raw materials' delivery from supplier s to producer p by transporting way of m

L_{pdm}^2 duration of product delivery from producer p to distributor d by transporting way of m

L_{dlm}^3 duration of product delivery from distributor d to customer l by transporting way of m

β_{lt} the percentage of unprovided demand of customers l to previous period in period t

PRO_a the possibility of event a occurrence

2.2.3. Decision-making variables

Y_{st}^1 if supplied s is purchased during period $t = 1$, otherwise = 0

Y_p^2 if there is producer p (that means making a new production line) = 1 but = 0

Y_d^3 if there is distributor $d = 1$ but = 0

Z_{pit} if producer p manufactures product i in period $t = 1$ but = 0

V_a if the profit of event a is less than $H = I$ but = 0

R_i the possibility of provided demand percentage of customer i

R minimum possibility of provided demand percentage of customers

FR the amount of financial risk by considering all events

TR_a total profit of all periods in event a

TR total profit of all periods in all events

W_{la} provided fraction of customers' demand l in event a

F	flexibility of the overall system by considering all events
F_a	flexibility of event a
X_{ipt}	the amount of product i by producer p in period t
X_{ilt}	the amount of unprovided demand of product i for customer group l in period t
X^1_{jsptm}	The amount of raw material j sent from supplier s to producer p in period t by transportation way m
X^2_{ipdtm}	the amount of product i sent from producer p to distributor d in period t by transportation way m
X^3_{idltm}	the amount of product i sent from distributor d to customer l in period t by transportation way m
I^1_{jpt}	the amount of raw material available j in production p at the end of period t
I^2_{idt}	the amount of product available i in distributor d at the end of period t
KP^1_p	selected capacity of producers' raw material water fare p based on shared unit of raw material
KP^2_p	selected capacity of manufactures' product p based on shared unit of product
KD_d	selected capacity for distributor d based on shared unit of product

2.2.4. Limitations

First group: Limitation of raw material ware fare capacity for each producer by considering the possible maximum and minimum capacities.

$$\sum_j A^1_j I^1_{jpt} \le KP^1_p \qquad \forall p,t \tag{1}$$

$$LK^1_p Y^2_p \le KP^1_p \qquad \forall p \tag{2}$$

$$KP^1_p \le K^1_p Y^2_p \qquad \forall p \tag{3}$$

Second group: limitations of production capacity for each producer by considering the possible maximum and minimum capacities.

$$\sum_j A^2_j X_{ipt} \le KP^2_p \qquad \forall p,t \tag{4}$$

$$LK^2_p Y^2_p \le KP^2_p \qquad \forall p \tag{5}$$

$$KP^2_p \le K^2_p Y^2_p \qquad \forall p \tag{6}$$

$$\sum_i Z_{ipt} \le T^1 Y^2_p \qquad \forall p,t \tag{7}$$

Third group: limitation of product ware fare capacity for each distributor by considering the possible maximum and minimum capacities.

$$\sum_i A^2_i I^2_{idt} \le KD_d \qquad \forall d,t \tag{8}$$

$$LK_d^3 Y_d^3 \le KD_d \qquad \forall d \tag{9}$$

$$KD_d \le K_d^3 Y_d^3 \qquad \forall d \tag{10}$$

Forth group: Limitation of production volume by considering the amount of raw materials available.

$$E_{ji} X_{ipt} \le I_{ip(t-1)}^1 + \sum_{s.m} X_{jsp(t-l_{spm}^1)m}^1 \qquad \forall i,j,p,t \tag{11}$$

Fifth group: limitation related to the amounts of raw material and product stock in two successive periods.

$$I_{jpt}^1 = I_{jp(t-1)}^1 + \sum_{s.m} X_{jsp(t-L_{spm}^1)m}^1 - \sum_i E_{ji} X_{ipt} \qquad \forall j,p,t \tag{12}$$

$$I_{idt}^2 = I_{id(t-1)}^2 + \sum_{p.m} X_{ipd(t-L_{pdm}^2)m}^2 - \sum_{i.m} X_{idltm}^3 \qquad \forall i,d,t \tag{13}$$

Sixth group: limitation related to maximum volume of transportation.

$$\sum_j A_j^1 X_{jsptm}^1 \le TC_{spm}^1 Y_{st}^1 \qquad \forall s,p,t,m \tag{14}$$

$$\sum_i A_i^2 X_{ipdtm}^2 \le TC_{pdm}^2 Y_p^2 \qquad \forall p,d,m \tag{15}$$

$$\sum_i A_i^2 X_{idltm}^3 \le TC_{dlm}^3 Y_d^3 \qquad \forall d,l,m \tag{16}$$

Seventh group: limitation related to demand.

$$X_{itl}^- + \sum_{d-m} X_{idl(i-L_{dlm}^3)}^3 = D_{ilta} + \beta_{ilta} X_{il(t-1)}^- \qquad \forall i,l,t,a \tag{17}$$

Eighth group: Limitation related to supplier's supply.

$$\sum_{p.m} X_{jsptm}^1 \le S_{jstd} Y_{st}^1 \qquad \forall j,s,t \tag{18}$$

Ninth group: limitation related to financial risk (M is a rather big number).

$$H - TR_a \le V_a M \qquad \forall a \tag{19}$$

Tenth group: limitation related to providing commitment against customer groups.

$$R_l = \sum_a (PRO)_a W_{la} \qquad \forall l \tag{20}$$

$$W_{la} = \sum_l \left[\frac{\sum_{i.d.m} X_{idl(t-l_{dam}^2)m}^3}{\sum_i (D_{ilta} + \beta_{lt} X_{il(t-l)}^-} \right] \qquad \forall l,a \tag{21}$$

Eleventh group: limitation related to flexibility.

$$F_a = W_1 \sum_p \left[KP_p^1 Y_p^1 - \sum_{i,j,t} \frac{A_j^1 E_{ji} X_{ipt}}{T} \right] + W_2 \sum_p \left[KP_p^2 Y_p^2 - \sum_{i,d,t,m} \frac{A_j^2 X_{ipdm}^2}{T} \right] \quad (22)$$
$$\forall a + W_3 \sum_d \left[KD_d Y_d^2 - \sum_{i,l,t,m} \frac{A_j^2 X_{idltm}^3}{T} \right]$$

Twelfth group: limitations of sign.

$$Y_{st}^1,\ Y_p^2,\ Y_d^3,\ Z_{ipt},\ V_a \in \{0,\ 1\} \quad (23)$$

Objective 1 income

Obj1.. $Z1 = e = \text{sum}(i,\ Ss(i) \times X2(i)) -$
$\text{sum}(j,\ A(j) \times ll(j)) - \text{sum}(i, B(i)) -$
$\text{sum}((j,s), C(j,s) \times X1(j,s)) -$
$\text{sum}(i, Ccc(i) \times X(i)) -$
$\text{sum}((j,s), T(j,s) \times X1(j,s)) -$
$\text{sum}(i, T2(i) \times X2(i)) -$
$\text{sum}(j, Ch1(j) \times l1(j))$

Objective 2 client

Obj2.. $Z2 = e = \text{pro} \times \text{sum}(i, X2(i)/D(i))$
;

Objective 3 flexible

Obj3.. $Z3 = e = \text{pro} \times (KP1 - \text{sum}((i,j), A1(j) \times E(j,i) \times X(i))) +$
$(KP2 - \text{sum}(i, A2(i) \times X2(i)))$

;
Obj4.. $Z4 = e = W1 \times Z1 + W2 \times Z2 + W4 \times Z3$;

2.3. Data

This data consist of the following main groups:

2.3.1. Suppliers

It includes 15 suppliers that are determined by symbols S1–S15. All of suppliers are stable because our program is based on the program of 2006.

2.3.2. Consumed raw material of factory

There are 85 consumed raw materials.

2.3.3. Manufactured products

Includes 16 complete sets.

Mathematical-related model was programmed using important software GAMS.

3. Results

The following model is obtained after processing the data by improved states, program for decision-making variables.

*Z*1: to maximize total profit in overall one-year period (2006). In this case, in improved state, it equals to 4,800 × 1010 Rls

*Z*2: to maximize the commitment providing against customer that with present improved state, the number of provided demand for customers equals to 1,600 in time answer.

*Z*3: to minimize total financial risk. In this case, in improved state, it equals to 222 Rls

*Z*4: to maximize volume flexibility in producers' ware fare and production. This case in improved state equals to 4,800 × 1012.

X: the amount of production for the variety of products by producer.

*X*0: unestimated demand amounts of products.

*kP*1: ware fare capacity, producers' raw material based on shared unit of raw material. In this case, in improved state, it equals to 9,295,700 shared units of raw material.

*kP*2: production, producer capacity-based shared unit of product. In this case, in improved state, it equals to 4,000 shared units of product during the year.

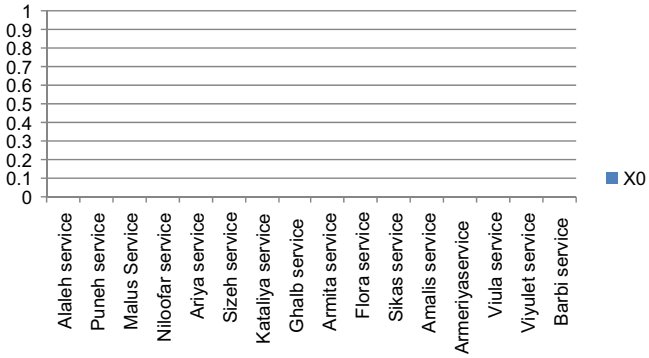
4. Discussion

Regarding the aims of the research, they were as follows: maximization of benefits, maximization of satisfaction of customers, minimization of financial risk, and maximization of flexibility in the volume of producing. According to the results, profit has increased to 4,800 × 1,010 Rls, the number of provided demand for customers equals to 1,600 in time answer which has increased, total financial risk has decreased and improved to 222 Rls, and flexibility in the volume of producing has increased and equals to 4,800 × 1,012. Therefore, the use of SCM in the factory has improved all of the factors and promoted management indices.

In order to reach an ideal profit in each manufacturing organization, promotion of management in all parts of that organization is unavoidable. Regarding Figure 1, it's clear that the unanswered demand against all products is zero that even by the present programming we can take actions to absorb new customers.

(1) In today's competitive world, the priority is with the customer. If on-time meeting of demand to customers does not happen, they would be dissatisfied and complain. If this is repeated, some customers will be missed. It is important to say that even expenditure of customer maintenance is very high; by far, it is less than the expenditure of customer absorption. So on-time meeting of customers' demand is one of the most important management programs that results in profit increase and we can get to this important result based on Figure 1 and all of the unanswered demands for products reach zero. So it can be said that by applying this model in Arjan company, customers' satisfaction is achievable and it guarantees their existence for company and the company can take some actions to absorb new customers in its future programs.

Figure 1. Unestimated demand of customers for all kinds of products.



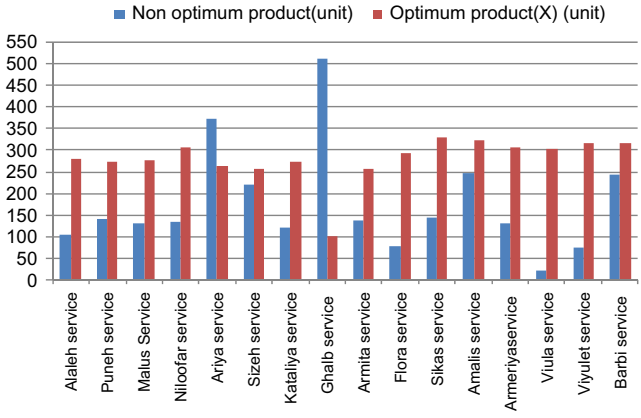


Figure 2. Comparison between nonoptimum and optimum production for each one of the products.

(2) Given the explanation of demand, there are various factors that influence demand that even some of them could be external (such as: commercial, competition, climate, and season); so, demand management includes all decisions that influence in some way on demand.

Given the above description, demand should be managed in a way to decrease expenditures, revenue increase, and decrease ware fare stock and improve customers' servicing level.

In Figure 2, the amount of produced products in the discussed period (2006) after improvement specifies greater amount of production to itself and it shows the market's and customers' need to these products that more profit could be obtained through more production. According to the above-mentioned subject, Figure 2 shows the comparison between initial and improved amounts of production.

Comparison between the amounts of initial and improved production.

But for two types of products (Aria and Ghalb), the opposite case is considered and less production is desirable because based on market's and customers' demand for these two products, more production results in the fullness of warehouses and increases expenses and depression of invest.

(3) About the amount of raw material purchase, it's notable that in a supply or provided chain, all the members of the chain are important and abnormality in one causes falling in efficiency of all the chain. Providers of raw materials as the first members of a chain play an important role in the success of the whole chain. A productive branch should take the most care to choose providers to avoid problems.

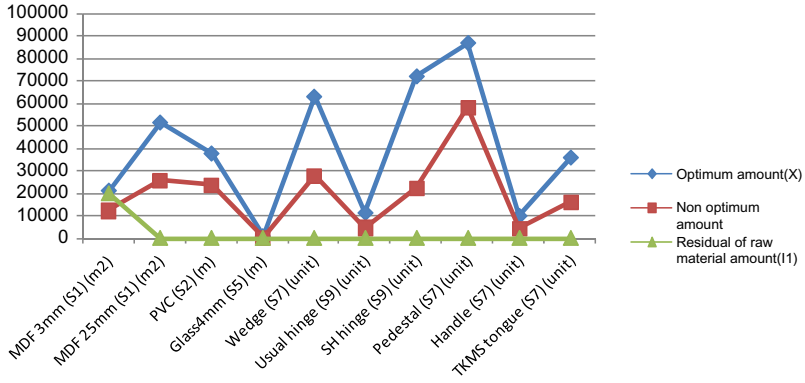


Figure 3. The amounts of exported raw materials (optimum and nonoptimum) from procurers and its residual in the last of the period.

Figure 4. Exported raw materials' amounts (optimum and nonoptimum) from procurers and its residual in the last of the period.

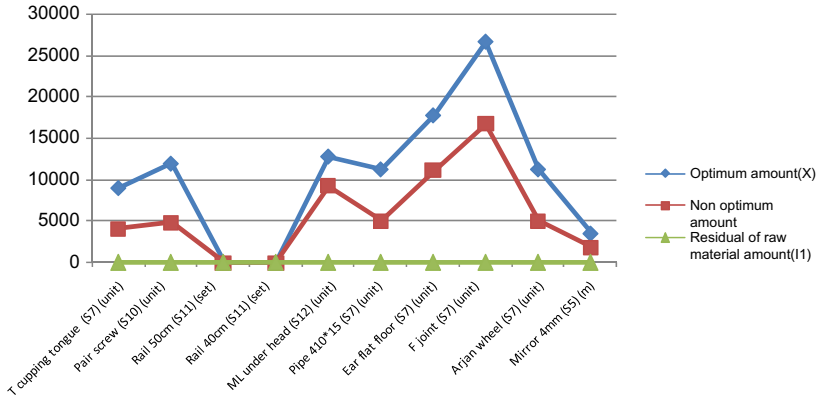


Figure 5. Exported raw materials' amounts (optimum and nonoptimum) from procurers and its residual in the last of the period.

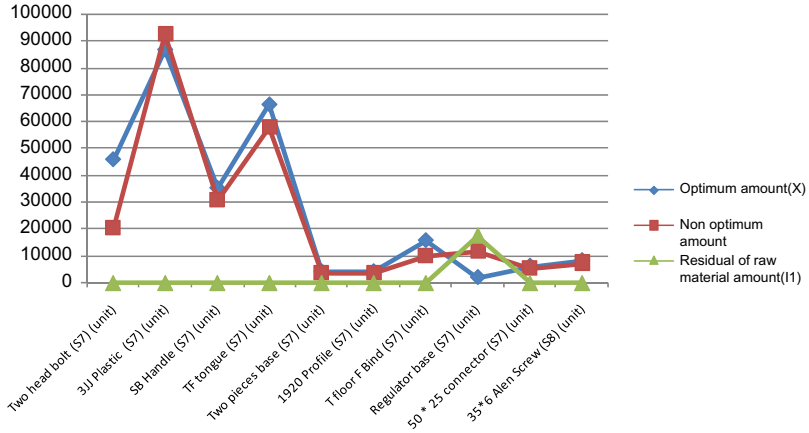
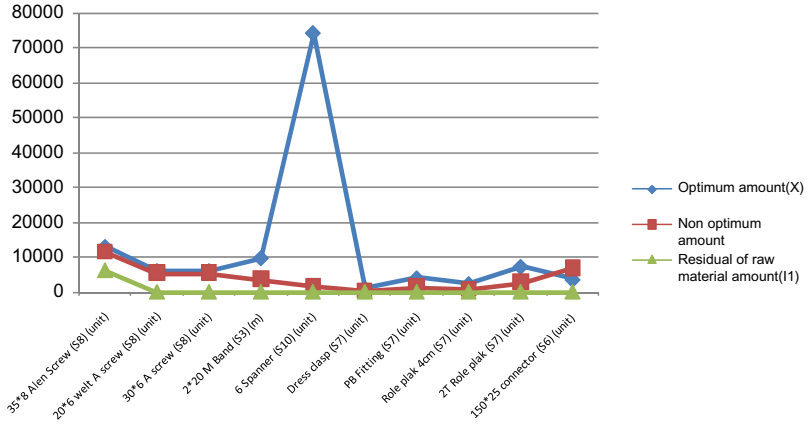


Figure 6. Exported raw materials' amounts (optimum and nonoptimum) from procurers and its residual in the last of the period.



A good provider should have characters like on-time preparation of raw materials, suitable price of raw materials, their good quality, etc. In cases where transportation of raw materials is the duty of the providers, problems about transportation should be considered too. During the time of ordering raw material to the provider, these orderings should be based on the amount of production, production program, and the capacity of the warehouse for the raw materials. The stock of raw materials at the end of period is very important for producers because if this stock increases too much, we will face increases in ware fare expenses and there would be some problems in warehousing to buy new raw materials.

In the proposed model, the amount of left raw materials at the end of period has been reached to the lowest level and the needed amount of the ordered raw materials is based on the production program. Figures 3–10 present improved ordered raw materials beside previous orders, by considering the large amount of raw materials which have been classified to better comparison.

As it's shown in Figure 3, the amount of raw materials purchased is increased in the improved condition, which means the increased need of company to raw materials that this subject justifies by considering the increscent of production.

In Figure 4, in all cases, if there is an increase in raw materials, shopping happens.

In Figure 5 it's clear that in the two first cases, if there is a decrease in raw materials, shopping happens and it shows that these two types of raw materials have been purchased more that the amount of producers' need decreases and their shopping saves determined expenses considerably.

In Figure 6, increase happens in all but one of the cases; this case also was being purchased more that produces' need that even by increasing of production in improved situation, decrease of purchase happens again.

In Figure 7, in all cases, if there is an increase in raw materials, shopping happens.

In Figure 8, four side screw (5.8 × 6) improved case is less that purchase amount in first case.

As it's shown in Figure 9, in the improved case, shopping decreased in two cases that contain double cases 20 × 8 and MF lock.

In Figure 10, as you see, in 11 cases, purchasing raw materials in improved case is zero that shows that purchasing raw materials from providers such as (S5, S15, S11, S6, S7, S4, and S8) is not in the company's favor.

In fact, provider S7 is the company itself that based on obtained results, it's better to provide related raw materials from other producers because production of raw materials is more expensive than purchasing them for the company and devotes part of the manager's power and mind to itself that by providing raw materials from another source this power and mind could be spent for other parts.

Too much attention should be paid to providers and for choosing them, the following conditions are presented below.

5. Conclusions

The research indicated the application of SCM has improved management indices which included benefits, satisfaction of customers, financial risk, and flexibility in the volume of producing in the furniture factory. Regarding improving risk, if we want to buy raw materials from a provider, the possibility of providing those raw materials from the considered provider in specified time is called risk. When the provider is exclusive, providing risk is high and the possibility of facing shortage of raw material is high too.

To better estimate the providing risk, we classify raw materials into four parts in which the first group is materials that have high providing risk and play important role in factories' strategy. About the providers of these raw materials, the method of dependency should be used so that in the long period, we don't face any problem.

For example, we can buy part of the provider's company's stock or sell part of the company's stock so that the provider can share in profit and loss. Next group includes raw materials that have low

Figure 7. Exported raw materials' amounts (optimum and nonoptimum) from procurers and its residual in the last of the period.

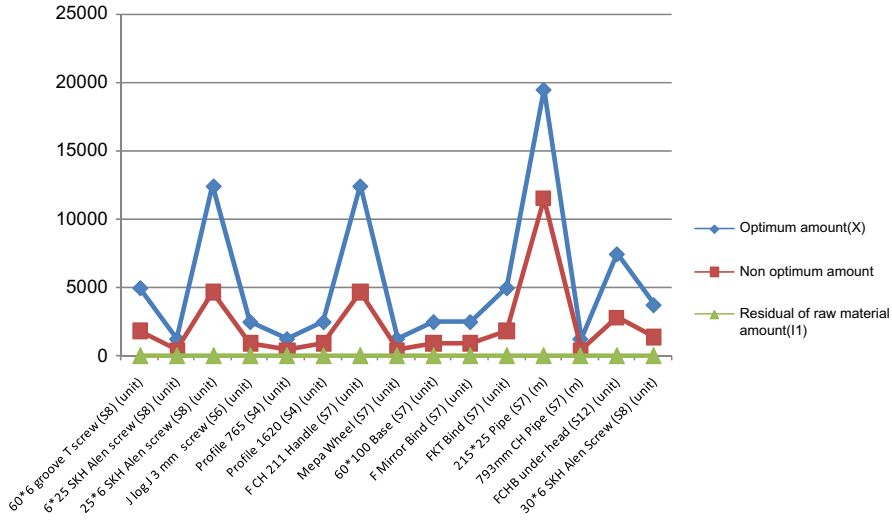


Figure 8. Exported raw materials' amounts (optimum and nonoptimum) from procurers and its residual in the last of the period

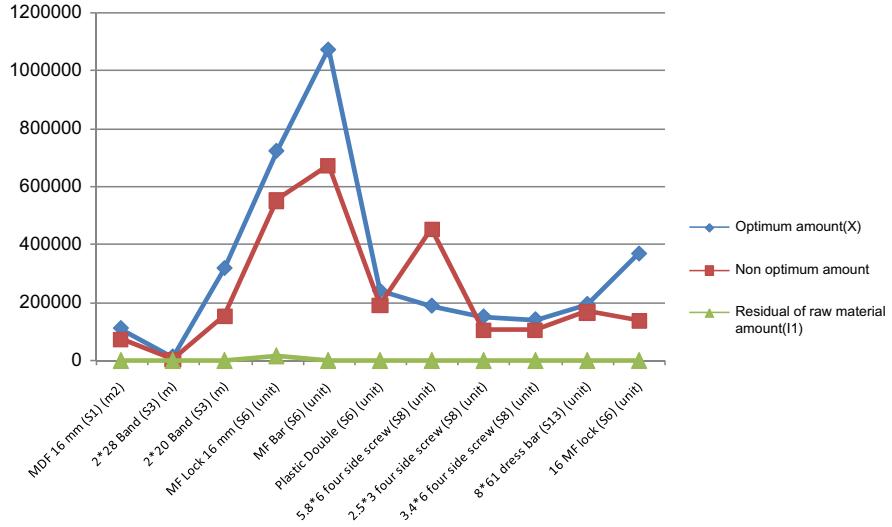
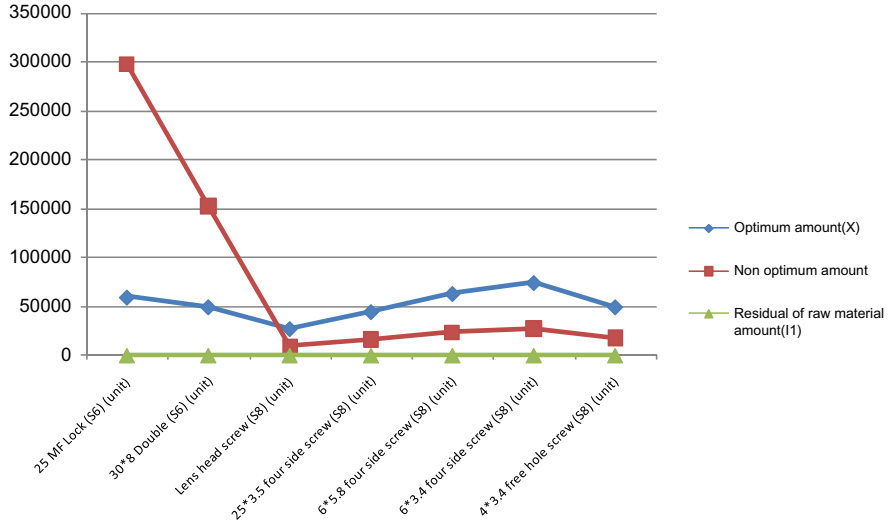


Figure 9. Exported raw materials' amounts (optimum and nonoptimum) from procurers and its residual in the last of the period.



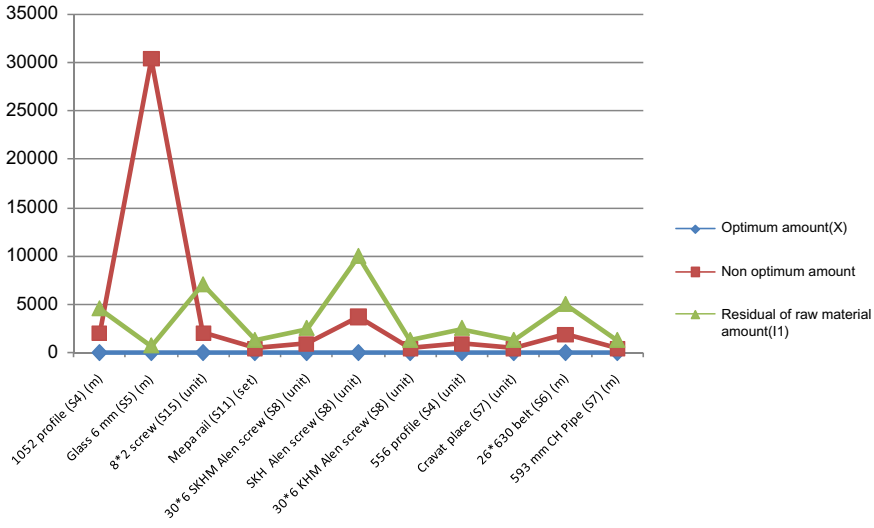


Figure 10. Exported raw materials' amounts (optimum and nonoptimum) from procurers and its residual in the last of the period.

providing risk because of the large number of providers in market and high strategic importance that in the case of this group, it's better to cooperate with the provider.

For example, training classes should be held for them and they should be invited to important seminars.

In this case, it's better to have relationship with a few numbers of providers and strengthen the providers because provided raw materials by them are very important for strategic aims.

Next group is raw materials that have high providing risk and low strategic importance. About providers of these raw materials, it's better to pay them longtime prize so that they don't make longtime problem for us.

For example, if in a period of time they provide 99% of our needs, we should buy their materials, more expensive. Next group includes raw materials with low providing risk and low strategic importance that for these raw materials, it's better to provide them from many sources or providers and at the end of one period omit those who have had weak performance.

To manage providers, we should use managing processes that consist nine processes that are called enablers and are as follows:

Es.1: That means there should be some people that determine the decision-making criterion and these criteria are based on factories' strategic criterion.

Es.2: In this part, providers' performance should be estimated.

Es.3: There should be a place in the department where information about providers should be provided and kept there because a good provider is not stable and it may have some losses like financial ones. So providers' condition should be estimated.

Es.4: There should be a process that determines stock policy.

Es.5: It should include assets management and how much assets are dedicated to providers.

Es.6: It should include input products management. For example, who transports?—the provider or transportation company? It also should include quality and product way of control.

Es.7: It considers providers' management net that means the time when provider exits from net and the time of providers' entrance and how many providers should be considered for a chip.

Es.8: There should be a management that controls import and export and evaluates some country rules like custom regulars and expenditures.

Es.9: It should include contracts managing with providers and in related contracts, ways to admire, punish, and evaluate performance should be presented.

Considering Figures 3–10, it should be noted that in most cases, we have raw materials' shopping raise that is related to the amount of production that by increasing the amount of production, we need more raw materials and more raw materials should be ordered. Also, the figures show the left out raw materials at the end of the period and in most cases, it reaches zero and we will have the least stock in the warehouse and as a result, we will have falling of depressed invest and warehouse expenditures will decrease too.

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