Journal of Industrial and Systems Engineering
Vol. 13, No. 1, pp. 287-300
Winter (January) 2020

JISE

Distribution system optimization in the field of cosmetic products: A case study

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Abstract

Considering the importance of distributing and selling products through various channels and their different costs, choosing a distribution channel and planning and controlling their operations in order to serve customers is a very important and high efficient affair. Regarding a generalized allocation model, this article has attempted to present a new type of distribution system in the supply chain, so that each one of the distributors can focus more on the retailers and prevent the conflict between distribution channels. A nonlinear multi-purpose mixed-integer programming model with a robust optimization approach has been considered, so that while minimizing distribution costs, the allocation ratio of orders to retailers was also maximized. In the phase of solving the designed model, at first the initial nonlinear model was converted into a linear model and as the model was multi-purpose, the metric LP method has been used for solving small dimensions. Then, to reinforce the model against uncertain parameter changes, the model has been reinforced by considering the demand as an uncertain parameter. The integrated QFD/AHP approach has also been used to evaluate and rank distribution methods, taking into account the important characteristics of the distributors and the retailers' desired criteria regarding distributors.

Keywords: Marketing and sales, optimization, distribution, generalized allocation, QFD/AHP

1-Introduction

Distrbution network activitis have been changed drastically during last decades and nowadays it encompasses logistics duties. In the past, the product delivery was done directly from manufacturers to the retailers, but today some part of this process is carried out by the distribution centers and this proportion is expected to increase in the future (Holzapfel et al, 2018). Offering services and products to the market through a wide range of various distribution channels increases the customer options and ultimately increases sales volume (Kumar and Reinartz, 2006). Multi-channel distribution system is a situation that a company uses two or more distribution channels simultaneously to achieve various market segments. Therefore, designing and selecting a distribution channel system requires analyzing the customers' needs and expectaions, forecasting the demand of each market segment, identifying different channels and distributions solutions and designing some criteria to compare and select the best alternative.

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ISSN: 1735-8272,

In this regard, Kumar's study (Kumar et al., 2006) revealed that diversifying the distribution channels, enables the executives to actively maintain or improve customer relationship and thereby increase the customers' lifetime value .

Marketing ability isabout thecapability to participate in collecting and acquiring market knowledge and ias well using it. This helps the company to effectively confront with market-related challenges and enhances the value of products and services (Moriarty and Moran,1990). Kansiku and Cast in theor research entitled "The Role of Marketing Capabilities, Absorption Capacity and Innovation Performance" that conducted on 333 Brazilian manufacturing managers contributing in the strategic marketing process, showed that the absorption capacity has no direct impact on organizational performance. However, this relationship has entirely a mediating role on organizational performance by marketing capabilities (innovation capabilities, new product development capability, and innovation performance). Ernst et al., (2010) also in their study entitled "Sales, Marketing, and the Collaboration of Research and Development across All the New Product Development Stages", showed that the collaboration between sales and research and development (R&D) departments, compared with the collaboration between marketing and research and development as well as collaboration between sales and marketing has a positive impact on the overall performance of the new product development process. Market coverage demonstrates the distributor's adequacy and effectiveness in the geographic area (Braglia and Petroni, 2000). Adequate market coverage is needed to achieve the expected market share of the manufacturer as well as to achieve the expected sales volume in each market(Cavusgil, 2004). Transportation capability is also proposed as an indicator of competitive advantage. Manufacturers need distributors carry out transportation operations by maintaining and improving efficiency, reducing cost and maintaining competitive advantage (Zhao, 2004). The ability to transport provides an opportunity to save cost, and at the same time increases the operational flexibility and the creates value for the customer.

Hua et al (2016) designed a network optimization model to find the best location of , distribution centers in order to maximize the efficiency of logistics system. Also they used Particles Swarm Optimization (PSO) algorithm to solve the problem in large scales. In their model, each customer is supplied only by a single distribution center (Vorhies and Harker , 1999), Vieira et al (2017) in a paper entitled "AHP-Based Framework on Logistics Operations in Distribution Centers" considering the distribution strategy, internal operations, and distribution operations characteristics, proposed a femework for distribution centers operations.

Holzapfel et al. (2018) published a paper entitled "Product Allocation to Various Types of Distribution Center in Retail Logistics Networks". they investigated three types of central, regional, and local distribution centers and proposed a MIP (Mixed Integer Linear Programming) model to determine which type of product should be allocated to each retailer. The MIP model illustrates the interdependence between inland transportation, abroad transportation, and stores logistics such as investing in inventory and the difference in the costs of collection between warehouses. Applying this new approach has decresed the operational costs of the company by 6% operating costs (Holzapfel et al,2018). Ren et al (2020) have developed an allocation model in the context of e-commerce. reviewing the related literature shows , it is observed that in spite of the plenty of researches that have been done in the area of location, inventory and also distribution network design problems , but there is a gap in allocating distribution channels to retailers with regard of the costs related to it. Also different multi-attribute decision making (MADM) methods, including AHP, FAHP, TOPSIS, FTOPSIS, and other hard OR methods have been used to investigate, rank and manage distribution channels but The concentration of allocation modeling in the subject literature is on production and operations topics. However, the possibility to use mathematical techniques in the optimization domain of systems related to marketing and sales can also be very effective. The main complexity in this type of problems is in estimating the coefficients and parameters. For example, calculating the cost or benefit of allocating a group of retailers to a distribution channel has a high complexity. This type of estimates has less been investigated in the literature, and the originality in the subject history has been given more to the type of models; actually lacking a proper model and approach concurrently to help managers. The present article addressed this decision making problem and presented an optimization model that regarding the costs of each one of the distribution channels, each one of the retailers by which method should supply their demanded products.

2- Research methodology

At the first stage, different options were investigated. The distribution channel can have the following forms in the in the company under investigation::

1- Marketing and sales with general discount
2- Marketing and sales with incremental discount
3. Sales with general discount
4- Sales with incremental discount
5- Electronics sales with incremental discount

Then, in order to compare these alternatives and select the best distribution channel, by reviewing the related literaturesome evaluation criteria were identified, using Lawshethresholssome of them were filtered. Also the experts verified the remaining criteria. In our investigating company, the retailers lie in one of these categories:

1. Stores and hypermarkets,
2. Pharmacies,
3- Atari, and
4- Hairdressing and laser centers.

Whose expectations are:

1- Fast delivery of requested products
2- Accessibility to the distributor for ordering
3. Discounts considered for customers
4- The confidence of both parties to the reliability of the promises made
5. Responsibility and accountability, if any problem occurs.

Using the integrated QFD/AHP method, each one of the proposed distribution methods in this research was weighted. Finally, by presenting a mathematical model and analyzing results obtained from it, the distribution system optimization was performed.

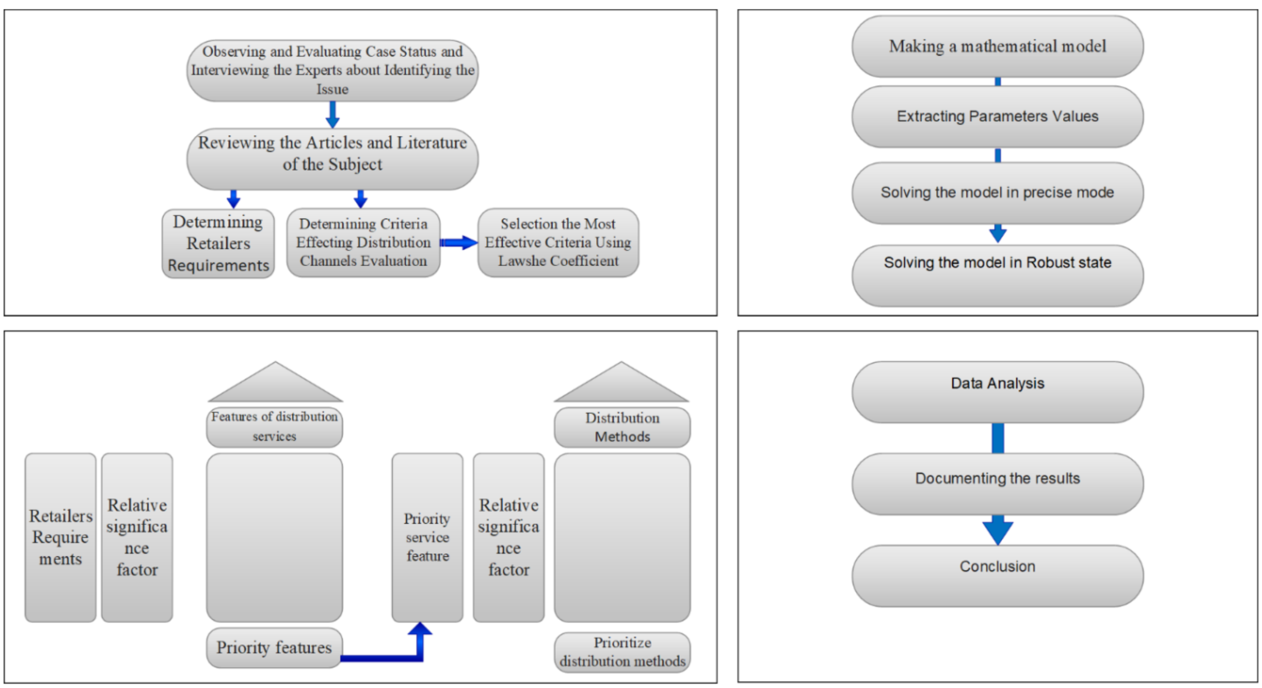

Fig 1: Research stages

3-Mathematical model of allocation

In this section,considering the conditions of the case problem a bi-objective mathematical model wasdesigned .

3-1-Model assumptions

- The model is multi-product, multi-echelon, with two levels of distributors and retailers.
- There were several types of distributor channels that each one had the possibility to distribute various types of product to several retailers. But each retailer can be assigne to only one distributor.
- Shortage in distributor site is allowed.
- Demand is assumed to be uncertain.
- A general and incremental discount state has been considered.

The model's indices are as below:

Sets

J	Index ofofDistribution methods
P	Index of final Products
V	Index of Retailers
K	Index of Discount intervals

Parameters

$\Pr_p$	Primary unit price of the product
PT_{jpvk}	Distributed product unit price P by distributor J to the retailer V in the discount interval K considering general discount policy k
PI_{jvpk}	Distributed product unit price P by distributor J to the retailer V in the discount interval K considering incremental discount policy k
UP_{jvpk}	Upper bound of distributor's discount J to the retailer V for the product P
LO_{jvpk}	Lower bound limit of distributor's discount J to the retailer V for the product P
cap_{jp}	Supplying capacity of the product P by distributor J
C_{jv}	Cost of allocating retailer V to the distributor J
Cs_{jpv}	Product shortage cost in allocating retailer V to the distributor J
Cd_{jp}	Failure unit cost of product P in distributor J
Cr_{jp}	Cost of returned product P in distributor J
A_j	importance coefficient of distributor J
D_{jpv}	Demand value of product P in the retailer V from distributor J
λ_{jp}	Product destruction coefficient P in distributor J
γ_{jp}	Product recycling coefficient P in distributor J
α	Return coefficient
M	Big number
X_{jvpk}	Number of products distributed by distributor J to the retailer V for product P in discount interval K
s_{jpv}	shortage amount of Product P in the supply of distributor J to retailer V
Rd_{jp}	The amount of product failureP in distributor J

Rr_{jp}	The amount of product recycling P in distributor J

Binary Vriable

$DisT$	If the discount is of the general type "1", otherwise "0"
$DisI$	If the discount is of incremental type "1", otherwise "0"
Q_{jv}	If distributor J allocated to retailer V is performed "1", otherwise "0"

The first objective function minimizesthe distribution costs. The first part of the function represented the general discount costs and the second and third parts arerelated to the incremental discount. The fourth part considered the costs of allocating the retailer to each one of the distribution methods. The fifth part involvesthe cost of the product shortage. The sixth and seventh parts showed the costs of returning products, including scrapsand recycling, respectively.

In the first objective function, assumptions of the distribution system including various methods of discounting and allocating retailers in the distribution channels with the considering the probability of shortage and return of products have been applied. Since the effects of the mentioned factors are imposed on the problem as a cost, all of these things are considered as an objective.

The second objective function represents the amount of product order that is allocated to retailers considering the importance of each one of the distribution methods.

$$Min\ Z_1 = \sum_j \sum_p \sum_v \sum_k ((\Pr_p - PT_{jpvk}).X_{jvpk}.DisT_{jpvk}.Q_{jp}) + \sum_j \sum_p \sum_v \sum_k (\Pr_p - PI_{jpvk}) .(X_{jvpk} - UP_{jvpk}).DisI_{jpvk}.Q_{jp} + \sum_j \sum_p \sum_v \sum_k (UP_{jvp(k-1)} - LO_{jvpk}).DisI_{jpvk}.Q_{jp} .(\Pr_p - PI_{jpvk}) + \sum_j \sum_p \gamma_{jp} Cr_{jp}.Rr_{jp} \tag{1}$$

$$Max\ Z_2 = \sum_j \sum_p \sum_v \sum_k A_j.Q_{jv}.X_{jvpk} \tag{2}$$

$$\sum_{j=1} Q_{jv} = 1 \tag{3}$$

$$X_{jvpk} \leq UP_{jvpk} + M(1 - DisT_{jpvk}) \tag{4}$$

$$X_{jvpk} \leq LO_{jvpk} + M(1 - DisT_{jpvk}) \tag{5}$$

$$\sum_k DisT_{jpvk} = 1 \tag{6}$$

$$X_{jvpk} \leq UP_{jvpk} + M(1 - DisI_{jpvk}) \tag{7}$$

$$X_{jvpk} \leq LO_{jvpk} + M(1 - DisI_{jpvk}) \tag{8}$$

$$\sum_k DisI_{jpvk} = 1 \tag{9}$$

$$\sum_p \sum_v \sum_k DisI_{jpvk} + DisT_{jpvk} = 1 \tag{10}$$

$$X_{jvpk} + s_{jpv} = D_{jpv} \tag{11}$$

$$X_{jvpk} \leq cap_{jpv} \tag{12}$$

$$Rd_{jp} + Rr_{jp} \geq \alpha.X_{jvpk} \tag{13}$$

Constraint 3 states that each retailer should be allocated to only one distribution method.

The fourth and fifth and sixth constraints have been intended to specify the appropriate discount interval for the general discount, such that the number of allocated products must lie between the upper and lower limits of the discount interval, and discount should also be given only in one of the discount intervals. The seventh, eighth and ninth constraints also arelike the three previous constraints, except that the discount type was incremental.

Constraint 10 states that each one of the distribution methods isonly capable to be used only by one discount method.

Constraint 11 states thatshortage is allowed and if the demand exceeds the number of products that are assigned to a distribution method, shortage is occurred.

Constraint 12 was related to the ratio of sending product by distributors to retailers, taking into account the maximum supply capability of each one of the distributors.

Constraint 13 was also related to the amount of recycled and destroyed product in reverse logistics in the above stated equation.

Original model has nonlinearities in objective function and also constrains and is converted to a linear model. In the present research, various nonlinear parts in the objective function and constraints were described separately.

For linearization of the multiplication parts of integer variables in binary, the variable change method is used to replace nonlinear expressions in the model. Changing the variables was as follows:

$$E = Q_{jv} . X_{jvpk} \tag{14}$$

$$T = E . DisT_{jpvk} \tag{15}$$

$$F = DisI_{jpvk} . Q_{jv} \tag{16}$$

Also, after linearization, the following constraints were added to the problem:

$$E \leq X_{jvpk} \tag{17}$$

$$E \leq M . Q_{jv} \tag{18}$$

$$E \geq X_{jvpk} - M(1 - Q_{jv}) \tag{19}$$

$$F \leq DisI_{jpvk} \tag{20}$$

$$F \leq Q_{jv} \tag{21}$$

$$F \geq DisI_{jpvk} + Q_{jv} - 1 \tag{22}$$

$$T \leq E \tag{23}$$

$$T \leq DisT_{jpvk} \tag{24}$$

$$T \geq E + DisT_{jpvk} - 1 \tag{25}$$

Regarding that the ratio of product demanded from the retailer has been considered as an uncertain parameter, the robust optimization approach has been used to confront the uncertainty in the model. The soyster approach is utilized.

The parameter of the ratio of product demand to convert the uncertain model to the robust model and the constraints`convertionwere as follows:

$$X_{jvpk} + s_{jpv} = D_{jpv} \tag{26}$$

Which was considered as the probable demand interval (420, 217000).

To make the above statement robust, which had an uncertain demand parameter, the variables of RO and D′, which respectively represented the variable related to the demand interval and the most probable demand state, were added to the constraintwhose obtained changes were as follows:

$$X_{jvpk} + s_{jpv} = D^{'} + RO \quad (27)$$

$$RO \leq 102000 \quad (28)$$

$$RO \geq -114580 \quad (29)$$

Thus, finally the proposed model included linearization and the constraints of linearization as well as robust method along with its constraints. In order to solve the multi-purpose model, the single-purpose metric LPG method has been used.

3- Case study

Pars AzmaTeba manufacturing company in cosmetics industry that produces 33 types of hair and skin care products. Its products can be categorized into four general families: as follows:

1. Hair care products (This category includes 18 various products, that is the largest class of the products of the company).
2. Products used for facial skin (This category contains 7 product items).
3. Products used for the eye and eyebrow (This category contains 3 product items).
4. Products used for body skin (This category contains 5 product items).

In order to achieve business goals and success in the areaof distribution management, Pars AzmaTeb Company pays special attention to its distribution network tomeet the needs of its customers directly and indirectly. cosmetic market is fairly good Iran, but the pace of change in marketing and distribution standards is slow and the company is almost using traditional channels to supply its products. Along with the sales topic, the company wants to acquire information about customers, their needs and expectations and the past distributors. Therefore, the collected data is very important andanalyzing the data can giveinsight about the customer's behavior. The set of collected data can be expressed in the form of the marketing capability of each one of the distributors, which helps the company dealing with market-related challenges and also enables the company to act in reaching the target market effectively compared with competitors. Information regarding the method of products` sales is based on geographical features, type of customer, and location of offering the product (Sales base: Pharmacy, Health Store, Atari (Herbal Store), and so on). Access to this information comprehensively is achieved in the form of interview and survey with the employees of distributors or by cooperation with distributors in a direct survey from the customers.

A group of these distributors never offer services to the customers unless it has financial benefits for them to do so. They are looking for a receipt for offering their services to customers, whether in the form of direct receipt from the manufacturer or additional receipt from customers. Therefore, the company cannot receive full price from this group of distributors. For this reason, the company aims to reduce the share of product allocation to this group of distributors.

One of the biggest barriers to use multiple distribution channels is the conflict of the interest between numerous channels to access customers. Therefore, in designing and compiling multiple channels strategy,this issue should be considered and prevented. One of these solutions is to allocate retailers to distribution channels appropriately. Decisions regarding the allocation of the ratio of distribution product to numerous channels are based on their sales volume, because managers, when taking decision to allocate product to numerous channels, usually allocate the highest share to a channel that has the distribution and sales growth. One of the cases of the emergence of conflict and dispute between the channels is their difference in offering discounts and prizes to retailers. Due to the willingness of retailers to receive discounts, the ratio of their loyalty to the channels is low, and sometimes they refuse to cooperate and participate constantly with one of the channels due to the reduction of their purchase costs and do not observe the principle of commitment.

4- Research findings

In this research, a channel with marketing and sales capability and another channel by exploiting a sales process have been considered. The purpose of considering the marketing factor in this classification of brand identity building of the company products was to change or influence the viewpoint of the target audiences, and the purpose of the sales was focusing on customer requirement and meeting it on time. Now, with regard to the costs resulting from advertising in the channels, these two factors have concurrently been considered for a series of distribution methods and the other group of channels simply performed the sales process. In sales and marketing channels, there were offering services such as sales advertising, showcasehandling, printing and copying advertising posters, holding sales festivals, offering services, placing trained people in sales bases to provide advice about products and their features. Another factor considered in the classification of distribution methods was the sales` promotion factor that exclusively includes discount, which is divided into two categories: general and incremental discounts.

4-1-Identification of factors affecting distribution channels performance

The primary criteria of distribution methods` selection are as below:

Managerial Infrastructure	Marketing Power	Relationship Intensity
Logistical Power	Physical Facilities	Market Coverage
Product Line	Market Control	Service Compensation

After collecting the initial questionnaire and interview with10 sales and distribution experts, the CVR score for the above criteria is obtained and presented in the following table. Based on theLawshe coefficient conditions, the minimum acceptable value of CVR with this number of experts is 0.62, so all of these criteria are accepted:

Criterion	CVR Score
Control	1
Market Coverage	1
Logistical Power	0.8
Marketing Power	1
Relationship Intensity	0.8
Services Compensation	0.8

After that using the pairwise comparisions of AHP, the relative importance of these criteria is calculated. The weight of different needs of retailers are presented in the following table:

Retailers' Needs	Mean	Eigenvector
Responsibility and accountability in case of occurring any problems	0.972	0.181
Distributor availability for ordering	1.085	0.202
The confidence of both parties in the promises made	0.701	0.130
Discounts considered for the customers	1.122	0.209
Faster delivery of requested products	1.492	0.278

4-2-Correlation matrix formation of retailers' needs and distribution services` characteristics (First House of Quality)

	Indicators' Coefficients	Marketing Power	Market Control	Market Coverage	Services Compensation	Logistics Power	Relationships Intensity
A	0.181		5	5	9	5	1
B	0.202	9		9	1	5	5
C	0.130	5	9	5	9	1	9
D	0.209	1		5	5	5	5
E	0.278	5		5		9	5

4-3-Determining the weight of each one of the services` characteristics

Services Characteristics	Characteristics Weights
Marketing Power	0.15
Market Control	0.08
Market Coverage	0.24
Services Compensation	0.15
Logistics Power	0.21
Relationships Intensity	0.18

4-4-Determining the degree of correlation between services` characteristics and each one of the distribution methods (Second House of Quality)

	Weight	Marketing and Sales With General Discount	Marketing and Sales With Incremental Discount	Sales with General Discount	Sales with Incremental Discount	Electronic Sales with Incremental Discount
Marketing Power	0.15	9	9	1	5	5
Market Control	0.08	5	9	5	5	1
Market Coverage	0.24	9	9	5	9	5
Services Compensation	0.15	9	9	5	5	5
Logistics Power	0.21	5	5	5	1	5
Relationships Intensity	0.18	5	5	5	5	5

4-5-Determining the relative weight of distributors

Distribution Method	Weight
Marketing and Sales with General Discount	0.26
Marketing and Sales with Incremental Discount	0.27
Sales with General Discount	0.16
Sales with Incremental Discount	0.15
Electronic Sales with Incremental Discount	0.17

As it can be seen, the second distribution method, namely marketing and sales with incremental discount, had the highest weight among the distribution methods.

In order to solve the proposed robust multi-objective model by L-P metric method in GAMS, BARON solver was used for solving nonlinear model and CEPLEXsolverwas used for solving linear model in small dimensions.

The proposed discount model in the present research has been considered as follows:

General discount for marketing and sales state: j_1	
Discount amount: 5% should be subtracted from the total P decrease.	IF: X = 0.5 cap
Discount amount: 9% should be subtracted from total P.	IF: X= 0.75 cap
Discount amount: 15% should be subtracted from total P.	IF: X = cap
General discount for sale state: j_3	
Discount amount: 6% should be subtracted from total P.	IF: X = 0.5 cap
Discount amount: 10% should be subtracted from total P.	IF: X= 0.75 cap
Discount amount: 16% should be subtracted from discount.	IF: X = cap
Incremental discount: j_2, j_4, j_5 The discount amount has been considered in terms of equal product type, and as three intervals with different discount rates (The upper and lower limits of discounts vary in terms of product type). Incremental discount j_2, j_5: First interval: 1.5% deduction from initial price Second interval: 2.5% deduction from initial price Third interval: 3.5% deduction from initial price Incremental discount of initial price Second interval: 3% deduction from initial price Third interval: 4% deduction from initial price j_4: First interval: 2% deduction from	

4-6-Model solution results in definite and robust state

Since the original model was a nonlinear mixed integer model, at first it is linearized.. Also, because of the small size of the problem dimensions due to the expression of the actual conditions of a case study sample, the nonlinear and linear model responses were very close to each other, that is why only the definitive model responses have been presented in this research. These results were then compared with the results obtained from the robust model.

Robust		Definite	
Z_2	Z_1	Z_2	Z_1
312564	492300	371860	400000

Considering that the first objective function was of minimization type and the second objective function was of maximization type, the computational results obtained from solving the model showed that the model solution in the robust state has been worse than the definite state and this was normal, because in the robust optimization state, this was is considered as the worst state. Therefore, implementing the robust model solution had a lower risk than the definite model.

The way of allocating each one of the retailers to the distribution methods proposed in the research, along with the allocation amounts, depending on the problem conditions were as follows:

	Store	**Atari**	**Drug store**	**Hairdressing and Laser Centers**
Marketing and Sales with General Discount				
Marketing and Sales with Incremental Discount			$P_1 = 115000$ $P_2 = 0$ $P_3 = 40000$ $P_4 = 15000$	
Sales with General Discount		$P_1 = 12000$ $P_2 = 24000$ $P_3 = 2000$ $P_4 = 1400$		$P_1 = 12000$ $P_2 = 24000$ $P_3 = 2000$ $P_4 =1400$
Sales with Incremental Discount				
Electronic Sales with Incremental Discount	$P_1 = 1000$ $P_2 = 300$ $P_3 = 3500$ $P_4 = 450$			

As it can be observed, retail was not allocated to the distribution methods of marketing and sales with general and marketing and sales with incremental discount, in spite of having the second and third ranks in the evaluation of distributors. The reason for the point can be attributed to considering the costs resulted from distribution that must be minimal. The two Atari and hairdressing retailers have also been allocated to distribution method with general discount, regarding that it has allocated the lowest weight to itself in ranking distribution methods.

The shortage amounts in the state of allocating retailers to the selective distribution methods were as follows:

	Store	Atari	Drug store	Hairdressing and Laser Centers
Marketing and Sales with General Discount				
Marketing and Sales with Incremental Discount			$P_1 = 0$ $P_2 = 115000$ $P_3 = 75000$ $P_4 = 100000$	
Sales with General Discount		$P_1 = 103000$ $P_2 = 91000$ $P_3 = 113000$ $P_4 = 113600$		$P_1 = 10300$ $P_2 = 91000$ $P_3 = 113000$ $P_4 = 113600$
Sales with Incremental Discount				
Electronic Sales with Incremental Discount	$P_1 = 114000$ $P_2 = 114700$ $P_3 = 111500$ $P_4 = 114550$			

In this case, the destruction value (Rd) has been considered equal to zero, and the solved model proposed the recycling of all returned products, the values of which were as follows:

J_2	J_3	J_5
$P_1 = 11500$	$P_1 = 1200$	$P_1 = 100$
$P_2 = 1900$	$P_2 = 2400$	$P_2 = 30$
$P_3 = 4000$	$P_3 = 200$	$P_3 = 350$
$P_4 = 1500$	$P_4 = 140$	$P_4 = 45$

5- Discussion and conclusion

In this research, using the integrated QFD/AHP method the characteristics of distribution services and also the requirements of the retailers, , is identified and also each one of the proposed distribution methods in this research was weighed. Then, using bi-objectivenonlinear mixed integer programming model, the optimal allocation of distribution methods to each one of the retailers to weredetermined. Using soyster approach the robust counterpart of the originimal model that have some uncertainties were obtained.

Findings of this research can help the executives to to choose a distribution system tailored to the needs of retailers in relation to distributors by offering a discount system to coordinate and prevent conflict due to discounts in different channels.

In this paper in addition to This research has not been performed merely by an economic view in order to optimize the distribution system, but it has evaluated the distribution system by considering the qualitative factors associated with the distribution methods and taking into account the demands of the interacting party with the distributors.

It has also dealt with waste management topic, considering the returned products due to product failure in distribution operations for recycling or destroying them. Accurate waste management had a direct impact on both the environment and in preserving the resources.

From the mathematical modeling dimension of the research achievements, eliminating the certain assumptions can be mentioned that in this research considering the uncertainty of the demand parameter and regarding the uncertainty set as interval and solving by the Soyster model, the model was close to real-world and the problem faced the challenge. It is also possible to mention that the shortage was virtual considering the returned products due to more adaptability to real situations.

5-1-Practical suggestions derived from the model

First suggestion: Allocating each one of the retailers to distribution methods using generalized allocation,
Second suggestion: Considering discount based on the number of sold products
Third suggestion: Adding hairdressing and laser centers to sell products.

5-2-Suggestions for future researches

Considering the points mentioned in this chapter, some of the cases that can be considered in future researches are as follows:

1. Considering the importance ratio of each one of the retailers to distributors and considering the weight to allocate the amount of product to them,
2. Separating products in a way that not all groups of product are allocated to all retailers.
3. In this research, returned products were classified into two categories related to human factors and product factor, but in mathematical modeling, the aim of minimizing the amount of returned products caused by product failure has merely been considered. It is suggested to consider returned ones due to human factors in the model.
4. Regarding the fluctuations in the exchange rate and its effect on supply and demand ratio, it is also suggested to consider this case in the model.
5. Considering that the cosmetic products have a specified expiration date, regarding the corruption rate is essential.

References

Braglia, M., & Petroni, A. (2000). A quality assurance-oriented methodology for handling trade-offs in supplier selection. *International Journal of Physical Distribution & Logistics Management*.

Cavusgil, S. T., Deligonul, S., & Zhang, C. (2004). Curbing foreign distributor opportunism: An examination of trust, contracts, and the legal environment in international channel relationships. *Journal of International Marketing*, *12*(2), 7-27.

Ernst, H., Hoyer, W. D., & Rübsaamen, C. (2010). Sales, marketing, and research-and-development cooperation across new product development stages: implications for success. *Journal of Marketing*, *74*(5), 80-92.

Holzapfel, A., Kuhn, H., & Sternbeck, M. G. (2018). Product allocation to different types of distribution center in retail logistics networks. *European Journal of Operational Research*, *264*(3), 948-966.

Hua, X., Hu, X., & Yuan, W. (2016). Research optimization on logistics distribution center location based on adaptive particle swarm algorithm. *Optik*, *127*(20), 8443-8450.

Kumar, M., Vrat, P., & Shankar, R. (2006). A fuzzy programming approach for vendor selection problem in a supply chain. *International Journal of Production Economics*, *101*(2), 273-285.

Kumar, V., & Reinartz, W. J. (2006). *Customer relationship management: A databased approach*. Hoboken, NJ: Wiley.

Moriarty, R. T., & Moran, U. (1990). Managing hybrid marketing systems. *Harvard Business Review*, *68*(6), 146.

Ren, S., Choi, T. M., Lee, K. M., & Lin, L. (2020). Intelligent service capacity allocation for cross-border-E-commerce related third-party-forwarding logistics operations: A deep learning approach. *Transportation Research Part E: Logistics and Transportation Review*, *134*, 101834.

Vieira, J. G. V., Toso, M. R., da Silva, J. E. A. R., & Ribeiro, P. C. C. (2017). An AHP-based framework for logistics operations in distribution centres. *International Journal of Production Economics*, *187*, 246-259.

Vorhies, D. W., Harker, M., & Rao, C. P. (1999). The capabilities and performance advantages of market-driven firms. *European journal of marketing*.

Zhao, X., Huo, B., Flynn, B. B., & Yeung, J. H. Y. (2008). The impact of power and relationship commitment on the integration between manufacturers and customers in a supply chain. *Journal of operations management*, *26*(3), 368-388.