A Survey on marketing characteristics and production system strategies-Case study: cans production

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***Abstract*.-** The companies try to obtain competitive advantages by producing customized products which meet customers' requirements. In addition, they ought to utilize their maximum capacity and reduce storage costs. According to the demand of product, selecting the appropriate production strategy can help to achieve these goals. In this paper, we examine the market to identify competitors. Then, we examine different strategies and present a model for selecting production strategy. The idea of the algorithm "Knapsack" is used to select production strategy. Moreover, we have attempted to utilize simple numerical method for solving model. We interpret the diverse production strategies such as, MTS, MTO, ATO and ETO. Finally, the numerical experiments reveal to show the advantages of the applied mathematical programming model.

Keyword- Production strategies; Knapsack; Decision system; drink production.

I. INTRODUCTION

Manufacturing companies utilize diverse production policies to satisfy the customer's demands. The most applicable production policies are Make-To-Stock (MTS), Make-To-Order (MTO), Assemble-To-Order (ATO) and Engineer-To-Order (ETO). Each policy has some specific advantages and disadvantages. Among them, MTS and MTO systems have been widely used in the production companies.

The manufacturing systems are the charge of realization to produce different kinds of productions. According to whether the product is common or specific, the adopted policy of management will be different. When a product is defined properly and developed, it belongs to "on-catalogue" products. The manufacturing is managed according to MTO (make-to-order), MTS (make-to-stock), or ATO (assemble-to-order) policies. However, when the product is specific with particular customer requirements, a project to develop new product should launched by the focal company. Subsequent of the customer's order, the focal company have involved in designing, developing, industrializing and manufacturing product [1]. This class of manufacturing systems called Engineer-to-Order (ETO) is considered to be time consuming (Ali, 2000) due to the necessity of requirements gathering, checking of component's availability, quoting, engineering and feasibility assessment, designing, etc (Figure 1).

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The scheduling practice in high value added manufacturing companies, competitive environment has been to release the manufacturing order before the customer order is released (forecast based), and subsequently match incoming customer orders to units in progress. As a result, there is the possibility of either getting more orders than can be accommodated causing the rejection of some, or getting too few orders leading to a finished unit without a buyer which is termed an "orphan"[2]. The physical size and financial value of the units make storing of the orphans highly undesirable[3].

This scheduling practice is an special hybrid of the make-to-order (MTO) and make-to-stock (MTS) production strategies. It is not the typical ATO situation, although in both a forecast of end items is made and in both the actual customer orders come in before the end products are completed. In the ATO situation the build process stops at a predetermined point and WIP inventories are held until customer orders arrive. In high value added manufacturing company production operations management, there is no stopping point in the production process and buffer inventories are avoided. Customer orders arrive throughout the production process and are matched to items in any state of production. Therefore, it permits both early and/or late customization and thus, offers a higher degree of customization than ATO (Figure 1). Also, volumes are much lower than in ATO [3]. This scheduling practice was initially labeled in the literature as Build-to-forecast (BTF)[1,3], and later on renamed as Make to forecast (MTF)[2,4,5,6,7].

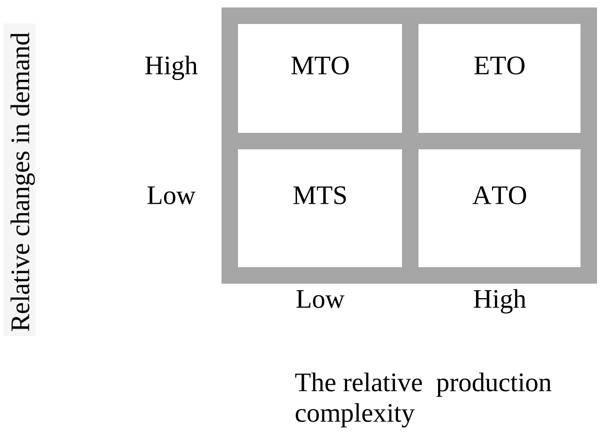

Fig.1 Adapt Industry to production methods

Consequently, these production operational strategies have been referred as floating decoupling points systems[8] in contrast to traditional fixed decoupling points systems i.e. ETO, MTO, ATO, MTS [9,10].

Iron and aluminum are two of the major components of earth's crust. Estimated reserves of iron ore and bauxite amount to 180 billion and 28 billion tons, respectively [15,16]. These two base metals also define two large industrial branches, which leads to the extensive processing of these ores into metallic products. As a consequence of this extensive technological, activity, metallic residues, known as scrap, are produced. These scraps, produced during the processing of the metal are known as new (or prompt) scrap and have a higher value than old (or post-consumer) scrap.

The scientists of Coca Cola Company, and the independent scientists with whom we have consulted, have thoroughly reviewed the data and have assured us that our beverage cans pose no public health risk. In addition, government regulators around the world have reviewed the science independently and have repeatedly stated that current levels of exposure to BPA through beverage packaging pose no health risk to the general population, including children.

Our top priority is to ensure the safety and quality of our products and packaging through rigorous standards that meet or exceed government requirements. If we had any concerns about the safety of our packaging, we would not use it.

Why choose cans?

• Cans from Ball Corporation are a sustainability success story as they are lightweight, contain an average of 68 percent recycled aluminum and are infinitely recyclable. Cans are the number one recycled beverage container of any kind in the United States.

• Cans are airtight and oxygen-free and cool down faster than any other beverage container resulting in a fresher, better taste.

• Cans take up less space than a bottle, allowing for more compact shipping.

• Cans are a great way to differentiate brands in displays and on the shelf, offering a 360- degree mini-billboard.

• Cans have superior portability and don't shatter [17].

New research shows that the overall consumer perception of drinks cans have improved since 2007, with cans of soft drinks and beer seen as offering "good value for money" and "freshness", as well as delivering a "recyclable pack" which is "easy to drink from". According to the research conducted by GfK on behalf of the Can Makers, cans are also seen to contain the "right amount" of drink and to keep a drink "colder".

72% of respondents think drinks taste "fresh" in cans, compared with 51% in 2007. 49% of respondents also think that cans are "good value" and 55% think cans contain the right amount of a beverage, compared with 42% in 2007. In the case of beer, Medium and Large cans are the most popular. For Carbonated Soft Drinks (CSDs), single serves in medium and large multipacks are the most popular. All age groups are drinking from cans more often, but particularly males and 14-17 year olds, where 75% are choosing cans compared with 62% in 2007. The results also show that more people than ever before are drinking from cans on the move.

In this model, the idea of a Knapsack algorithm is used. Suppose that we want to fill our knapsack with the things may choose from a variety of devices that provide maximum comfort for ours. In the following, we have n kinds of items, 1 through n. Each kind of item i has a value v_i and a weight w_i. We usually assume that all values and weights are nonnegative. To simplify the representation, we can also assume that the items are listed in increasing order of weight. The maximum weight that we can carry in the bag is W. Its objective function leads to the maximum value.

This paper has been organized as follows: Production strategy selection model is presented in Section 2. In Section 3, a case study is illustrated. In the first phase, we assess competitors. Then, the decision model is determined by a linear programming model. Finally, conclusions are presented in Section 5.

II. MANUFACTURING MODEL

A. Parameters and variables in the model

Max_{profit}: Total score which is obtained according to the decision algorithm.
$d=1,2,\dots,D$: The criteria for selection
$j=1,2,\dots,J$: Products
$W_d=[d_1, d_2 \dots d_D]$: Organization's the value of the vector.
$B_d=[d_1, d_2 \dots d_D]$: Market's the value of the vector.
Cu: Auxiliary variable.
M: The maximum investment for selection.
X_d: If $W_d \leq \mathrm{Cu}$ then $X_d = 1$ else $0 \leq X_d < 1$
Profit: The value obtained for the decision according to criteria d.

B. Mathematical formulation

Step 1.Recognizing market and competitors:

The company should strive to collect information about your competitors to achieve a marketing competitive, efficient and effective policy. The company ought constantly to compare products, prices, sales distribution channels and advertising to promote its close competitors. For this purpose, the companies will be able seeking to enhance their potential competitive advantages.

It seems like a simple task to identify a company's rivals. The company's competitors can know the companies which sell products and services at prices comparable to similar customers; however, we must accept this fact that companies are faced with a wide range of competitors. Generally, a company can define all his rival companies that produce similar goods or class of these goods of company. It means that the competition can include all companies which are competing for dollars with the same consumers.

The companies can identify their competitors by two ways:

- Industry perspective: Many companies determine their competitors by analyzing industry perspective. The industry is a set of institutions that the supplier's goods are another alternative. Automotive, oil, pharmaceuticals and beverages are examples of this definition. If an industry increases price of a commodity, the demand will increase for other goods.

- Market perspective: In this case, competitors have the same customers or serve to the customer groups. Overall, market perspective opens the gate to the company to know better their actual and potential rivals and do long-term planning for the market.

Step 2.Determining production policy by key factors:
Firstly, the internal and external factors directly affect on the selecting strategy to produce the identified product. Muda and Hendry introduced 14 principles which offer a way to implement MTO strategy in a manufacturing system [11]. According to these essential rules and some other suggested ideas by researchers such as: Schonberger, Hays and Clark and Olhgar are presented methods for the MTO, MTS, ATO and ETO decision [9,12,13,14]. These criteria are shown in Table 1(vector d=[$d_1, d_2, d_3, \ldots$].

Table 1 Criteria

	Factors	D	ETO	MTO	ATO	MTS
Product	Obsolescence risk	D_1	7	5-6	3-4	1-2
	Product quality	D_2	7	5-6	3-4	1-2
	Product design	D_3	5-6	3-4	7	1-2
	Fluctuationsin demand	D_4	5-6	3-4	7	1-2
	Product variety	D_5	7	5-6	3-4	1-2
	Product complexity	D_6	5-6	3-4	7	1-2
	Cost of product	D_7	5-6	3-4	7	1-2
Customers and Suppliers	Commitment tocustomer	D_8	7	5-6	3-4	1-2
	Commitment to Supplier	D_9	7	5-6	3-4	1-2
	Customer feedback	D_{10}	7	5-6	3-4	1-2
Internal factors	Human resources Flexibility	D_{11}	7	5-6	3-4	1-2
	Rewards, recognition and pay system	D_{12}	7	5-6	3-4	1-2
	Equipment of flexibility	D_{13}	7	5-6	1-2	3-4
	Integrating the functions of production and marketing	D_{14}	7	5-6	3-4	1-2
	Information flow	D_{15}	7	5-6	3-4	1-2
	Technology	D_{16}	7	5-6	1-2	3-4
	Maintenance and support	D_{17}	7	5-6	3-4	1-2
	Return of investment	D_{18}	7	5-6	3-4	1-2
	Up buying	D_{19}	1-2	3-4	5-6	7
	Delivery lead-time	D_{20}	7	5-6	3-4	1-2

We divided criteria into three groups as follows:

1. Product
2. Customers and Suppliers
3. Internal factors

Then, we are calculated the algorithm that are presented for each group.

Step 3.The weighted criteria:
B & W vectors are creating criteria. Vector W is a company's current and products and vector B is competitors's current and their products.
Very Low=1 , Low=2 , Medium Low=3 , Medium=4 , Medium High =5 , High=6 , Very High=7

Step 4.Prioritizating criteria:
In order to express the criteria for selecting which will be B or W and the vector which are superior to select criteria, for each criterion in the above vectors obtains ratio $\frac{B_d}{W_d}$ Based on the $\frac{B_1}{W_1} \geq \frac{B_2}{W_2} \geq \ldots \geq \frac{B_D}{W_D}$ We evaluated the model.

Each measure is bigger than it is the excellence criteria. If this ratio is equal for two criteria which are selected, the vector D is expressed.

Step 5.Determining investment rate:
Variable M is the investment company for the production of policy. Being able to control the available amount of assets for each stage, we use the variable Cu. X_d is a control variable. If $W_d \leq Cu$ be established, $X_d = 1$ will otherwise $0 \leq X_d < 1$ will.Variable *Profit* shows how many points in each stage.

For each product to be resolved under the model with initial values:

$X_d = 0$, $Profit = 0$, $Cu = M$.

$$M = \sum_{d=1}^{D} B_d \quad (1)$$

The companies usually determine due to market conditions and competitors that they need to compete. Therefore, the competitors can determine the rate of investment for each criterion acquire in this sector (Eq. 1).

Step 6.Computing profit according to the investment rate:

Until the score of assets is lower than the criteria case ($W_d \le Cu$) we have:

$$\sum_{D} Profit = Profit + W_d \quad (2)$$

$$X_d = 1 \qquad \forall d \quad (3)$$

$$Cu = Cu - B_d \qquad \forall d \quad (4)$$

$$X_d W_d \le M \qquad \forall d \quad (5)$$

Profit is the total score what the company acquires according to each criteria (Eq. 2). Whenever, we add score of criteria to *Profit*, we will consider $X_d = 1$ to control the situation of algorithm(Eq. 3). After reviewing the criteria, we will lower its criteria score from total assets. Therefore, we will be amount of the remaining assets for reviewing other criteria (4). We use the Eq. (5) to control measures that have been review. We do this stage to remain assets that may not be enough for the next criteria.

Step 7.Final Profit:

$$X_d = Cu / B_d \quad (6)$$

$$MAX_{Profit} = Profit + X_d \times W_d \quad (7)$$

At this stage, we will review next criteria only much as assets that are available; because we do not have enough investment for other criteria. MAX_{Profit} is represents a privilege for firm what intended to conditions obtains with regard to measures and it is used to select manufacturing policy MAX_{Profit} should be calculated for each three groups of criteria.

This classification helps to get more and deeper understanding of the situation ahead of the company. Also, if the company desires to use a combination of policy, these categories can aid in this decision. For instance, company facilities to get in 3-point ranges in MTO and in a group within the MTS, MTO policy which is selected but it able to use the strategy of combining MTO and MTS (Table 2).

The implementation of the algorithm is shown in figure 2.

Table 2 Important criteria for affecting decision

Factors		D	ETO	MTO	ATO	MTS
Product	Risk of obsolescence	D_1	More than 41	16-30	31-40	Less than 15
	Product quality	D_2				
	Product design	D_3				
	Fluctuations in demand	D_4				
	Product variety	D_5				
	Product complexity	D_6				
	Cost of product	D_7				
Customers and Suppliers	Commitment to customer	D_8	More than 19	13-18	7-12	Less than 6
	Commitment to Supplier	D_9				
	Customer feedback	D_{10}				
Internal factors	Human resources Flexibility	D_{11}	More than 60	40-59	30-39	Less than 29
	Rewards, recognition and pay system	D_{12}				
	Equipment of flexibility	D_{13}				
	Integration the functions of production and marketing	D_{14}				
	Information flow	D_{15}				
	Technology	D_{16}				
	Maintenance and support	D_{17}				
	Return of investment	D_{18}				
	Upbuying	D_{19}				

Delivery lead-time	D_{20}

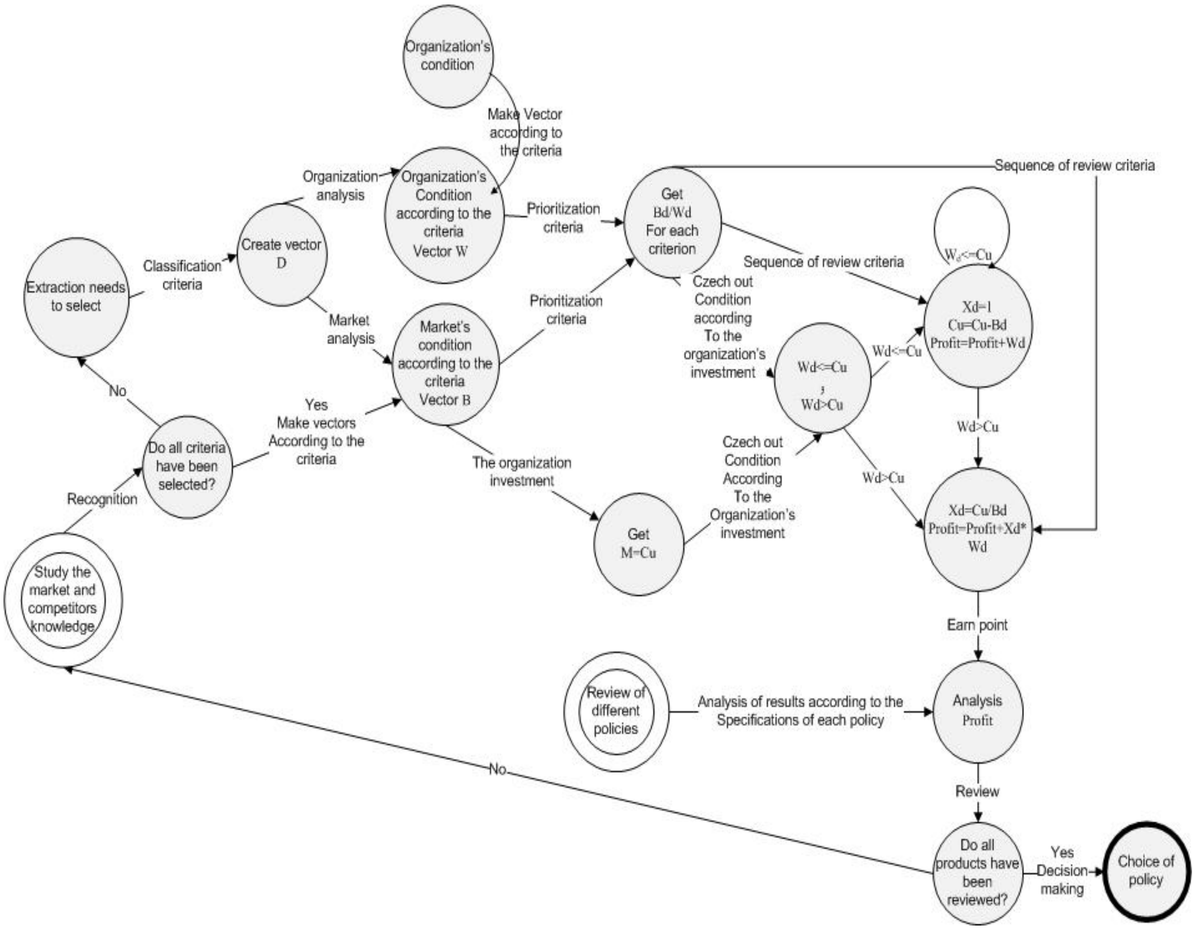

Fig.2 Schematic model

III. CASE STUDY

A. Introducing Product

More than forty years, the aluminum containers make up the major part of materials in the packaging industry. The metal abundance as natural, inherent properties, heat tolerance and recovery has led to use for packaging materials. On average, 40% of total packaged consumer drinks make up the aluminum cans. By simplest definition of the product, we can say that steel cans are used for storage and consumption of beverages at once. They have ability to maintain content along with their properties, light weight, portability, style, good printing capabilities, ability to properly collect and recycle.
Goods that can be used as a good alternative:

- Plastic bottles
- Glass Bottles

Due to weight and fragility functions, glass bottles lose many of its advantages compared to cans. The plastic bottles can also be said given the raw material for this product soil and oil products, due to the numerous environmental benefits, using less oil. In some parts of the world, they are advisable to use less.
Products which are available in cans include:

- Non-alcoholic beer and non-greed
- Soft drinks
- Juice
- Energy drinks
- Soda
- Sparkling water
- Dough (Iranian drink)
- Milk
- Hot drinks like coffee, cappuccino
- Types of canned fruit

In this paper, cans are divided into three categories base on the products are available in their:

1. Cold drinks cans (Product 1)
2. Fruit cans and food cans (Product 2)
3. Warm drinks cans (Product 3)

B. Market Survey

Nowadays, the total intake of drinks cans has grown to more than 220 billion pieces. The share of North

American consumers have been 114 billion number that has been to the total used elsewhere. Europe, Asia, South America and Australia have the highest consumption after North America (Figure 3).

Market for drinks cans has a high growth in some parts of the world. The following table shows the total consumption and per capita consumption of this product around the world (Table 3).

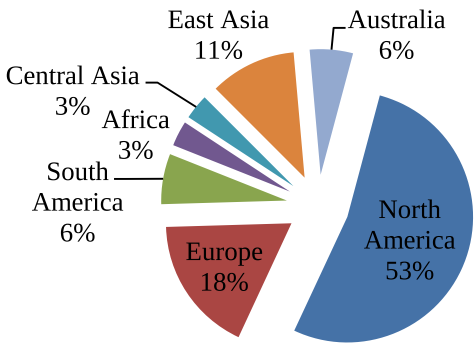

Fig.3 Total consumption in the world

Table 3 Total consumption and per capita consumption of this product

Area	North America	Europe	South America	Africa	Central Asia	East Asia	Australia
Consumption(billion)	114	38	14	7	7	24	12
Per capita consumption(number)	400	73			14		

Nowadays, 45% of world carbon dioxide drinks are served in cans. The proportion of alcohol is about 30%. The global market for packaging products has been growth 4% in the past decade.

A few companies utilize major producers of cans. These companies have achieved the expertise over time and synergy between the various components of its production. Due to the high-scale production, these companies have been formed benefit from the significant advantage.

Historically, after the formation of cans producers in the world market, the first wave of mergers and acquisitions appending in the world, SMEs were buying small companies which have produced cans. The second wave occurred in the 90s, large companies of cans bought the industry's SMEs. After this merge, Rexam, Crown Cork & Seal, Ball Corporations screwed up as the big three manufacturers cans in the world (Table 4).

Table 4 Market share of active companies in the production of cans in the world

Name of Companies	Share
Rexam	24%
Ball	21%
Crown	17%
Metal Containers	12%
Local Companies	31%

In the late 80 sand early 90s, there were a few manufactures that can produce cans in the world. After that, this industry in some markets such as Europe, America and China has been stable. The main reason for the lack of reception of this product in other countries has been related to the economic and level of development in those countries. But recently, due to the relatively high growth global economy gradually, other developing countries join to the consumer beverages which are served in cans.

We show active units in the Middle East in the table5 to demonstrate the capacity of markets and export for Iranian companies in the field.

Table 5 Active companies in the production of cans in the Middle East

Company	Country Place	Location Plan	Number of lines
Rexam	Egypt	Cario	1/Style
Kaveh	Iran	Tehran	2/Aluminum
Caniel Beverage Packaging	Israel	Telaviv	1/Style
Crown Middle East	Oman	Jordan	3/Aluminum
Crown	Qzaqzstan	Almaty	1/Aluminum
United Beverage Co.	Kuwait	Kuwait	1/Aluminum
Crown Arabian can	Saudi Arabia	Aldmam	2/Aluminum
Crown Jeddah can	Saudi Arabia	Jadah	3/Aluminum
Southern Can Making Co.	Saudi Arabia	Jadah	2/Style
United Arab Can	Saudi Arabia	Aldmam	2/Style
Algamia	Saudi Arabia	Riyadh	1/Style & 1/Aluminum
Consolidated Can Manufacturing Co.	Saudi Arabia	Jadah	2/Aluminum
Abuldajadel Beverage	Saudi Arabia	Jadah	1/Aluminum
Crown Maghreb Can	Tunisia	Tunisia	1/Aluminum
Crown	Turkey	Izmir	2/Aluminum
Rexam	Turkey	Manys	2/Aluminum
Crown Emirates Co.	UAE	Dubai	2/Aluminum
Can Park	UAE	Dubai	1/Aluminum
	The total number of lines		31

In the cans industry, diversification of products is low. Production environment is a continuous. Product is based on the prediction. While production of the final product is delayed to the customer, the order is received. Competition in this market is limited to companies which have this product in the market in during years. Flexibility of equipment and human resources is high. Return on investment is appropriate. The final cost of the product is a direct relationship with its quality; however, in the market is determined by standard quality.

According to the results of the algorithm, for all three products must be used ATO policy. Since the production of cans is in the field of the packaging industry. In this industry, suitable production policies is ATO (Table 6 and figure 4).

Table 6 Algorithm results

	Factors	Product1	Product2	Product3
Product	Risk of obsolescence Product quality Product design Fluctuations in demand Product variety Product complexity Cost of product	30	20.66	37
Customers and	Commitment to customer Commitment to Supplier	9.33	12	12

Suppliers	Customer feedback			
Internal factors	Human resources Flexibility Rewards, recognition and pay system Equipment of flexibility Integration the functions of production and marketing Information flow Technology Maintenance and support Return of investment Up buying Delivery lead-time	35	37.25	31.2

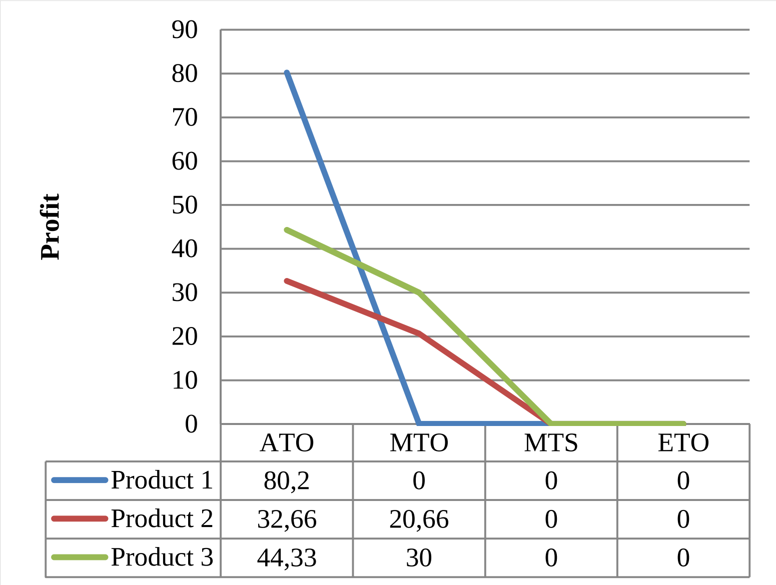

Fig.4 Algorithm results

IV. CONCLUSIONS

Selecting production polices are difficult given the qualitative and quantitative criteria. This research is done in two phases. In the first phase assess pay competitors in a competitive environment. The second phase will select production polices. Advantage of this algorithm can be pointed to the following: Strategic visions in selecting production polices and identify competitors consider the qualitative and quantitative factors together, considering the processes and types of products.

In this study, a multilevel supply chain is considered. In the supply chain decisions about inventory levels by producers in the central and producer answer the needs of retailers. Producer works according to the production policy selected with a finite rate and determined to respond to the needs of retailers. Although, much of the research in the field of production planning and control systems are MTS or MTO but many companies to reduce their production costs and improve customer service are used production of other policies, especially combination policies. In this study, we were trying providing model to meet companies what is generated with different policies. This algorithm can be easily implemented with a spreadsheet package and its computation is fast. Therefore, the proposed model can be applied easily in practical situations. Expertise, experience, authority, and the responsibilities of decision makers are not equal in practice. Furthermore, in the mathematical model, the weights of internal and external criteria are determined by decision makers. It is useful to propose a scientific method for determining these weights. In future research can be added a combination policies to this model.

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