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Evaluation of Iranian Food Manufacturing and Processing Industries

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ABSTRACT

Background: The Iranian Food Manufacturing and Producing Industries (IFMPI) were evaluated by the Iranian evaluator team according to the guidelines of the industrial projects before entering the full-scale implementation step. The current cluster study followed the objective of a similar research about evaluating the initial data of 57 various kinds of IFMPI in terms of energy, materials streams, and technical aspects.
Methods: The present research took into consideration the assessment of initial data in the screening step of project identification to further processing via Multi-Criteria Decision Making (MCDM) models and developing a techno-economic assessment model empirically.
Results: A good reliability (∝= 0.808) among the weight values in MCDM models confirmed a developed classification. The proposed economic assessment model is able to estimate the outlays for the screening step of IFMPI projects.
Conclusion: It can be concluded that the present study executed IFMPI in input and output materials besides energy streams and placed them in the reliable ranking levels using MCDM models along with Data Envelopment Analysis (DEA).

1. Introduction

Industry means an organization that is able to supply the demands of humans in a defined pathway. Industries have been classified into four kinds of scales including micro, small, medium, and large units. The main criteria regarding land use, number of staff, power, fuel, and water consumption depend on the industrial scale. In Iran, micro, small, and medium-sized industries have recruited up to 10, 50, and 500 employees respectively. Iranian economic cycle is widely derived from petroleum industries that fall into a large class of industries consisting nearly 2% of whole Iranian industries [1]. IFMPI include a variety of food processing industries. In the current study 57 cases were identified and discussed. The increasing demand of food, rapid growth of population and the reduction of food resources are among the most important issues that government officials, scientists, and researchers are facing. In this regard, the importance of optimal use of existing food resources, proper methods of storage, providing new food resources, proper food packaging, and improving the quality of products are not hidden from anyone. In addition, due to technological and scientific advancement that has led in developing new eating habits, the need for various products, the appearance of new food products, and food additives are increasingly felt [2].

Globally, the food processing industries comprised 3 large groups; namely grain products, processed food products, and livestock products. Each of the mentioned groups include lots of subscales [2, 3].

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The quality of food products is strongly related to the quantity of water, fuel, and energy consumption within processing technologies. The elasticity and viscosity of food products can be an indicator of the product quality [4]. IFMPI technologies use different kinds of mixing and blending additives in food processing technologies that provide the input materials for industries. The outcome included a large group of products which are called output materials [5]. Patel [6] examined the stability, rheology, and the effect of different environmental factors on the formation of food protein-stabilized nano-gels derived from nano-emulsions. In another study, Peressini *et al.* (2017) investigated the relation between ultrasonic properties, rheology, and baking quality for bread dough by adding various formulations [7].

Chaudhary *et al.* (2015) investigated the exploitation of enzymes in food processing technologies [8]. The running technologies in pilot plant scales consisted of a wide variety of processes to produce the food products, although lots of them are in developing or experimental steps. In the present study, we tried to investigate only the industrial units of food industries before full-scale implementation. The Environmental Impact Assessment (EIA) plan enacted to examine the performance of industrial and engineering units with regard to a variety of instruments such as decision making theory (MCDM models), DEA, and techno-economic assessment, etc. The public involvements also allocated different kinds of models and practices to assess the projects but it is not a big deal in project identification steps because it can be a push to stand away using new technologies (plasma reactors) which emerged in handling and controlling the environmental pollutants in industries [9].

The screening step of project identification was taken to provide an inventory and make sure of the availability of the projects. The inventory goes through public involvements of projects and conducts them for the next decision making and approval steps of projects. The decision making step of any project demands a variety of techniques and methods to reach a certain agreement on approval or disapproval of projects. The present study used the Multi-Attributive Border Approximation area Comparison (MABAC) to classify IFMPI based on 5 main criteria of water, power, fuel demands, land area used, and the number of staff determined by the Iranian evaluator team. The Fuzzy set theory (incorporated with simple additive weighting), Weighted Aggregated Sum-Product Assessment (WASPAS), Simple Additive Weighting (SAW), and Additive Ratio Assessment (ARAS) were employed as a sensitivity analysis to verify the obtained values from the MABAC model. It needs to be explained that the MABAC model is a newly developed model of MCDM containing a few empirical equations to assess the criteria of industries like other MCDM models [10, 11]. To the best of our knowledge, this is the first research about IFMPI in the EIA plan that included 57 various kinds of industries based on Nominal Capacity (NC) in Iran. The main objectives followed by the current research encompassed (1) Classification of IFMPI based on 5 main criteria of water, fuel, the power consumption, number of staff and the land use to accommodate IFMPI via MABAC model (2) Investigation of classified industries using other MCDM models in a sensitivity analysis (3) Aggregation of initial data of IFMPI based on both energy and materials streams (4) Developing an economic assessment model via an inventory of availability in IFMPI which has been reported by Iranian evaluator team. The rapid development in the industrial ecology posed the difficulties in industries like executing the networks of energy, materials streams, industrial technologies, economic estimation models based on input and output materials demands, and an inventory of availability and classification of industries in certain clusters pertain to NC. Therefore, the present study attempted to discover the demands and recede the challenges in this regard.

2. Materials and Methods

The current cluster study includes 57 various kinds of IFMPI underwent an empirical evaluation pertaining to secondary data. The initial data of IFMPI released by the Iranian evaluator team from in-charge organizations. The sampling has been selected to study 57 different types of IFMPI projects in a cluster (individual sample from similar cases) that moved from project identification step to screening, decision making theory, and techno-economic assessment modeling [12]. IBM SPSS Statistic 20 software was used to analyze the data of industries. Figure 1 displays the steps of the followed work.

The initial data of materials and energy streams of IFMPI have been published by the corresponding author in the article [3]. The present study partially relied on the mentioned data along with some new information to process additionally. The recently developed model of decision-making theory, called MABAC was employed to classify IFMPI based on 5 main criteria of industries (water, power, fuel demands, land area used, and the number of staff) according to equations 1 to 5. In the first step, the evaluation of the m alternatives by the n criteria is carried out. By the equations 1 and 2, aij, ai+, and ai- devoted to the existing values of 5 main criteria (it is the value of i alternative according to the j criteria (i =1, 2,...,m; j =1, 2,..., n)), the highest and the lowest value in the initial matrix of data of 5 main criteria (criteria by alternatives). This step is called the normalization of the matrix of data [13]. The second step is for the normalized and weighted data of the matrix (Vij). The weighing procedure (wn.n) of main criteria also relied on the previous study by the author. The same data and values of weights were used [3]. The weight values was reported as 4.98, 3.95, 2.26, 2.17, and 1.64 for the land area used, power, fuel, employees, and water by Friedman test . In equation 4, gi is the approximate border area.

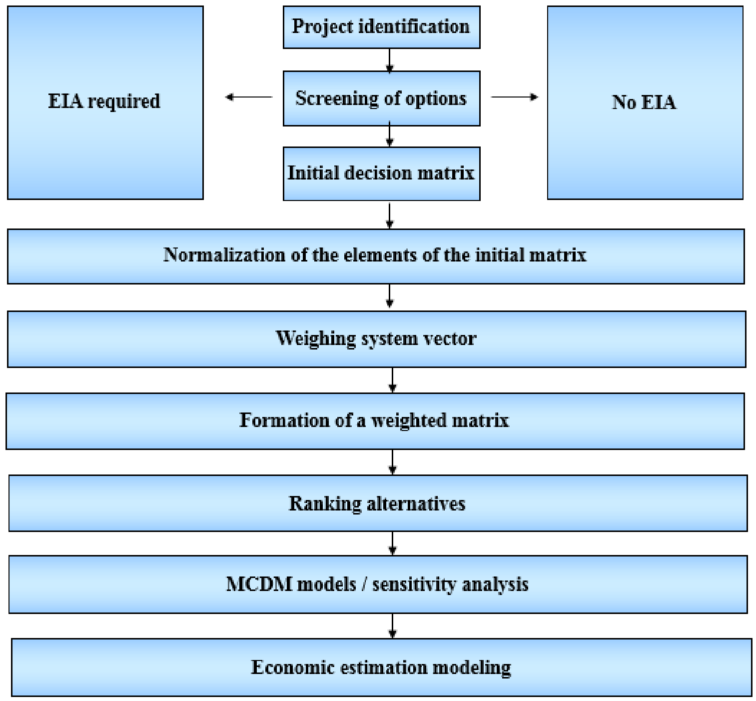


Figure 1: Flow diagram of the followed work [This study]

The geomean of normalized and weighted matrix went through equation 4 to calculate the final weights released by the ranking model of MABAC (Qi). Finally, the ranking alternatives was done based on the highest value to the lowest one [14].

$$\mathrm{Xij} = \frac{aij - ai^{-}}{ai^{+} - ai^{-}} \quad (1)$$

$$\mathrm{Xij} = \frac{aij - ai^{+}}{ai^{-} - ai^{+}} \quad (2)$$

$$\mathrm{Vij} = (\mathrm{Xij} + 1).\mathrm{Wn.n} \quad (3)$$

$$gj = \left(\prod_{i=1}^{m} Vij\right)^{1/m} \quad (4)$$

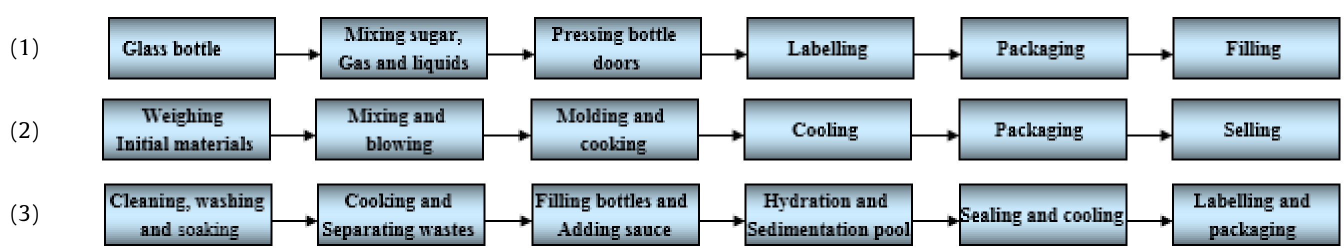
$$Qi = \sum_{j=1}^{n}(Vij - gj) \quad (5)$$

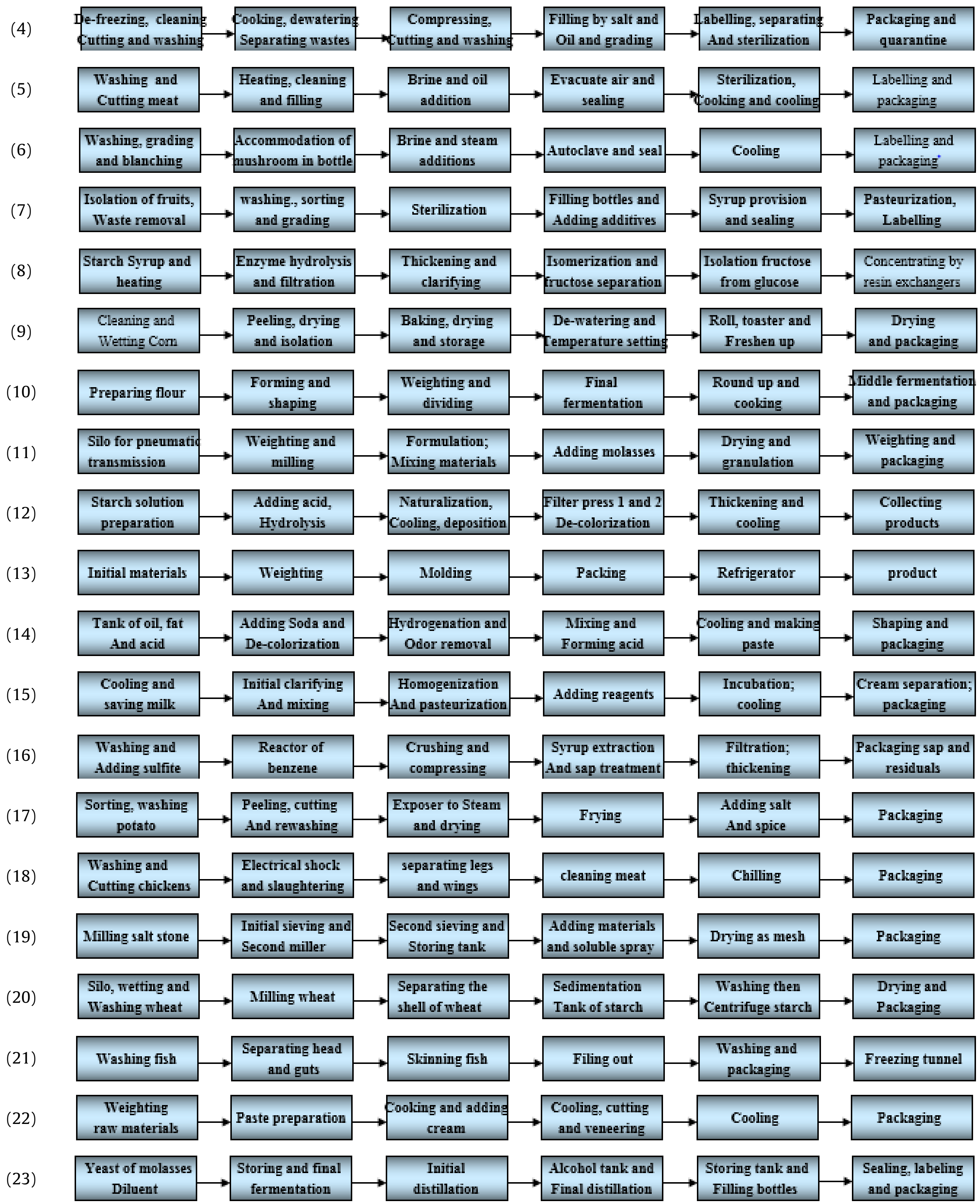
The values of weights in the ranking model of MABAC was examined by other MCDM models including SAW, ARAS, and WASPAS. Then all the values were compared with the findings of the study by the author regarding the ranking system of the Delphi Fuzzy set incorporated with the SAW model [3].

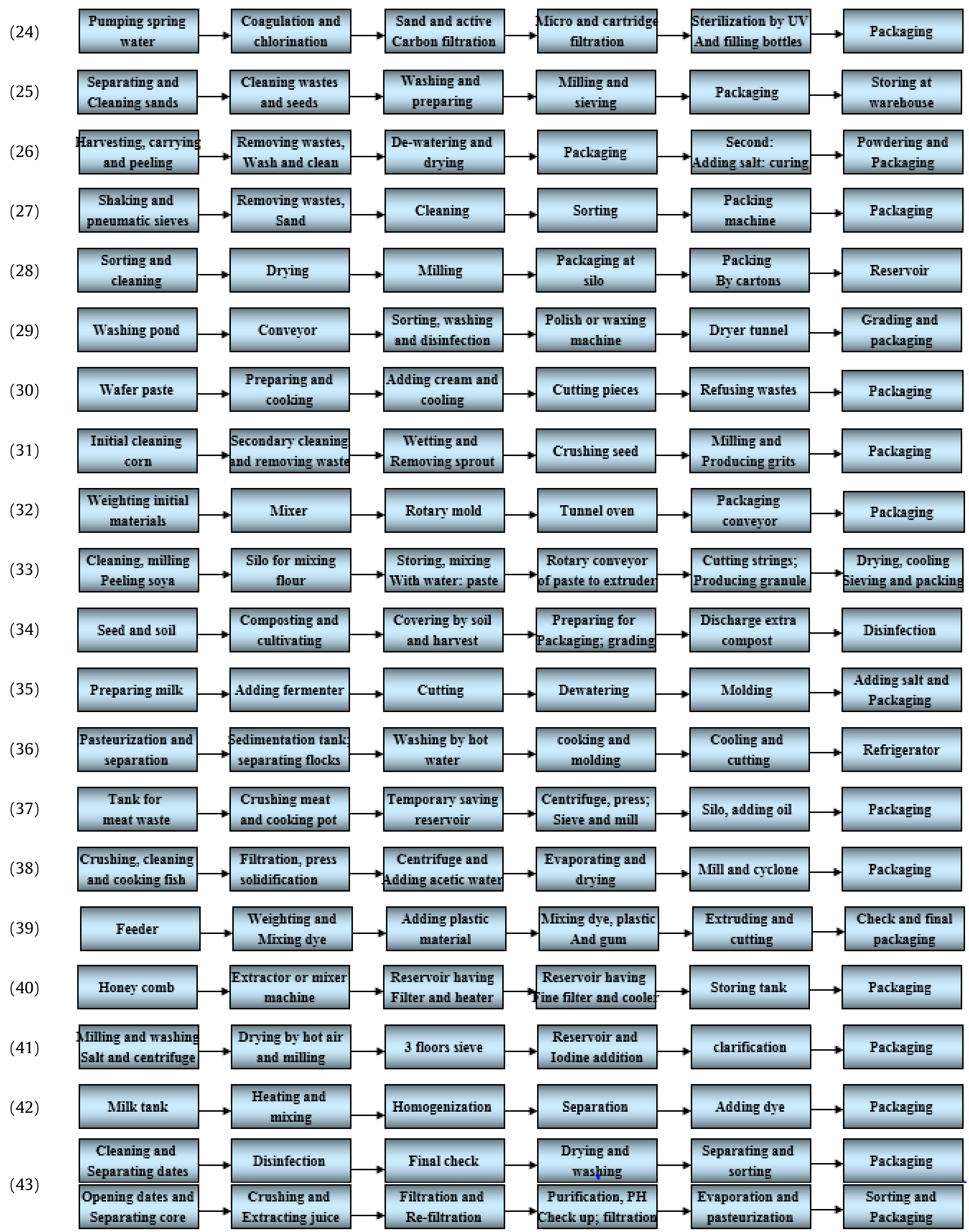
3. Results and Discussion

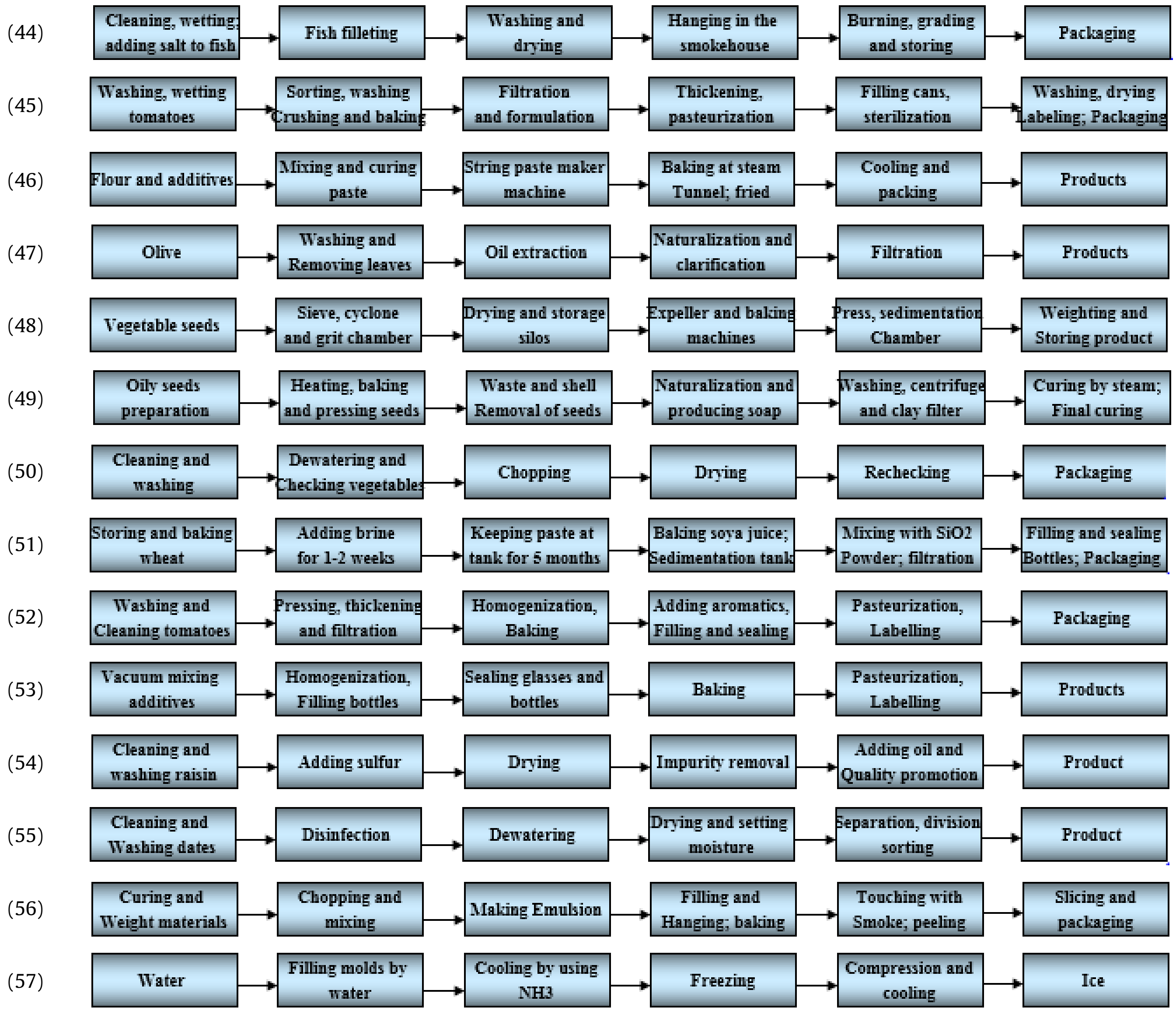
3.1. IFMPI Technologies

The IFMPI technologies comprised the knowledge of the fluidity, deformation, shear stress, rheology, and viscosity of a variety of food products [15]. The applied technologies in food products are exploited to escalate the quality of raw materials, additives, and combined ingredients. Figure 2 displays the running technologies in IFMPI based on input materials, and their processes.




(4)
De-freezing, cleaning Cutting and washing
Cooking, dewatering Separating wastes
Compressing, Cutting and washing
Filling by salt and Oil and grading
Labelling, separating And sterilization
Packaging and quarantine
(5)
Washing and Cutting meat
Heating, cleaning and filling
Brine and oil addition
Evacuate air and sealing
Sterilization, Cooking and cooling
Labelling and packaging
(6)
Washing, grading and blanching
Accommodation of mushroom in bottle
Brine and steam additions
Autoclave and seal
Cooling
Labelling and packaging
(7)
Isolation of fruits, Waste removal
washing., sorting and grading
Sterilization
Filling bottles and Adding additives
Syrup provision and sealing
Pasteurization, Labelling
(8)
Starch Syrup and heating
Enzyme hydrolysis and filtration
Thickening and clarifying
Isomerization and fructose separation
Isolation fructose from glucose
Concentrating by resin exchangers
(9)
Cleaning and Wetting Corn
Peeling, drying and isolation
Baking, drying and storage
De-watering and Temperature setting
Roll, toaster and Freshen up
Drying and packaging
(10)
Preparing flour
Forming and shaping
Weighting and dividing
Final fermentation
Round up and cooking
Middle fermentation and packaging
(11)
Silo for pneumatic transmission
Weighting and milling
Formulation; Mixing materials
Adding molasses
Drying and granulation
Weighting and packaging
(12)
Starch solution preparation
Adding acid, Hydrolysis
Naturalization, Cooling, deposition
Filter press 1 and 2 De-colorization
Thickening and cooling
Collecting products
(13)
Initial materials
Weighting
Molding
Packing
Refrigerator
product
(14)
Tank of oil, fat And acid
Adding Soda and De-colorization
Hydrogenation and Odor removal
Mixing and Forming acid
Cooling and making paste
Shaping and packaging
(15)
Cooling and saving milk
Initial clarifying And mixing
Homogenization And pasteurization
Adding reagents
Incubation; cooling
Cream separation; packaging
(16)
Washing and Adding sulfite
Reactor of benzene
Crushing and compressing
Syrup extraction And sap treatment
Filtration; thickening
Packaging sap and residuals
(17)
Sorting, washing potato
Peeling, cutting And rewashing
Exposer to Steam and drying
Frying
Adding salt And spice
Packaging
(18)
Washing and Cutting chickens
Electrical shock and slaughtering
separating legs and wings
cleaning meat
Chilling
Packaging
(19)
Milling salt stone
Initial sieving and Second miller
Second sieving and Storing tank
Adding materials and soluble spray
Drying as mesh
Packaging
(20)
Silo, wetting and Washing wheat
Milling wheat
Separating the shell of wheat
Sedimentation Tank of starch
Washing then Centrifuge starch
Drying and Packaging
(21)
Washing fish
Separating head and guts
Skinning fish
Filing out
Washing and packaging
Freezing tunnel
(22)
Weighting raw materials
Paste preparation
Cooking and adding cream
Cooling, cutting and veneering
Cooling
Packaging
(23)
Yeast of molasses Diluent
Storing and final fermentation
Initial distillation
Alcohol tank and Final distillation
Storing tank and Filling bottles
Sealing, labeling and packaging


(24)
Pumping spring water
Coagulation and chlorination
Sand and active Carbon filtration
Micro and cartridge filtration
Sterilization by UV And filling bottles
Packaging
(25)
Separating and Cleaning sands
Cleaning wastes and seeds
Washing and preparing
Milling and sieving
Packaging
Storing at warehouse
(26)
Harvesting, carrying and peeling
Removing wastes, Wash and clean
De-watering and drying
Packaging
Second: Adding salt: curing
Powdering and Packaging
(27)
Shaking and pneumatic sieves
Removing wastes, Sand
Cleaning
Sorting
Packing machine
Packaging
(28)
Sorting and cleaning
Drying
Milling
Packaging at silo
Packing By cartons
Reservoir
(29)
Washing pond
Conveyor
Sorting, washing and disinfection
Polish or waxing machine
Dryer tunnel
Grading and packaging
(30)
Wafer paste
Preparing and cooking
Adding cream and cooling
Cutting pieces
Refusing wastes
Packaging
(31)
Initial cleaning corn
Secondary cleaning and removing waste
Wetting and Removing sprout
Crushing seed
Milling and Producing grits
Packaging
(32)
Weighting initial materials
Mixer
Rotary mold
Tunnel oven
Packaging conveyor
Packaging
(33)
Cleaning, milling Peeling soya
Silo for mixing flour
Storing, mixing With water: paste
Rotary conveyor of paste to extruder
Cutting strings; Producing granule
Drying, cooling Sieving and packing
(34)
Seed and soil
Composting and cultivating
Covering by soil and harvest
Preparing for Packaging; grading
Discharge extra compost
Disinfection
(35)
Preparing milk
Adding fermenter
Cutting
Dewatering
Molding
Adding salt and Packaging
(36)
Pasteurization and separation
Sedimentation tank; separating flocks
Washing by hot water
cooking and molding
Cooling and cutting
Refrigerator
(37)
Tank for meat waste
Crushing meat and cooking pot
Temporary saving reservoir
Centrifuge, press; Sieve and mill
Silo, adding oil
Packaging
(38)
Crushing, cleaning and cooking fish
Filtration, press solidification
Centrifuge and Adding acetic water
Evaporating and drying
Mill and cyclone
Packaging
(39)
Feeder
Weighting and Mixing dye
Adding plastic material
Mixing dye, plastic And gum
Extruding and cutting
Check and final packaging
(40)
Honey comb
Extractor or mixer machine
Reservoir having Filter and heater
Reservoir having Fine filter and cooler
Storing tank
Packaging
(41)
Milling and washing Salt and centrifuge
Drying by hot air and milling
3 floors sieve
Reservoir and Iodine addition
clarification
Packaging
(42)
Milk tank
Heating and mixing
Homogenization
Separation
Adding dye
Packaging
(43)
Cleaning and Separating dates
Disinfection
Final check
Drying and washing
Separating and sorting
Packaging
Opening dates and Separating core
Crushing and Extracting juice
Filtration and Re-filtration
Purification, PH Check up; filtration
Evaporation and pasteurization
Sorting and Packaging



Up to down; (1) Barley water (NC=30000000 No), (2) Cake and muffins (NC=650 t), (3) Canned Beans and Caviar Eggplant (NC=3700 No), (4) Canned fish (tuna) (NC=11000 No+1056t), (5) Canned meat (NC=6500000 No), (6) Canned mushrooms (NC=2800000 No), (7) Compote (NC=8000000 No), (8) Concentrated fructose syrup of corn sugar (NC=2400t), (9) Corn Flakes (NC= 600t), (10) Fantasy Bread (NC=1000000t), (11) Fish food (NC=12000t), (12) Glucose from starch (NC=2160t), (13) Hamburger (NC=1000t), (14) Margarine (NC=12000t), (15) Milk, yogurt and pasteurized cream (NC=8255t), (16) Date sap (NC=2000t), (17) Potatoes based foods (NC=800t), (18) Poultry slaughterhouse (NC=3780000 No), (19) Iodinated salt (NC=10000t), (20) Starch from wheat (NC=1580t), (21) Treating fish (NC=1000t), (22) Wafer chocolate (NC=500t), (23) Alcohol from beet molasses (NC= 1500000 No), (24) Mineral water (NC=12000t), (25) Wheat flour (NC=27000t), (26) Pistachio packaging (NC=1269.5t), (27) Packing grains; peeling off barley (NC= 2430t), (28) Spice Packing (NC=250t), (29) Fruit packaging (NC=10000t), (30) Wafer biscuits (NC=1000t), (31) Corn grits (NC=5800t), (32) Biscuit (NC=1000t), (33) Soya protein (NC=1900t), (34) Mushroom cultivation (NC=600t), (35) Cheese from fresh milk (NC= 1500t), (36) Cheese Pizza (NC=1500t), (37) Meat and Olive Industrial Powder (NC=545.5t), (38) Fish powder (NC=500t), (39) Artificial sausage and sausage coating (NC=243t), (40) Preparation; packaging of honey (NC=24000 No), (41) Purification and packaging of salt (NC=21600t), (42) Cream dyed (NC= 1400t), (43) Dates and liquid sugar (NC=4680t), (44) Smoked fish (NC=15t), (45) Tomato paste (NC=1500t), (46) Flour string (NC=24192 No), (47) Olive oil (NC=280t), (48) Oil Seeds from Vegetable Seeds (except soya; olive) (NC=8000t), (49) Drying oils (NC=1500t), (50) Dried vegetables (NC=1412000 No), (51) Soya sauce (NC= 60000 barrels+72000 bottles), (52) Ketchup (NC= 16000t), (53) Food sauces (NC=4451998 (bottles 300g)+1250000 (bottles 120g)), (54) Raisin Packaging (NC=1000t), (55) Dates packaging (NC= 400t), (56) Sausage (NC=1000000t), (57) Ice (NC=12920t).

Figure 2: IFMPI technologies [This study]

With regard to the fact offered by IFMPI, relevant technologies for processing the food ingredients (Figure 2) are obsolete. We need to have a look at recent studies and reports in this regard. Developing and manufacturing food in the industrial dimensions with 3-Dimensional printing technology paved the way for producing food by more advanced techniques in terms of shape and nutritional combination, rheological properties, operational conditions, and melting degrees [16, 17]. Compton *et al.* (2018) studied the latest food processing technologies such as membrane separation, high-pressure processing, microwave, ultrasound, pulsed high electric fields, ozone, and hydrogen/electricity generation practices to discern the energy consumption trend in FMPI [18]. Baroutian *et al.* (2018) reported the rheological behavior of food wastes such as carbohydrates, vegetables, fruits, and meat at 25-45 ℃ [19]. Obtained results revealed that shear-thinning flow behavior and viscosity of food wastes are closely related to conducted temperature and mixed composition. Meza *et al.* (2014) investigated and compared average thickness of obtained amounts by dip coating on commercial food glaze materials at 20-50℃ [20]. Rheological characteristics were found favorable with the full agreement between experimental and theoretical film thickness in food materials. The NC of IFMPI presents the values of products released from industries. It also can be a distinguishing feature of industries. The Iranian industries can be classified based on NC to realize the industries even for the same industries in terms of technology and other belongings.

3.2. Description of ranking models of MCDM and Sensitivity Analysis

As indicated in Table 1, ranking system of MABAC was used to classify IFMPI based on 5 main criteria of water, fuel, the power consumption, the number of staff, and the land area applied to accommodate IFMPI. In addition, Table 1 shows the findings of SAW, ARAS, WASPAS, and Fuzzy Set along with the DEA model. Figure 3 displays a sequence number of the values of weights in ranking models.

According to Table 1, IFMPI originated from MABAC model to classify the industries based on 5 main criteria. The same ranks were observed (numbers 23; 25; 30 and 32) from the industries containing the same values of the criteria. To verify the findings, both statistical and sensitivity analysis were employed by other MCDM models.

The application of the sequence diagram (Figure 3) refers to the existing interaction between various kinds of ranking models of MCDM in developed scenarios. The diagram typically offers a graphical expansion of appeared functions in the weight values released in ranking systems. The linear development in outlined functions confirms a high overlapping in the obtained results. Furthermore, more compliance is observed by straight and parallel developments in the results [22]. According to Figure 3, the functionality does not fall in a linear expansion of values due to a high fluctuation in the initial data of criteria. However, conducting the one-sample t-test among 5 columns of weight values in the ranking systems confirmed no significant difference among them. Using Cronbach's Alpha formula, the reliability of the 5 ranking models was estimated to be 0.808. With regard to the fact that the reliability test of Cronbach's Alpha has been caculated to be in $\alpha \geq 0.9$ (excellent), $0.8 \leq \alpha < 0.9$ (good), $0.7 \leq \alpha < 0.8$ (acceptable), $0.6 \leq \alpha < 0.7$ (questionable), $0.5 \leq \alpha < 0.6$ (poor), $\alpha < 0.5$ (unacceptable) ranges. The null hypothesis was rejected based on the distribution of the weight values in 5 ranking models via the one-sample Kolmogorov-Smirnov test [3].

The sustainability of OPEC countries was investigated by 41 indicators and the MCDM model namely Combined Compromise Solution and the results compared with MABAC and WASPAS, etc. in various scenarios [22]. The optimal selection of firefighting helicopters has been investigated via interval-valued fuzzy-rough numbers, the Best–Worst method, and the MABAC model. The validity of the results was determined based on a comparison with the findings of fuzzy and rough extension of the MABAC, COmplex PRoportional ASsessment and, VIse Kriterijumska Optimizacija I Kompromisno Resenje models [23].

The strategic project portfolio selection used the MABAC model with 34 indicators. The validation of findings has been investigated via a comparison with other MCDM models in different scenarios [24]. The MABAC model was employed to select the location of a single-span bailey bridge by Bozanic *et al.* (2019) [25]. The findings of the current research are in full agreement with the reviewed reports.

As shown in Table 1, DEA is a separate decision-making system employed as an economic instrument to evaluate the projects. However, the objective followed by the current research does not include the procedure of DEA estimation. It needs to be explained that the data of the research has been extracted from the author's study mentioned in reference [21]. It is a new type of classification of energy and materials streams when the values in the currency are inaccessible. The procedure used the integration of the ARAS model with the traditional DEA model to rank the industries.

3.3. Economic Estimation Model

The inventory of devices, facilities, and equipment of IFMPI is presented in Table 2. Table 2 extracted from the initial data of the Iranian evaluator team in the Persian report submitted to both Iranian industries organization and the Iranian environment protection agency. The whole requirements of IFMPI to set up an arranged economic model are presented in Table 3. The main sections divided into the costs of equipment, materials and product, Transportation facilities, employee, energy consumption, land, and landscaping. The following part was implemented as a framework of economic modeling by equations 6 to 14 and their definitions via Table 4.

By screening the projects, developing a techno-economic assessment modeling was facilitated. The model comprised the whole requirements of IFMPI.

Table 1: The values of ranks in MCDM models [This study]

IFMPI	ARAS	SAW	MABAC	WASPAS	Fuzzy Set* [3]	DEA [21]
1	7	7	4	5	6	3
2	42	42	40	40	40	42
3	16	16	14	14	16	56
4	6	6	6	6	9	49
5	34	34	31	31	13	7
6	15	15	17	17	32	4
7	8	8	5	7	8	8
8	45	45	42	42	44	22
9	29	29	26	26	29	45
10	54	54	54	54	52	1
11	3	3	7	4	17	20
12	32	32	32	32	33	26
13	53	53	53	53	52	23
14	12	12	13	13	4	17
15	10	10	9	8	12	35
16	23	23	21	21	25	27
17	14	14	15	15	14	46
18	19	19	19	19	34	6
19	21	21	27	27	15	16
20	27	27	24	24	27	34
21	35	35	37	37	37	38
22	51	51	51	51	50	39
23	17	17	16	16	11	11
24	38	38	38	38	39	29
25	17	17	16	16	11	10
26	48	48	46	46	44	25
27	49	49	49	49	47	18
28	55	55	55	55	52	44
29	26	26	25	25	30	13
30	46	46	45	45	45	32
31	11	11	10	11	5	21
32	46	46	45	45	46	33
33	20	20	29	29	23	30
34	25	25	20	20	19	52
35	18	18	18	18	18	36
36	43	43	43	43	41	24
37	47	47	48	48	43	40
38	39	39	39	39	38	48
39	31	31	33	33	31	54
40	52	52	52	52	48	43
41	9	9	8	9	7	14
42	2	2	1	1	1	55
43	4	4	2	2	2	31
44	50	50	50	50	51	57
45	24	24	23	23	22	37
46	37	37	34	34	42	41
47	22	22	30	30	20	53
48	1	1	11	10	21	51
49	41	41	44	44	28	28
50	36	36	35	35	33	9
51	5	5	3	3	3	19
52	13	13	12	12	10	15
53	28	28	28	28	26	5
54	30	30	22	22	24	47
55	44	44	47	47	49	50
56	40	40	41	41	36	2
57	33	33	36	36	35	12

*Delphi Fuzzy set incorporated with SAW model.

Table 2 was extended to include the case demands of Table 3. Table 3 was arranged to connect the ring between economic modeling and technical assessment of IFMPI via rows. It is obvious to realize the connection between the mentioned costs and the introduced model. The costs of equipment, materials, and products are estimated via equations 6 and 7.

The costs of Fc = \$4 and TPc = \$5 are estimated via equations 8 and 9 regarding the required facilities depending on the NC of industries and the area used for IFMPI individually.

$$\$1 = \mathrm{Dp} + (5\%\ \mathrm{of\ IC}) \quad \text{This study} \quad (6)$$

$$\$2, \$3 = \sum Min + \sum Mgen - \sum Mdes - \sum Mout \quad (7)$$

$$\mathrm{Fc} = \sum \$4 \quad \text{This study} \quad (8)$$

$$\mathrm{TPc} = \sum \$5 \quad \text{This study} \quad (9)$$

$$\$6 = \sum Ms + INc + COc \quad \text{This study} \quad (10)$$

$$Ec = \sum \$7$$ This study (11)

$$RW = \sum DWb + AWC$$ This study (12)

$$W = 0.75 \times (\sum e) \times A$$ This study (13)

$$\$8 = \sum LC + \sum LPAC + \sum CCB + \sum CCF$$ (14)

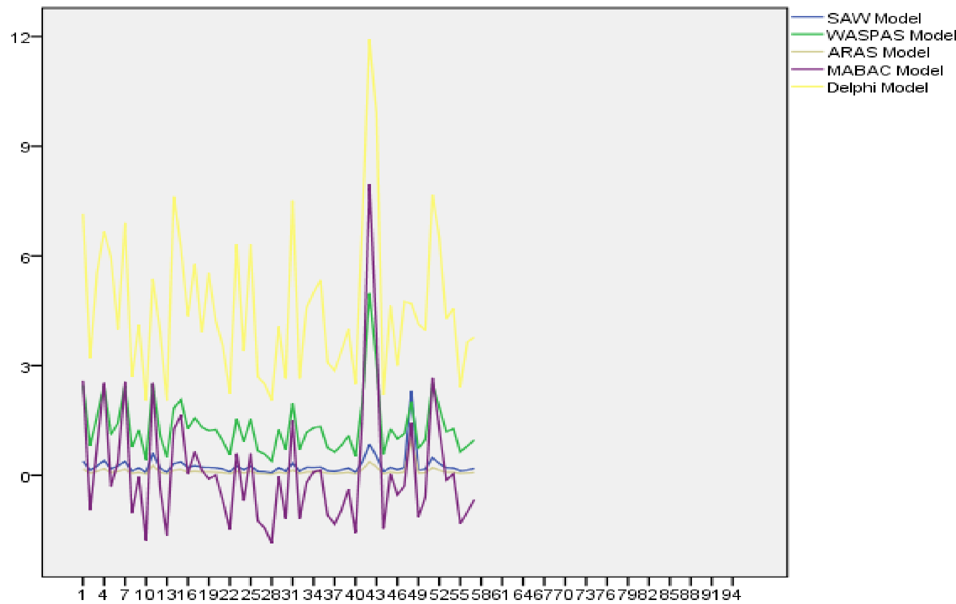


Figure 3: The sequence number of the weight values in ranking systems; (the weight value in ranking systems / number of industries on the vertical and horizontal axes respectively) [SPSS Software output]

Table 2: All available facilities of IFMPI [This study]

Industry	Facilities
(1)	Filler machines of 12000 bottles/h (1 No); Glass cleaner of 14000 bottles/h (1 No); Bottles checking machine about 15000 bottles/h (1 No); Labelling device (1 No); Packaging machine (1 No); Conveyor (1 No); Packaging machine for around 125 packs/h (1 No)
(2)	Mixer (1 No); Ovex aerator (1 No); 8-row dioziter 20kW (1 No); Tunnel oven, w= 20 m (1 No); Automatic packaging (1 No); Oven (1 No); Grill (2 No); Cake and muffins frame as piston (1 No); Trays of about 60840 and 60*90 cm^2 (1 and 1 No); Chariot wheel (1 No); Cooking pot (1 No)
(3)	Cleaning machine, 300 kg/h, (1 No); Washing machine of bens, 300 kg/h (1 No); Steel conveyor, 1.5t (1.5 No); Cooking pot, 300 kg/h (1 No); Washing tank, 150 kg/h (1 No); Bottles sealant machine, 10 bottles/min (3 No); Exhaust, L= 9 m (1 No); Formulation pot, 300 kg (1 No); Autoclave, capacity of 450 cans of 500 g (5 No); Washing machine of cans, capacity of 1200 cans/h (1 No); Conveyor, L= 6 and 3 m (3 and 6 No); Baking pot, capacity of 200 kg/h (1 No); Silos, d and h= 3 and 5 m (5 No); Incubator, 37℃ and 150℃ (1 No)
(4)	Vertical autoclave, capacity of 1 ton, 5 kw (5 No); Workbench with conveyor, in size of 0.5*4 m^2, 215 kw (1 No); Washing machine of empty and filled cans, 4 kw (1 and 1 No); Horizontal bake pot, 5 kw (3 No); Labelling machine 1.5 kw (1 No); Flexible tube, in size of 1*2 m^2, 350 liters (2 No); Capping machine, 2.5 kw (3 No); Electrical saw, 1 kw (1 No); Workbench, in sizes of 1*2 m^2 (3 No); Conveyor, 8 m, 4.5 kw (2 No); Oil supply machine, 250 liters (2 No); Refrigerator for fish and canned fish and its compressor (4 and 4 No)
(5)	Boiler, 1 ton (1 No); Capping machine, 1500 cans/h (1 No); Automatic labelling machine (1 No); Autoclave, 150 kg, 500 cans (6 No); Refrigerator (1 No); Automatic oil supply machine (1 No); Automatic salt addition machine (1 No); Conveyors, L= 3 and 6 m (3 No)
(6)	Refrigerator, 150 m^3 (1 No); Steam tunnel, 80-90 ℃ (1 No); Vertical autoclave (6 No); Mushrooms filling machine, 1600 cans/h (1 No); Salt water filling machine, 1600 cans/h (1 No); Automatic labelling machine (1 No); Conveyor, 250 kg/h, 2 kw (3 No); Capping machine (1 No); Lab (1 unit)
(7)	Washing machine, capacity of 3t/h (1 No); Checking and sorting conveyors, w and L= 50 and 4 m (2 No); Cherry blower machine, 2 t/h (1 No); Chemical Removal Machine of Fruit Shell, 2t/h (1 No); Steel network, d and h= 100 cm (5 No); Final washing machine (1 No); Lifter in size of 1.5*1.5*30 m^3 (1 No); Blanching machine in dimension of 1*2*2.5 m^3 (1 No); Fruit and juice filling machine, 2400 cans/h (2 No); Juice producer machine (1 No); Capping machine, 2400 cans/h (1 No); Vertical autoclave (6 No); Printed cans, 200 cans/min (1 No); Labelling, 200 cans/min (1 No); Exhaust, L and w= 4 and 0.5 m (1 No)
(8)	Mixing tank, 4 ton (1 No); Starch Liquid Machine, 4 tons (1 No); Starch solution tower, 3500 liters (1 No); Heater (1 No); Sugar Reservoir (1 No); Filtration tank, 3 tons (2 No); Primary desalination equipment, 3 tons (1 No); Isomerization equipment (1 No); Secondary filtration, 3 tons (1 No); Concentrator machine (1 No)
(9)	Cleaning machine, 500 kg/h (1 No); Stainless steel spiral pipe for moisture addition, L= 4 m (1 No); Machine for separating skin and corn germ, 500 kg/h (1 No); Drying machine, 500 kg/h (2 No); Separator, 500 kg/h (1 No); Boiler 500 kg/h (1 No); Formulation chamber, 100 liters (2 No); Conveyor in size of 3*0.5 m^2 (1 No); Silo in size of 3*4*1.5 m^3 (1 No); Steam spiral, L= 4 m and d=40 cm (1 No); Convertible temperature adjustment, with the size of 3*4 m^2 (1 No); Rolling machine, 500 kg/h (1 No); Automatic sieve, 3*4 m^2 (1 No); Plastic packaging machine, 250 and 450 No/h (3 No); Capping machine, 250-900 No/h (2 No); Tunnel dryer, Land d= 4 and 0.5 m (1 No)
(10)	Mixer and its pot (2 and 6 No); Multi-layers and circular cooking oven, 360 and 150 kg/h (1 and 1 No); Incubator (1 No); Single-layer sieve (2 No); Dough roller, 2 tons (4 No); Dough mixer, capacity of 4 tons/d (1 No); Balance, 30 kg (1 No); Trailer for carrying trays 20-floors with wheels (20 No); Steel worktables in size of 3*5 m^2 (2 No); Paste flattening machine (1 No); Trays of 60*90 cm^2 (400 No); Dough or paste cutting machine (1 No)

Table 2: All available facilities of IFMPI [This study] (continue)

Industry	Facilities
(11)	Pneumatics conveyor, L= 2 m (2 No); Storage tank, 2 m^3 (1 No); Hammer mill, 2 ton/h (1 No); Balance, 20 tons (1 No); Mixer, 2 tons/h (2 No); Powdering machine, 2.5 tons/h (1 No); Sieve (2 No); Pellet machine, 2 tons/h (1 No); Cooler, L= 3 m (1 No)
(12)	Vacuum cyclone, d and h= 70 and 230 cm (1 No); Operator (1 No); Filter press (1 No); Vacuum machine (1 No); Steel tank d and h= 150 cm (1 No); Power panel (1 No); Plumbing equipment of assembly line (1 No)
(13)	Guillotine for cutting meat (1 No); Industrial meat grinder (1 No); Mixer (1 No); Refrigerator (1 No); 10-floors carriage (1 No)
(14)	Crude oil storage tank (2 No); Acid remediation facility (1 No); Filter press (1 No); Deodorant facility (1 No); Hydrogenation tank (1 No); Sterilization tank, stainless cast iron, 2 tons (1 No); Additives tank, stainless steel, 50 m^3 (2 No); Electrolysis cell for hydrogen generation, 50 m^3/h, 99.9% (1 No); Packaging machine in boxes of 250 and 500 g (1 No)
(15)	Milk tank equipped to all the required facilities (2 No); Pasteurization machine (1 No); Pasteurization machine, 100 L (1 No); Storage tank of pasteurized milk equipped to all the required facilities (2 No); Yogurt packaging machine, 500 liters (2 No); Cream packaging machine including centrifuge pumps of 1000 liters, 0.75 kw (2 No); In situ washing unit, 200 liters, 2.2 kw (2 No); Cooling unit (1 No); Spare parts (1 series); Fitted lab (1 unit)
(16)	Dates mixer, 1000 kg/h, 5 kw (2 No); Spiral press, 1200 kg/h, 15 kw (2 No); Storage tank, 20000 liters (2 No); Mechanical filter, 9 kw (1 No); Concentrating dye, 12.5 kw (2 No); Tank for storing concentrated juice, 1000 liters (1 No); Conveyor, L= 6 m (3 No); Hot air chamber, 12 kw (1 No); Storage silos, 3 m^3 (1 No); Central chiller (1 No); Fitted lab and repair workshop (1 and 1 No)
(17)	Conveyor, L and w= 9 and 0.5 m (5 No); Peeling off machine, 500 kg/h (1 No); Potato chopping machine, 250 kg/h (2 No); Tunnel, L= 4 m (2 No); De-watering machine (3 No); Fryer machine, 250 kg/h (2 No); Salt and spice addition machine, 250 kg/h (2 No); Packaging machines of 1000 and 2500 No/h (2 No); Starch separator, 1000 L/h (1 No); Lab facilities (1 No)
(18)	Galvanized conveyor, L= 10 m (1 No); Air conveyor line, L= 80 m, steel (1 No); Voltage regulating device (1 No); Blood collector channel, L= 2o m (1 No); Hood (1 No); Filling machine containing 4 electromotor, 1.5 kw (1 No); Steel cap (1 No); Conveyors, L= 4 m, containing 2 channels (1 No); Table (4 No); Special machine for separating chickens muscles (feet, head etc.) (individually 1 No); Spiral chiller made of steel, L= 6 m (1 No); Air blower (1 No)
(19)	Stone crusher, 50 tons, 10 kw (1 No); Jaw mill, 20 kw (2 No); Elevator with electromotor 1000 rpm, 1.5 kw (1 No); Salt stone storage tanks, stainless steel, 12 m^3 (2 No); Silo, stainless steel, 15 m^3 (3 No); Formulation tank, 20 m^3, 1 kw, stainless steel (1 No); Spray machine, 3 kw (2 No); Conveyor, 6 kw, L= 15 m, 5 ton/h (4 No); Dryer by hot air blower (1 No); Mixer, 1 ton/h, stainless steel, 6 kw (1 No); Cyclone, input flow of 180 and 300 m^3, 4 kw (2 No); Fan, 1500 rpm, 12 kw (1 No); Furnace equipped to hot air blower, 400 rpm, 10 kw (1 No); Semi-automatic packaging machines of 180-250 box/h (2 No)
(20)	Cleaning machine, 300 kg/h, 4 hp (1 No); Elevator, 6 and 8 m, 3 and 4 hp (1 and 1 No); Wheat washing tank equipped to mixer and electromotor, 6 tons (6 No); Spiral helix plus milling tank, 5 tons/shift (1 No); Starch washing tank, 1500 liters (3 No); Centrifuge, 7.5 hp (1 No); Drying flames, 28000 kcal (1 No); Miller, 3.5 kw, 150 kg/h (1 No); Sewing machine of bags, 10 bags/min (2 No); Electro motors, 1.5-3 hp (10 No)
(21)	Bone separator machine, 100 kg/h, 2 kw (1 No); Ice machine, 2000 kg/d, 15 kw (1 No); Worktable (3 No); Washing and cleaning machine (1 No); Fish storage tank (5 No); Electrical saw, 0.5 kw (1 No); Vacuum packaging machine, 2 kw, 5 bar (1 No); Freezing tunnel and cold storage refrigerator, 60 tons (1 No); Plate freezing machine, -40℃ (1 No)
(22)	Guillotine (1 No); Industrial meat grinder (1 No); Mixer (1 No); Refrigerator containing -25℃ (1 No); The carriage of burgers, 10 floors (1 No)
(23)	Cooking and sterilizing equipment for molasses (3 No); Equipment for breeding, 3000 liters (2 No); Fermentation equipment, 20000 liters (2 No); Initial distillation system, 3000 liters (6 No); Final distillation, stainless steel, 7500 liters (1 No); Alcohol storage tank, stainless steel, 2000 liters, 40℃ (4 No); Alcohol storage tank, 96℃, 10000 liters (3 No); Automatic electric filler, 5000 bottles/shift, 8 kw (1 No); Labelling machine, 6000 No/shift, 2 kw (1 No); Capping machine, 5000 No/shift (1 No); Pumps, 1, 6, 1.5 kw (4 No); Pure acid storage tank, 20000 kg (1 No)
(24)	Water disinfection tank, 40 m^3/d (1 No); Air striping tank (1 No); Sand filter, 4 tons (1 No); Water treatment tank (1 No); Activated carbon, 3.5 tons (1 No); Fine filter (1 No); Cartridge filter (1 No); UV sterilization system (1 No); Filling machine, 5 m^3/h (1 No); Capping machine (1 No); Fitted lab (1 unit)
(25)	Wallace machine, 25*100 cm^2, 15 kw (6 No); Pneumatics ventilator, 100 hp (1 No); 4 layers sieves (4 No); Filter jet (1 No); Elevator, 2 kw (6 No); Pneumatics loader and cyclone (16 and 14 No); Knee iron (28 No); Spiral, L= 14 m (1 No); Typhoon with the engine (2 No); Dust cyclone, 200 m^3 (1 No); Cleaning machine, 1.5 kw (4 No); Gravel and sand removal machine (1 No); Humidity machine (2 No); Mixer (2 No)
(26)	Pistachio peeling off machine, 0.5 ton/h (1 No); Sorting machine, 0.5 ton/h (2 No); Small peeling off and cleaning machine, 200 kg/h (2 No); Pistachio core separator machine from rigid shell, 1 kg/h (1 No); Pistachio double glazing machine of steam and roller types 350 kg/h (1 No); Small miller machine, (1 No); String producing machine (1 No); Vacuum conveyor and packaging machine with N_2 injection (1 No); Conveyor, 1 ton/h (1 No); Checking and testing conveyor, 1 ton/h (1 No); Tank containing salt solution, stainless steel 2 m^3 (1 No); Air compressor, 7 atm, 3 m^3/min (1 No); N_2 gas capsules, 40 L (1 No); Fitted lab (1 No)
(27)	Pneumatics cleaning machine (1 No); Brushing and paraffin addition machine (1 No); Elevators, 2 m (1 No); Cyclones (1 No); Silos (1 No); Packaging machine (1 No); Peeling off machine (2 No); Brushing machine of around 1.5*2 m^2 (1 No); Conveyor, W= 4 m (2 No)
(28)	Dryer at 500℃ (1 No); Mill, 30 kg/h (1 No); Packaging machine with capacity of 15-22 packs/min (1 No); Electrical oven (1 No); Table covered by steel (1 No); Packaging table (1 No); Tray (30 No); Plastic box (25 No)
(29)	Small pond (1 unit); Table (2 No); Conveyor (3 No); Secondary washing pond (1 No); Polishing machine (1 No); Tunnel dryer (1 No); Packaging machine (1 No)
(30)	Mixer, 1 ton/h, 5 kw (1 No); Cream machine, 12 kw (1 No); Mill, 1 ton/h, 0.5 kw (1 No); Baking oven, capacity of 60 bread/min, 5 kw (1 No); Cooler, 5 kw (1 No); Cream injector, 0.5 kw (1 No); Cutter, 12 sheets/min, 2 kw (1 No); Refrigerator, 1.5 KW (1 No); Packaging (200 No/min), 1.6 kw (1 No)
(31)	Material cleaning facility (1 No); Separating buds machine (1 No); Mill equipped to 3 grinders (1 No); Sieve (1 No); Extracting and filling machine (1 No); Lab (1 No)
(32)	Dough Making Machine (3 No); Molding machine (1 No); Tunnel oven, L= 27 m (1 No); Cooler (1 No); Packaging boxes, 50-300 g (1 No); Weighing facilities (1 No)
(33)	Hammer mill, 5 hp, 450 kg (1 No); Cleaning machine, 650 kg, 15 hp (1 No); Mixer, 50 kg/h (2 No); Spiral conveyor, steel, L and w= 3 and 1 m (1 No); Cyclone, h and d= 600 mm and 3 m (1 No); Extruder, 450 kg/h (1 No); Drying and cooling machine, 50 kg/h (1 No); Cutting machine, 3 hp (1 No); Vibrator set and filling bag, 3 hp (1 No); Contactor and power panel (1 set); Spare parts for the year (1 set)
(34)	Ventilator, 2200 m^3/h (2 No); Chiller (2 No); Conveyor, L and d= 40 and 1 m (2 No); Stainless steel mixer equipped to gearbox (1 No); Fan, 5 kw (16 No); Channel (1 No); Sprayer, 300 liters (1 No); Humidity measurement device (17 No); Refrigerator (1 No); Refrigerator as a car containing a truck with capacity of 15 m^3 (1 No); Weighbridge, 50 kg (1 No); Pallet for carrying materials (50 No); Fitted lab and repair workshop (1 and 1 unit)
(35)	Milk cooling machine, 1500 kg (2 No); Cream sweepers, 500 kg (2 No); Hot water pasteurization system, 1000 kg (2 No)
(36)	Pasteurization system, 2 tons/h (1 No); Sweeper machine, 2 tons/h (1 No); Single filter (1 No); Plate cooler, 2 tons/h (1 No); Knife (1 No); Frames (1 series); Weighbridge with tank, 500 liters (1 No); Tank of 1000 liters (1 No); Raw milk storage tank, 5000 liters (1 No); Storage tank, 1250 liters (1 No); Material distribution board (2 No); Steel pump (7 No); Cream tank, 300 liters (1 No); CIP Plate (1 No); Plumbing equipment (1 series); Meat grinder and grate (1 No); Packaging devices (2 No); Cutting machine, 200 g (1 No); Cooking pot (3 No)

Table 2: All available facilities of IFMPI [This study] (continue)

Industry	Facilities
(37)	Meat carcass crushing machine (2 No); Double layer storage tank (1 No); Feeder (2 No); Baking pot with its mixer (1 No); Perforator (1 No); Centrifuge machine (1 No); Spiral press (1 No); Hammer mill (1 No); Elevator (2 No); Storage silo, 10 and 3 tons (1 No); Packaging machine (1 No); Oil transmission pump (1 No); Cyclone (1 No); Fitted lab and repair workshop (1 unit)
(38)	Crushing machine (1 No); Cooking machine (1 No); Shaker (1 No); Press (8 No); Centrifuge (1 No); Evaporator (1 No); Drying machine (1 No); Hammer mill (1 No); Cyclone (1 No); Elevator (2 No);
(39)	Double screws plus silos, feeders and weighing with relevant stations / compressor mixers, cutter of drying and fitting machine (1 series)
(40)	Extractor (2 No); Steel tank (2 No); Gear pump, 2 bar (1 No); Tank equipped to filter and heater (1 No); Tank equipped to filter and cooling facilities (1 No); Storage tank and wax tank, steel and with h and d= 100 cm (2 No); Packaging machine (1 No)
(41)	Storage hoppers of salt, stainless steel (2 No); Feeding system from hopper to conveyor, 11 tons/h (2 No); Rubber conveyor, w and L= 60 cm and 32 m, 10 hp (1 No); Mill with 12 hammers, 8 tons/h, 40 kw (2 No); Roller mill, 5 tons/h, 20 kw (2 No); Conveyor, L= 22 and 29 m, 10 hp (1 and 1 No); Salt washing machine, 11 tons, 15 hp (2 No); Brine treatment machine (2 No); Centrifuge, 5 tons/h, 25 hp (2 No); Feeder of salt to dryer, 11 tons/h (1 No); Salt dryer, 11 tons/h, 5 hp (1 No); Three-layers sieve and roller mill, 7 tons/h, 25 kw (2 No); Tank containing mixer for brine, 1 m^3, 5 hp (1 No); Packaging machine, 3 tons/h, 15 hp (5 No); Cyclone , 300 m^3, 12 kw (2 No); Salt solution machine, stainless steel, 5 hp (1 No)
(42)	Carding machine, two stages, 1.5 m (5 No); Coil machine (10 No); Press machine (14 No); Dyeing machine, 150 kw, 4 atm (3 No); Caldron and pond, d= 113 cm (6 No); Washing machine, 50 kg (6 No); Centrifuge, 150 kg (6 No); Dryer machine, 50 kg (2 No); Fitted lab (1 series); Air compressor, 500 L/min (1 No)
(43)	Date packing line consisting of disinfectant, discharged drainage tank equipped with removable drain valve, washing tunnel and related conveyor, sorting, humidifier, drying tunnel, filler along with weighing system and tubular packing machine (1 unit); The juice and date liquor production line: The device for the separation of kernel and date meat, warm water heat exchanger, date palm separation, primary saponification system, mixer, Date retention tank, date straightener, equipped with final purifier (1 unit); Refrigerator of 1000 tons (1 No); Air compressor, 30 m^3 (1 No)
(44)	Polyethylene (PE) tank, 200 liters (1 No); Packaging table (1 No); Balance 500 kg (1 No); Electrical saw,100 kg, 0.5 kw (1 No); Saw table, L and w= 1 and 0.5 m (1 No); Nylon cutting machine (1 No); Refrigerator, 7.5 hp (1 No)
(45)	Sorting line, 4 tons/h (1 No); Crash with the tank and pump, 4 tons/h (1 No); Cylindrical preheater (1 No); Three stages filter (1 No); Spiral conveyor (1 No); Steel formulation tank, 2500 l (2 No); Baking pot with full vacuum system, mixer and condenser (2 No); Storage tank, steel, 1 tons (1 No); Pasteurization machine (1 No); Piston filling machine (1 No); Capping machine, 10 caps/min (1 No); Conveyor, L= 4 m (1 No); Pasteurization tunnel, L= 13 m (1 No); Dryer with fan, L= 3 m (1 No); Labelling machine, 10 cans/min (1 No); Balance (1 No); Boiler, 1000 tons (1 No); Emergency generator, 100 kwh (1 No)
(46)	Silo containing automatic feeder, 2 tons (1 No); Mixer, 2 tons (1 No); Rolling machine (1 No); Boiler, 1 ton (1 No); Proper stuffing (2 No); Fryer, 10 kg/min (2 No); Cooler conveyor, L= 2 m (1 No); Packaging machine, 45 packs/min (1 No)
(47)	Silo in size of 2*2*1.2 m^3 (5 No); Dust separator (1 No); Soap maker tank of h and d=2 and 4 m (2 No); Filter, d and h= 1 and 3 m (1 No); Packing machine, 2000 No/h (1 No); Filter press, 200 tons/h (1 No); Olive washing chamber (1 No); Mill (1 No); Olive oil extraction machine (1 No); Centrifuge separator (2 No); Steel oil storage tanks (3 No); Deodorant machine (1 No); Olive tank (1 No)
(48)	Silo, 10 m^3 (4 No); PE packaging machine, 50 kg (1 No); Conveyor, L= 10 m (3 No); Sieve with gearbox facilities (1 No); Preheater, 250 kg/h (1 No); Cyclone (2 No); Machine with 2-20 cm d of cylinder saws and whiskers (1 No); Cooking tower equipped to gearbox, 4 m^3 (1 No); Spiral press, 230 kg/h (1 No); Oil tank of 1 m^3 (1 No); Sedimentation tank, flat roof, filling floor, inlet filter, 1 m^3 (1 No); Centrifuge oil pump, stainless steel (2 No); Filter press (1 No)
(49)	Oil extraction unit from oil seeds including storage tanks, pressurized presses, heaters, filter presses and packing device (1 No); The oil purification unit includes neutralization, mixing, washing, bleaching, smelling and centrifuging (1 No); Improvement unit for drying, including aeration reactor, storage tanks and filling system (1 No); Fitted lab and workshop (1 unit)
(50)	Galvanized washing chamber (5 No); Conveyor, L= 5 m, 6 kw (2 No); Vegetable chopping machine, 3 stainless steel rollers with a castor blade, each with a capacity of 700 kg/h, 0.32 kw (3 No); Storage tank of chopped vegetables, 5000 liters, fiberglass (2 No); Elevator, 2.2 kw, 2 tons/h (1 No); Dryer, as fixed bed, 63.5 kg/h (1 No); Packaging machine of 100-500 g, 20 packs/min (1 No); Mill, 3.5 kw (1 No); Fitted lab and repair workshop (1 and 1 unit)
(51)	Chambers (19 No); Funnel (3 No); Feeder, 20 kg (9 No); Mill machine (3 No); Baking machine (1 No); Air compressor (1 No); Fermentation chambers (27 No); Press machine (1 No); Soya tank, 2 tons (2 No); Oven (1 No); Derrick (7 No); Naturalization and sedimentation tanks (2 No); Filter (1 No)
(52)	Conveyor (1 No); Washing and sorting machine, 40 tons/h (1 No); Continuous thickening machine, stainless steel, 8 m^3 (1 No); Filter, 200 kg/min (1 No); Homogenization machine, 6 m^3 (1 No); Mixer, stainless steel, 8 m^3 (1 No); Bottles filling machine, 130 No/min (1 No); Water cooler with circulation system (1 No); Labelling machine, 150 No/min (1 No); Packaging machine (1 No); Water tank (1 No); Fitted lab and repair workshop (1 and 1 No)
(53)	Onion chopping machine, 2 kw (1 No); Steel cooking pot, 1000 liters, 5 kw (1 No); Mixer with vacuum pump, 6 kw (1 No); Homogenization machine, 1000 liters, 7.5 kw (1 No); Washing and pasteurization machine, 2.5 kw, 30 No/min, 4 atm (1 and 1 No); Refrigerator, 5 hp (1 No); Boiler, 1 ton (1 No); Fitted lab and repair workshop (1 and 1 unit)
(54)	Cleaning machine (2 No); Washing equipment (1 No); Sieve (1 No); Centrifuge, (2 No); Centrifuge separator (3 No); Suction (2 No); Sorting machine (1 No); Conveyor (10 No); Dryer, with flames (4 No); Packaging machine (1 No)
(55)	Preliminary cleaning line includes raw bunkers, flat belt conveyors, vibration conveyors, Checking conveyors, platforms, box washing, box filling (1 No); Disinfection chambers (1 No); Washing and fixing facilities include bunkers, belt conveyors, washing machines, drying tunnels and bench fixing (1 No); Feeder connected to conveyors (1 No); Packaging, 5-20 g, Conveyor belt, semi-automatic filling machine and weighing belt (1 No); Thermo pack line includes conveyor belt, curing sprayer, weighing and thermoforming filling with air (1 No); Lab and repair workshop (1 and 1 unit)
(56)	Meat grinder, industrial and steel type (1 No); Cutter (1 No); Vacuum filter (1 No); Sausage covering machine (1 No); Cooking and smoking room with insolation (1 No); Ice crusher machine (1 No); Worktables (2 No); Wheel carrying product (12 No); Standard trolley, 2000 liters (5 No); Steel processing chamber (2 No); Mixer (1 No); Compressor (1 No); Boiler (1 No); Water treatment machine (1 No); Guillotine (1 No); Refrigerator (2 No)
(57)	6, 2 and 4 cylinders compressors of NH_3, 9, 34 and 65 KW (1, 1 and 1 No); Condenser, for cooling NH_3 (1 No); Operator (1 No); NH_3 receiver (1 No); Derrick, 3 kw (1 No); Ice frames (1600 No); Ice tank, containing 25 frames, 64 rows, L, w and h= 2048, 663 and 130 cm (1 No); Electromotor, 8 kw (2 No); Connection equipment (1 No); Discharge and filling of ice molds (1 No); Repair workshop (1 No)

W= width, L= Length, d= diameter, h= height.

The costs of employees, EC, land, and landscaping are estimated via equations 10, 11, and 14 [26-28].

A similar study has been conducted to investigate the key factors of economic modeling of food and utilization of organic residue by tabulating the variables, economic indices, and ingredients. The model has been introduced via the layout of 13 equations [26]. Dupuy *et al.* (2005) developed a mathematical and graphical model of sausage production in a French food company with regard to different variables such as proportion, quantity, number, the type of raw materials, and finished products [29]. The model summarized the number of requests for disassembling and assembling operation of bills. To figure out the total productivity factor of 27 Malaysian food industries the statistical analysis along with economic estimation model regarding the capital, labor, productivity aspects, and materials stream from 1971-2000 were used [30].

Table 3: The requirements of IFMPI [This study]

Requirements	Cost
Equipment costs According to Table 2	$1
Materials costs (annually) According to reference [3]	$2
Product costs (annually) According to NC of industries below Figure 2	$3
Facilities costs (annually) Fire extinguishers (Total) Stoves (Total) Cooler (Total) Ventilation system (Total) Office equipment, furniture and, etc. (Total) Lab equipment	$4
Transportation facilities costs (annually) Transportation (vehicles, car and etc.)	$5
Employees' costs Staff salary [according to reference 3]	$6
Energy consumption costs (annually) Required water [according to reference 3] Split AC (Internal wiring, transformers, and emergency power generators in need cases) Required electrical energy [according to reference 3] Required fuel (Stoves) [according to reference 3] Petroleum expenses (Transportation vehicle and cars) [according to reference 3]	$7
land and landscaping costs Required land [according to reference 3] Construction of infrastructure (Buildings) Pavement and asphalt Landscaping	$8

Table 4: The symbol/variables definitions [26-28]

Symbol/variable	Definition
Dp	Daily price of each equipment
IC	Installation costs
M_{in}	Mass flow-rate entered to a specific process
M_{gen}	Mass flow-rate of material generation
M_{des}	Mass rate of material destruction inside the process
M_{out}	Mass rate coming out of the process
Ms	Monthly salary
INc	Interest costs
COc	Commuting costs
DWb	Digging well and its belonging costs
AWC	Annual Water Consumption
RW	Required Water (m^3)
W	Electrical energy demand (kW)
e	Total electrical energy employed in lines
A	Area (m^2)
Fc	Facilities costs
TPc	Transportation Facilities costs
Ec	Energy consumed
LC	Land Costs
LPAC	Landscaping, Pavement, and Asphalt Costs
CCB	Construction Costs of Building
CCF	Costs of Contractor Fee

Another report has also been published with the same objective including 30 food industries of the United States. Economic modeling deployed to find out the economic index of productivity growth [31].

The results offered a benchmarking framework for the growth rate and productivity assessment for future developments. The research encompassed various environmental variables in terms of outlays (such as costs of natural resources, energy, transportation, fertilizer, pesticides, sanitary, and similar services) to classify and rank 10 FMPI via an economic assessment model in Thailand. Therefore, employing different types of variables led to the classification of industries in parallel with the sustainable development [26].

4. Conclusion

EIA as a dominant instrument in project assessment attracted the attention for handling the requirements of projects in the screening step. The project identification steps facilitate the assessment of the impacts in a defined framework and media. The aggregation of input and output streams in IFMPI paved the way towards the classification and techno-economic modeling of industries. The developed economic model procures a way towards estimation of outlays for IFMPI. The high propinquity that was appeared among 5 ranking models proved the precision and accuracy of classification developed for IFMPI. The functionality of models receded the linear expansion in outlined scenarios because of the existing variations among values of main criteria. The present study offered a way to develop various models of a simple collection of materials and energy demands within industries such as DEA, techno-economic model, statistical flow-diagrams, etc. The project management steps were executed via applied instruments for further decision-making levels.

According to the exhibition of various IFMPI based on NC, it can be suggested to develop a certain cluster for all related industries. The NC will sort out different classes due to variations in energy and materials demands. In addition, future studies can take into consideration the recent developments in the technologies applied in IFMPI. By maturation of knowledge towards recent technologies, the economic modeling needs lots of variables and expand essentially and sufficiently. Therefore, further processing models are recommended to reach the sustainability of IFMPI in future studies. Integrating the economic models with recently developed and introduced models of DEA will help us to figure out the performance and efficiency of industries easily. Surging the interests towards DEA based on additive ratio models for industries in certain clusters consisting of miscellaneous materials stream in industrial cycles besides using other MCDM models are recommended for classification purposes.

Authors' Contributions

The author conceived and developed the idea for the article, designed the study, analyzed the data, drafted the manuscript. The author approved the final manuscript.

Conflicts of Interest

The Authors declare that there is no conflict of interest.

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