Int. J. Res. Ind. Eng. Vol. 8, No. 2 (2019) 115–139

International Journal of Research in Industrial Engineering

www.riejournal.com

Evaluation of Iranian Automotive Industries

M. Hassanpour [*]

Department of Environmental Science, UCS, Osmania University, Telangana State.

A B S T R A C T

The automotive industry comprises all sectors of the design, development, and production as well as marketing and selling of vehicles. Iran's automotive industries possess the largest sector after the oil and petroleum sectors in Iran. The preliminary assessments taken by both of Iranian industries organization and environment protection agency were reported to the presence of around 71 various kinds of Iranian Automotive Industries (IAI) and provided the data from initial screening once prior to set up industries and process by present research. Current cluster study is targeted to weight and rank all the IAI empirically via Simple Additive Weighting (SAW) and COmplex PRoportional ASsessment (COPRAS) methods supported with weighing systems of Friedman test and Entropy Shannon, SPSS IBM 20, and Excel 2013 software to process raw data. The SAW method is resulted to classify IAI from the largest industry to the smallest one depends on 5 criteria, such as the number of staff, energy consumed (water, fuel, and power), and the land area used. COPRAS model is assigned to rank IAI pertaining to both negative and positive criteria. Finally, awareness of input materials stream introduced into IAI cycle paves the way towards the development of studies related to industrial ecology and industry 4.0.

Keywords: Evaluation, COPRAS, Iranian automotive industries.

Article history: *Received: 25 March 2019* *Revised: 06 June 2019* *Accepted: 20 June 2019*

1. Introduction

The car manufacturing history gets back to the beginning of 1962 in Iran. Iran's automotive industries are the largest sector after the oil and petroleum sectors in Iran. Iran placed the 20th largest automaker in the world and the Middle East, with 1395421 vehicles and 35,901 commercial vehicles in 2009. In 2009, Iran was ranked fifth in the world's fastest growing car industry after China, Taiwan, Romania, and India. Iranian car manufacturing is available in a variety of different vehicles, including passenger cars, van, trucks, buses, minivans, and pickups. In Iran, about 500,000 staff (approximately 2.3% of the total workforce) directly work in the

* Corresponding author

E-mail address: malek.hassanpour@yahoo.com

DOI: 10.22105/riej.2019.183148.1085

automotive industry and many more in the industries related to this industry. Approximately 75% of the total vehicle manufacturing in the country is related to passenger cars and around 15% belongs to small trucks [1]. There is no certain classification for automotive industries globally. But some classifications collected and embedded this class with machinery, tools, equipment, and metal products industries. Current study includes around 71 active Iranian automotive industries and their belongings, such as a cluster study besetting flasher of automatives, automotive rubber parts, brake pads, car camshaft, car shatton, car coil, car gas condenser, car glass pump, car odometer, car oil filter, car oil sprayer, car sealant, car seat, car tire disc, combined tap of gas fueled vehicles, crankshaft, disc-shape brake pads, dynam fan, full car fly wheel, grease pump of car, insulated foil car sunshade, lock of car, rubbing clutch, safety glass (car bend), seat belt, snow sweeper engine, steering wheel, car water nozzle, water pump, car wire, automatic starter, automatic of signal light, automotive starter, complete exhaust, oil pump, car antenna, mirrors of car, car heater, lightweight cars heater, car wiper, car brake booster, car horn, car pedal, propeller motor (fan radiator), hydraulic brake pump, car pump (auto gas station), crankshaft covering, car bolts and nuts, trans burner torch and fuel sprayer, hand brake, car thermostat, car strap, car light, car hazard light warning, delco capacitor, car dashboard, car fuel grade and gasoline tank, car oil barometer, gear knob of gearbox, signal rod, delco, brass gear of car gearbox, car brake disc, car clutch disc, bike and motorcycles rims, car wheel rims, car wheel chains (non-metallic), car bumper, bike and motorcycle speedometer, sibak, and car alarm system [2].

In Iran, all the industrial projects come through some assessment levels prior to layout on an industrial scale. So, present research collects the raw data of the first screening of IAI assessment that is done by both Iranian industries organization and environment protection agency to process in next levels of evaluation especially decision-making processes. Decision-making processes encompass a variety of methods to assess. Actually, decision-making models are introduced as a channel to either approve or disapprove industrial and engineering projects once before installation. But they are different belongs to kind of projects and their purpose. The current study includes both methods of COPRAS and SAW to conduct this research. In this study, SAW model is used because of the simplicity and high accuracy of the method. In recent years, the COPRAS method has been used as a multi-factor decision-making method for these reasons; the simplicity of the calculation method, total ranking of options, simultaneous utilization of quantitative and qualitative criteria, ability to calculate the positive (maximum) negative criteria (minimum) separately in the evaluation process, estimation of importance degree for each option to indicate the size of the better or worse one option as well as adaptation to local and empirical conditions and realities. This method is used for planning, accounting, financial, geography purposes and so on. COPRAS model has been widely employed by Zavadskas et al. [3] in a variety of studies. This practice is a suitable procedure for value assessment comprising data of maximizing and minimizing variables. Application of COPRAS procedure and its ability to sort out and rank data has appeared in a wide range of researches completed by Zavadskas et al. [3], Vilutiene and Zavadskas [4], Zavadskas et al. [5], Kaklauskas et al. [6], Kaklauskas et al. [7], and Zavadskas and Turskis [8]. COPRAS method needs to assign one weighting system to estimate the first weights of factors such as Entropy Shannon, Friedman test, etc.

In the weighing system by Shannon Entropy, the main idea of this method is based on the basis that the dispersion in the values of an index is more than that, the index is more important. Shannon Entropy method gives the highest weight to the index with the highest degree of deviation. This method also is a multi-index decision-making methodology that is used to calculate the weight of the criteria and widely used as auxiliary approaches. It consists of forming a matrix in which the rows of research choices and its columns form the research criteria. In the following steps, it gives the weight of the criteria. Mostly, the weights that come from the Shannon Entropy method are in many of the cases appeared to be unrealistic. SAW method is one of the simplest elements of the multi-criteria decision-making process. In this method, after scaling the decision matrix, using the criterion weight subtleties, the weighted scalar decision matrix is obtained, and according to this matrix, the score of each option is computed. According to the above-named cases, this method also widely used in lots of studies by the same authors, etc. Thus, the present study targets to weight and rank all the IAI as a cluster study using the SAW and COPRAS methods supported with weighing systems of Friedman test and Entropy Shannon.

2. Literature Review

El Mkhalet et al. [9] selected Entropy method to identify the best supplier in the Moroccan industrial automotive sector pertaining to machine availability, number of occupational damages, efficiency of generation lines, health, and safety. So, the weighing and ranking systems resulted to prioritize the items in the following steps. Danaei [10] classified 13 projects of Kish airport containing 7 criteria using the weighing system of Shannon Entropy. The weighing system distinguished values for each criterion individually and TOPSIS model assigned to rank projects from 1 to 13. Ozturk [11] utilized Shannon Entropy weighing system to unearth the urban sprawl based on 4 criteria such as built-up area (km^2), built-up density (%), built-up area growth rate (%), change in built-up area (km^2) supporting with geographic information system during 24 years since 1989-2013 in the Atakum, Ilkadim and Canik districts of Samsun, and Turkey. Thus, the developed weighing system proved an extensive expansion and alteration for the case study area. Hashemzadeh et al. [12] tried to offer a practice to sort and weight around 16 factors and criteria in the implementation of an individual dies exchange in 14 plastic industries running with the injection method. To run the process, the Shannon Entropy had been used as a weighing system.

Zolfani and Zavadskas [13] employed the COPRAS model to assess about 5 samples of buildings constructed in Iranian villages in order to figure out the sustainability of small society's buildings frameworks. By the way, 13 criteria and 5 options were selected to carry out the research. After weighing the criteria, the ranking system appeared as Iranian traditional systems was used in deserts > light gauge steel frames > insulating concrete frameworks > Tronco systems > 3D

Sandwich panels for main options. Popovic et al. [14] used the COPRAS model to select the best investment projects pertaining to cost estimation. The results came out of ranked and weighted factors and criteria for 4 projects. Medineckiene et al. [15] applied the COPRAS method to evaluate building life-cycle assessment in sustainability and its implication, comprising 2 kinds of living buildings possessing heating network. They tried to expand their study with including a variety of factors and criteria, such as emission of construction operation, outlays, energy consumed and materials streams, etc. Findings came into view as identifying the proper alternative via ranking and weighing parameters. Vujicic et al. [16] employed the COPRAS model to select the best option as an indicator to purchase the fluorescent lamp. Aforementioned research used key factors to rank and weight. So, the COPRAS method paved the way to select the best and worst indicators. Jamali et al. [17] used the COPRAS model to evaluate the 5 automotive manufacturers based on some criteria such as flexibility, productivity, inventory, operating expenses, and responsibility and reshaping in Iran. Finally, 5 automotive industries were ranged from 1 to 5 based on obtained weights. Pamucar et al. [18] offered a new method in the incorporation of both DEMATEL and COPRAS to weight and rank the various criteria and select a temporary military road. By this experience, COPRAS technique was applied for ranking alternatives based on distinguished values. In the study by Zarbakhshnia et al. [19], COPRAS procedure was exploited to prioritize and choose third-party reverse logistics providers in the presence of risk factors in a certain automotive industry in Iran.

The classification of Iranian food industries and Iranian leather and textile industries were done using SAW model completed by a weighing system of Friedman test considering 5 main criteria of the number of employees, energy consumed (water, fuel, and power), and the land space applied to set up industries [20, 21].

3. Methodology

The required steps from project identification to project implementation in studies associated to Environmental Impact Assessment (EIA) encompass the initial screening of project, consider the public involvements and decision-making process, approve the project and finally implementation of the project, and post EIA. Therefore, the present study attempts to move the aforementioned steps from initial screening to the decision-making process (using SAW and COPRAS). Figure 1 displays the diagram of the followed work.

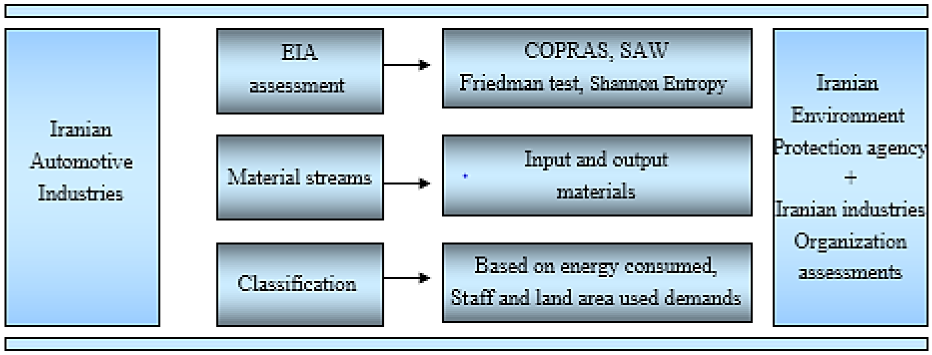

Figure 1. Diagram of the followed work.

3.1. Shannon Entropy

The first step in the process of Entropy is the formation of a decision table. Therefore, the raw data obtained from the assessments of both Iranian industries organization and Iranian environmental protection agency have formed the decision matrix. The normalization of data was done using the arithmetic method based on Eq. (1). The Eqs. (3) and (4) were used to estimate the Entropy value. The distance between each of the indicators was calculated from the Entropy value using Eq. (4). It was used the Eq. (5) to calculate the weight of each indicator by Excel 2013.

$$\mathrm{Pij} = \frac{\mathrm{Xij}}{\sum_{i=1}^{m} Xij} \qquad j = 1, \dots, n \,. \tag{1}$$

$$\mathrm{Ej} = -\mathrm{k} \sum_{i=1}^{m} Pij \times Ln\, Pij \qquad i = 1,2, \dots, m \,. \tag{2}$$

$$\mathrm{k} = \frac{1}{\mathrm{Ln}\, m} \,. \tag{3}$$

$$\mathrm{dj} = 1 - \mathrm{Ej} \,. \tag{4}$$

$$\mathrm{Wj} = \frac{\mathrm{dj}}{\sum dj} \,. \tag{5}$$

3.2. Friedman Test and SAW Method

This test was done by SPSS software (IBM SPSS Statistic 20), in which Eqs. (6-10) were used to calculate the values. The data introduced into software were composed of a matrix containing some columns and rows to process. Normalization of the decision matrix was done according to Eq. (11). In the following SAW, the method was assigned to collect weights using the special vector obtained from the Friedman test.

$$\hat{r}.j = \frac{1}{n}\sum_{i=1}^{n} rij \quad . \tag{6}$$

$$\hat{r} = \frac{1}{nk}\sum_{i=1}^{n}\sum_{j=1}^{k} rij \, . \tag{7}$$

$$SSt = n\sum_{j=1}^{.}(\hat{r}.j - \hat{r})^2 \, . \tag{8}$$

$$SSe = \frac{1}{n(k-1)}\sum_{i=1}^{n}\sum_{j=1}^{k}(rij - \hat{r})^2 \, . \tag{9}$$

$$Q = \frac{SSt}{SSe} . \tag{10}$$

$$Pij = \frac{Xij}{\sum_{i=1}^{n} Xij} \qquad i = \Gamma, m; \;\; j = \Gamma, n \;\; . \tag{11}$$

3.3. COPRAS

COPRAS method was introduced by technical researches, this method was used for multi-criteria evaluation, maximization, and minimization of the criterion values. In fact, this feature was a superior advantage over the method of the SAW. The steps involved in evaluating this approach are as below. Normalization of the decision matrix was accomplished using Eq. (12).

$$Pij = \frac{Xij \, . \, W}{\sum_{i=1}^{n} Xij} \qquad i = \Gamma, m; \;\; j = \Gamma, n \, . \tag{12}$$

The Xij and W are the values and weighted values, respectively. The calculation associated with the sum of the normalized values for positive and negative criteria were done via Eqs. (13) and (14). In order to determine the relative importance of the options, Eq. (15) was applied. The greatest value of relative importance ($Qmax$) of the options was calculated by Eq. (16). By the way, $S - \min$ and Nj are identical with the minimum value of $S - i$ and ranking amount, respectively. In the below equations, $S + j$, min $S - I$, and $S - i$ are the maximizing criterion of jth alternative, the minimum value of the summation of minimizing criteria of the jth alternative, and summation of the minimizing criteria of the jth alternative [6-8].

$$S + j = \sum_{i=1}^{m} +Pij \qquad i = \Gamma, m; \;\; j = \Gamma, n \;\; . \tag{13}$$

$$S - j = \sum_{i=1}^{m} -Pij \qquad i = \Gamma, m; \;\; j = \Gamma, n \;\; . \tag{14}$$

$$\mathrm{Qj} = \mathrm{Sj}+,+\frac{\mathrm{S}-\min\times\ \sum_{I=1}^{n} sj -}{\mathrm{Sj}-,\ \sum_{i=1}^{n}\left(\frac{S-min}{Sj-}\right)} \ = \mathrm{Sj}+,+\frac{\sum_{I=1}^{n} Sj -}{\mathrm{Sj}-,\ \sum_{i=1}^{n}\ (\frac{1}{Sj-})}\ . \qquad (15)$$

$$\mathrm{Nj} = \frac{\mathrm{Qj}}{Qmax} * 100\ . \qquad (16)$$

4. Results and Discussion

The term "technology" in the industry refers to a set of physical objects or technological artifacts, human activities in order to design, construct and implement, and the work done by facilities which are related to production processes. Figure 2 portrays all generation processes and technologies exploited in IAI, extracted from diagrams depicted by evaluator team of Iranian industries organization in the Persian language.

(14) Cutting metal band → Press and cutter mold → Stretching → Hydraulic press → Plating and Cutting edges → Pressing and Stretching disc

(15) Injected parts → Slicing and polishing parts → Lathing parts and montage → Pressing parts → Electrical sensor → Final montage

(16) Heating of shaft thousand thorns → Scraping and drilling the metal → Hydraulic press and grinding → Drilling by quadruple drill → Cutting, bending and welding of pipes → Montage and selling

(17) Cutting metal and configuration → Fat removal and Sand blast → Hot press → Polishing metal by furnace → Adding gum and dyeing → Product

(18) Tensile steel cutting → Hydraulic press 100 ton → Hydraulic press 60 ton → Plating → Packing → Selling

(19) Melting and Scraping steel → Casting and cleaning → Heating and melting → Drilling and hanging → Pressing → Packaging

(20) Ingot scraping → Drilling and hanging → Plating → Assembling → Packaging → Selling products

(21) Initial materials → Cutting, bending and gluing → Assembly or montage → Forming and drying → Sewing, packaging → Selling

(22) Cutting metal sheets → Cutting → Press → Plating → Key maker machine → Montage

(23) Cutting sheets → Press → Bending → Perforation → Montage → Packaging

(24) Edging and polishing → Vertical and horizontal cut → Bending furnace → Washing → Coverage and Autoclave at 200°C → Packaging

(25) Cutting sheets And wires → Rebar press and plating → Melting and Molding machine → montage → Connecting parts → Packaging

(26) Cutting sheets → Press → Plastic injection → Rebar cutting and preparation → Montage → Packaging

(27) Press and formation → Cutting metal materials → Welding and plating → Plastic injection → Montage → Packaging

(28) Copper and brass sheets → Press → Assembling → Adding wires → Packaging → Selling

(29) Aluminum alloy casting → Polishing → Machining operations → Washing shell and crust → Preliminary Montage and press → Perforation and Final montage

(30) PVC, Cu and Silicone wires → Extrusion → Cooling wires → Print → Tension check up → Packaging

(31) Installation of plate on body → Install the winding reel to plate → Press shell to plate → Montage circuit connector; absorber → Installation of Double head screw → Testing and packaging

(32) Cutting sheets of Al, Fe, Cu and tin → Press → Welding → Montage punching → Testing → Packaging

(33) Cutting and Scraping pipe → Perforating pipe; adding phosphate → Twin lever and actuator cap → Scraping and Perforating + rebar → Connecting parts and montage → Packaging

(34) Cutting, bending and rolling sheets → Welding, shaping and pressing → Cutting and Bending pipes → Expanding and Pressing pipe → Electrical welding, Shaping by press → Edging, final Welding and dyeing

(35) Cutting mesh Sheets and shaping → Stretching and Scraping → Using metal ECN-200 and Cutting → Perforating, hanging and adding Al shell → Adding metal, C35 Ag and perforating → Final montage and Packaging

(36)	Molding resin Fiber + Asbestos	Dyeing	PP Plastic Injection + Rebar	Dry leas base + PP+ hanging	Joining and Connecting parts	Products
(37)	Ag spray on glass	Cutting mirror	Polyethylene Injection	Molding at plastic	Using pigment	Montage and packaging
(38)	Cutting various Metal sheets	Pressing and dyeing	Cutting wires and pieces	Press and montage Wires and pieces	Packaging	Selling
(39)	Cutting various Metal sheets	Washing, drying and dyeing	Plastic, rubber and Fiberglass pieces	Press and montage Wires and pieces	Screws, nuts and Other parts	Joining radiator and electromotor
(40)	Poly propylene Poly ester	Cutting sheets and Iron strap	Pressing	Washing and dyeing	Montage	Packaging
(41)	Cutting and initial scrapping	Scrapping floor and walls of cylinder	Perforating and cutting	Perforating, Pressing, rolling	Bending sheets; assembling parts	Packaging
(42)	Cutting plastic materials	Shaping and cutting by press	Perforating, dyeing and shaping	Injection plastic materials	Assembly and test	Packaging
(43)	Cutting metal sheets	Stretching and Cutting around	Perforating and pressing	Molding and shaping	Initial assembly and dyeing	Final assembly
(44)	Poly amid 6 and 6	Injection machine	Molding	Polishing	Checking	Keep at warehouse
(45)	Casting and cutting	Perforating and hanging	Plating and polishing	Cutting rebar	Pressing and assembling	Packaging
(46)	Cutting sheets	Stretching	Perforating and welding	Scraping	Cutting and assembling	Products
(47)	Cutting and shaping sheets	Scraping and soldering	Perforating	Hanging	Welding	Packaging
(48)	Steel wire	Threading and hanging	Polishing and heating	Adding water and detergent	Plating and tension removal	Cooling and Packaging
(49)	Cutting and Pressing sheets	Using wire and insulator	Joining parts and assembly	Winging tests; adding and testing core	Cap replacement Press and seal	Using bitumen, Dyeing, press; print
(50)	Cutting, pressing and bending sheets	Welding parts	Polishing	Fat removing	Dyeing, montage	Packing
(51)	Cutting brass and Metal sheets	Cutting and Stretching brass belt	Re-baking pieces Adding rubber to it	Using rebar, drilling Cap and punching	Heating, punching Making piston	Joining screws and Washers;Packaging
(52)	Cutting fibers and adding rubbers	Weighting and mixing	Rolling, mixing and Shaping; stretching	Baking and cooling	Printing and packaging	Adding latex
(53)	Cutting metal or Plastic sheets	Pressing, washing and fat removal	Adding lacquer and curing	Heating by furnace and adding additives	Final assembling parts	Packaging
(54)	Cutting steel-37 and Metal sheets	Plating	Adding plastic materials	Heating by furnace and adding additives	Plastic injection machine	Assembling and Packaging
(55)	Rolling and cutting Metal sheets	Pressing and Bending Al sheets	Rolling and cutting Plastic sheets	Cutting wires and assembling parts	Joining and Assembling pieces	Packaging
(56)	Cutting and pressing Metal sheets	Shaping	Welding and washing	Dyeing, cutting locks	ABS and foam Plastic injection	Packaging
(57)	Cutting; pressing Metal sheets	Bending	Plastic injection; pressing machine	Welding, pressing and assembling	Connecting parts	Packaging
(58)	Cutting; pressing sheets	Hanging, cutting and polishing	Plastic injection; and twisting wires	Joining parts	Final assembling	Packaging
(59)	Cutting metal rebar	Pressing, polishing and perforating	Bending and plating	Riveting coil and Poly amid injection	Assembling and Joining pin	Packaging

Up to down: Flasher of automatives (1), Automotive rubber parts (2), Brake pads (3), Car camshaft (4), Car shatton (5), Car coil (6), Car gas condenser (7), Car glass pump (8), Car Odometer (9), Car oil filter (10), Car oil sprayer (11), Car sealant (12), Car seat (13), Car tire disc (14), Combined tap of gas fueled vehicles (15), Crankshaft (16), Disc-shape brake pads (17), Dynam fan (18), Full car fly wheel (19), Grease pump of car (20), Insulated foil car sunshade (21), Lock of car (22), Rubbing clutch (23), Safety glass (car bend) (24), Seat belt (25), Snow sweeper engine (26), Steering wheel (27), Car water nozzle (28), Water pump (29), Car wire (30), Automatic starter (31), Automatic of signal light (32), Automotive starter (33), Complete exhaust (34), Oil pump (35), Car antenna (36), Mirrors of car (37), Car heater (38), Lightweight cars heater (39), Car wiper (40), Car brake booster (41), Car horn (42), Car pedal (43), Propeller motor (fan radiator) (44), Hydraulic brake pump (45), Car Pump (Auto Gas Station) (46), Crankshaft covering (47), Car bolts and nuts (48), Trans burner torch and fuel sprayer (49), Hand brake (50), Car thermostat (51), Car strap (52), Car light (53), Car hazard light warning (54), Delco capacitor (55), Car dashboard (56), Car fuel grade and gasoline tank (57), Car oil barometer (58), Gear knob of gearbox (59), Signal rod (60), Delco (61), Brass gear of car gearbox (62), Car brake disc (63), Car clutch disc (64), Bike and motorcycles rims (65), Car wheel rims (66), Car wheel chains (non-metallic) (67), Car bumper (68), Bike and motorcycle speedometer (69), Sibak (70), Car alarm system (71).

Figure 2. IAI and their generation processes.

The Friedman test analysis revealed the mean rank ratios about 2.94, 4, 1.78, 1.27, and 5 for the existing values of employees, power, water, fuel, and land, respectively in Table 1.

Table 1. IAI, their energy consumptions, staff and, land properties based on nominal capacity.

Industry	Nominal capacity (No)	Employees	Power (kw)	Water (m^3)	Fuel (Gj)	Land (m^2)
(1)	100000	24	62	6	3	2100
(2)	400	85	394	23	103	9000
(3)	500	75	262	14	16	4100
(4)	100000	33	155	8	5	5700
(5)	350 tons+100000	122	392	22	21	6900
(6)	100000	28	61	5	3	1800
(7)	70000	99	289	24	8	9900
(8)	100000	28	91	6	4	2600
(9)	100000	15	48	5	2	1200
(10)	300000	28	183	6	4	2600
(11)	100000	28	48	5	4	2300
(12)	1350	83	261	15	8	4700
(13)	21600	68	335	20	35	12600
(14)	320000	20	63	4	3	1900
(15)	24000	25	97	7	8	5200
(16)	100000	36	146	11	6	7900
(17)	300	37	656	13	5	3200
(18)	200000	14	30	3	2	1300
(19)	16200	33	309	7	12	3600
(20)	1200	13	16	3	2	1300
(21)	30000+60000 pair	48	160	10	8	4800
(22)	150000	19	35	4	2	1500
(23)	100000	27	77	6	5	3600
(24)	60000 m^2	36	545	8	6	5200
(25)	50000	20	93	5	8	2100
(26)	100000	37	112	8	5	3200
(27)	20000	42	343	12	14	7200
(28)	1000	26	38	5	3	2000
(29)	100000	40	240	8	5	3000
(30)	1600	59	137	17	5	6000
(31)	100000	36	37	7	5	2500
(32)	200000	30	38	6	2	1600
(33)	20000	23	66	8	4	2300
(34)	50000	48	234	11	5	3700
(35)	20000	37	120	8	6	3500
(36)	100000	35	297	9	8	4200
(37)	1260000	41	139	12	4	4900
(38)	50000	51	219	17	20	5800
(39)	9600	30	79	8	9	5600
(40)	100000	24	81	6	3	1900
(41)	100000	40	124	9	5	5200
(42)	150000	26	152	6	4	2900
(43)	100000	40	193	9	4	3000
(44)	100000	15	71	4	2	1300
(45)	50000	23	58	4	3	2100
(46)	52000	27	78	6	4	2400
(47)	80000	31	151	7	5	3200
(48)	1620	48	391	35	38	12600
(49)	100000	24	45	6	4	2700
(50)	100000	29	100	9	50	2900
(51)	120000	27	76	6	4	2500
(52)	850	82	382	28	185	7600

Industr y	Nominal capacity (No)	Employe es	Power (kw)	Water (m^3)	Fuel (Gj)	Land (m^2)
(53)	250000	40	371	10	23	4900
(54)	100000	44	106	9	4	2300
(55)	200000	19	54	4	3	1700
(56)	120000	80	276	17	19	5800
(57)	100000	30	120	9	5	2500
(58)	100000	28	56	8	4	2000
(59)	100000	18	60	5	4	2200
(60)	100000	29	45	5	3	2000
(61)	100000	31	141	7	4	4100
(62)	769230	20	209	5	5	2600
(63)	100000	28	152	7	5	3300
(64)	50000	33	131	7	4	2500
(65)	200000	54	260	27	9	5900
(66)	200000	46	415	16	13	4500
(67)	40000	95	320	22	7	5000
(68)	40000	27	290	10	5	6700
(69)	20000	24	86	7	2	1600
(70)	350000	71	321	13	120	2700
(71)	40000	15	44	4	2	1500

Then, the extracted special vector was employed to collect the values (via equation 12) in the rows of the normalized matrix obtained via Eq. (11) according to Table 2.

Table 2. Normalized and weighted matrix based on the SAW method.

Industry	Nominal capacity	Employees	Power	Water	Fuel	Land	Weights
(1)	100000	0.02568	0.02021	0.01519	0.00409	0.03794	0.10314
(2)	400	0.09097	0.12848	0.05823	0.14065	0.16263	0.58098
(3)	500	0.08026	0.08543	0.03544	0.02184	0.07408	0.29709
(4)	100000	0.03531	0.05054	0.02025	0.00682	0.10299	0.21594
(5)	350 tons+100000	0.13057	0.12783	0.05570	0.02867	0.12468	0.46746
(6)	100000	0.02996	0.01989	0.01266	0.00409	0.03252	0.09914
(7)	70000	0.10595	0.09424	0.06076	0.01092	0.17889	0.45078
(8)	100000	0.02996	0.02967	0.01519	0.00546	0.04698	0.12727
(9)	100000	0.01605	0.01565	0.01266	0.00273	0.02168	0.06878
(10)	300000	0.02996	0.05967	0.01519	0.00546	0.04698	0.15728
(11)	100000	0.02996	0.01565	0.01266	0.00546	0.04156	0.10530
(12)	1350	0.08883	0.08511	0.03798	0.01092	0.08492	0.30777
(13)	21600	0.07277	0.10924	0.05064	0.04779	0.22768	0.50814
(14)	320000	0.02140	0.02054	0.01012	0.00409	0.03433	0.09050
(15)	24000	0.02675	0.03163	0.01772	0.01092	0.09396	0.18100
(16)	100000	0.03852	0.04761	0.02785	0.00819	0.14275	0.26494
(17)	300	0.03959	0.21392	0.03291	0.00682	0.05782	0.35109
(18)	200000	0.01498	0.00978	0.00759	0.00273	0.02349	0.05858
(19)	16200	0.03531	0.10076	0.01772	0.01638	0.06505	0.23524
(20)	1200	0.01391	0.00521	0.00759	0.00273	0.02349	0.05294
(21)	30000+60000 pair	0.05137	0.05217	0.02532	0.01092	0.08673	0.22653
(22)	150000	0.02033	0.01141	0.01012	0.00273	0.02710	0.07171
(23)	100000	0.02889	0.02511	0.01519	0.00682	0.06505	0.14107
(24)	60000 m^2	0.03852	0.17772	0.02025	0.00819	0.09396	0.33867
(25)	50000	0.02140	0.03032	0.01266	0.01092	0.03794	0.11326
(26)	100000	0.03959	0.03652	0.02025	0.00682	0.05782	0.16103

Industry	Nominal capacity	Employees	Power	Water	Fuel	Land	Weights
(27)	20000	0.04495	0.11185	0.03038	0.01911	0.13010	0.33641
(28)	1000	0.02782	0.01239	0.01266	0.00409	0.03614	0.09311
(29)	100000	0.04281	0.07826	0.02025	0.00682	0.05421	0.20236
(30)	1600	0.06314	0.04467	0.04304	0.00682	0.10842	0.26611
(31)	100000	0.03852	0.01206	0.01772	0.00682	0.04517	0.12032
(32)	200000	0.03210	0.01239	0.01519	0.00273	0.02891	0.09133
(33)	20000	0.02461	0.02152	0.02025	0.00546	0.04156	0.11341
(34)	50000	0.05137	0.07630	0.02785	0.00682	0.06685	0.22922
(35)	20000	0.03959	0.03913	0.02025	0.00819	0.06324	0.17042
(36)	100000	0.03745	0.09685	0.02278	0.01092	0.07589	0.24391
(37)	1260000	0.04388	0.04532	0.03038	0.00546	0.08854	0.21359
(38)	50000	0.05458	0.07141	0.04304	0.02731	0.10480	0.30116
(39)	9600	0.03210	0.02576	0.02025	0.01229	0.10119	0.19160
(40)	100000	0.02568	0.02641	0.01519	0.00409	0.03433	0.10572
(41)	100000	0.04281	0.04043	0.02278	0.00682	0.09396	0.20682
(42)	150000	0.02782	0.04956	0.01519	0.00546	0.05240	0.15045
(43)	100000	0.04281	0.06293	0.02278	0.00546	0.05421	0.18820
(44)	100000	0.01605	0.02315	0.01012	0.00273	0.02349	0.07555
(45)	50000	0.02461	0.01891	0.01012	0.00409	0.03794	0.09570
(46)	52000	0.02889	0.02543	0.01519	0.00546	0.04336	0.11835
(47)	80000	0.03317	0.04924	0.01772	0.00682	0.05782	0.16479
(48)	1620	0.05137	0.12750	0.08862	0.05189	0.22768	0.54707
(49)	100000	0.02568	0.01467	0.01519	0.00546	0.04878	0.10980
(50)	100000	0.03103	0.03261	0.02278	0.06827	0.05240	0.20711
(51)	120000	0.02889	0.02478	0.01519	0.00546	0.04517	0.11951
(52)	850	0.08776	0.12457	0.07089	0.25263	0.13733	0.67319
(53)	250000	0.04281	0.12098	0.02532	0.03140	0.08854	0.30906
(54)	100000	0.04709	0.03456	0.02278	0.00546	0.04156	0.15147
(55)	200000	0.02033	0.01760	0.01012	0.00409	0.03071	0.08288
(56)	120000	0.08562	0.09000	0.04304	0.02594	0.10480	0.34942
(57)	100000	0.03210	0.03913	0.02278	0.00682	0.04517	0.14603
(58)	100000	0.02996	0.01826	0.02025	0.00546	0.03614	0.11008
(59)	100000	0.01926	0.01956	0.01266	0.00546	0.03975	0.09670
(60)	100000	0.03103	0.01467	0.01266	0.00409	0.03614	0.09860
(61)	100000	0.03317	0.04598	0.01772	0.00546	0.07408	0.17643
(62)	769230	0.02140	0.06815	0.01266	0.00682	0.04698	0.15603
(63)	100000	0.02996	0.04956	0.01772	0.00682	0.05963	0.16371
(64)	50000	0.03531	0.04271	0.01772	0.00546	0.04517	0.14639
(65)	200000	0.05779	0.08478	0.06836	0.01229	0.10661	0.32984
(66)	200000	0.04923	0.13533	0.04051	0.01775	0.08131	0.32414
(67)	40000	0.10167	0.10435	0.05570	0.00955	0.09035	0.36164
(68)	40000	0.02889	0.09457	0.02532	0.00682	0.12106	0.27668
(69)	20000	0.02568	0.02804	0.01772	0.00273	0.02891	0.10309
(70)	350000	0.07598	0.10467	0.03291	0.16387	0.04878	0.42624
(71)	40000	0.01605	0.01434	0.01012	0.00273	0.02710	0.07036

The obtained results in Table 2 led to developing a classification for IAI as below: 52>2>48>13>5>7>70>67>17>56>24>27>65>66>53>12>38>3>68>30>16>36>19>34>21>4>37>50>41>29>39>43>15>61>35>47>63>26>10>62>54>42>64>57>23>8>31>51>46>33>25>58>49>40>11>1>69>6>60>59>45>28>32>14>55>44>22>71>9>18>20.

The weights values were calculated via Entropy Shannon procedure in the Excel sheet and it was found the amounts according to Table 3.

Table 3. Weighted values based on Entropy Shannon procedure.

	Employees (-)	Power	Water	Fuel	Land (-)
E	0.967486806	0.935416172	0.957871297	0.773397931	0.96040046
dj=1-Ej	0.032513194	0.064583828	0.042128703	0.226602069	0.03959954
Wj	0.080194875	0.159298159	0.103911846	0.558921539	0.097673581
$\sum dj$			0.405427334		
K			-0.2346		

In industry 4.0, expansion of industries was encouraged in parallel with an expansion in employee's recruitment. In other words, automation in industries is not sufficient with sustainability definitions enacted in Industry 4.0 [22]. So, the more decline in the number of staff, the more decline in outlays will be taken. But automation in industries needs large land area used and rise in outlays, while energy consumptions can be replaced by renewable resources, etc. As a result, both criteria of the number of employees and the land area used were assumed as negative criteria. As we know in this situation, the COPRAS model is posed as a dominant practice to prioritize the positive and negative criteria supported by the weighing system of Entropy Shannon. Eqs. (11) and (12) were used to estimate the normalized and weighted decision matrix. So, results have appeared in Table 4. The ranking system was completed using Eqs. (15) and (16) according to Table 5.

Table 4. The normalized and weighted decision matrix.

Industry	Nominal capacity	Employees (-)	Power	Water	Fuel	Land (-)
(1)	100000	0.02114	0.02429	0.02676	0.05440	0.02236
(2)	400	0.01038	0.02140	0.01422	0.25893	0.01328
(3)	500	0.02176	0.03382	0.02057	0.20448	0.01438
(4)	100000	0.01553	0.03246	0.01907	0.04846	0.03244
(5)	350 tons+100000	0.02295	0.03280	0.02095	0.08132	0.01569
(6)	100000	0.02553	0.02474	0.02308	0.05632	0.01985
(7)	70000	0.02092	0.02717	0.0256	0.03480	0.02530
(8)	100000	0.02051	0.02966	0.02225	0.06033	0.02303
(9)	100000	0.01906	0.02713	0.03217	0.05232	0.01843
(10)	300000	0.01726	0.05019	0.01873	0.05077	0.01938
(11)	100000	0.02416	0.01842	0.02184	0.07105	0.02399
(12)	1350	0.02462	0.03444	0.02252	0.04885	0.01685
(13)	21600	0.01212	0.02657	0.01806	0.12850	0.02717
(14)	320000	0.02070	0.02901	0.02096	0.06393	0.02378
(15)	24000	0.01342	0.02317	0.01903	0.08844	0.03376
(16)	100000	0.01389	0.02506	0.02149	0.04766	0.03685
(17)	300	0.01055	0.08321	0.01876	0.02934	0.01103
(18)	200000	0.02190	0.02088	0.02376	0.06442	0.02459
(19)	16200	0.01318	0.05491	0.01415	0.09869	0.01738
(20)	1200	0.02212	0.01211	0.02585	0.07007	0.02675
(21)	30000+60000 pair	0.01982	0.02939	0.02090	0.06801	0.02396
(22)	150000	0.02408	0.01973	0.02567	0.05218	0.02298

Industry	Nominal capacity	Employees (-)	Power	Water	Fuel	Land (-)
(23)	100000	0.01831	0.02324	0.02061	0.06983	0.02953
(24)	60000 m^2	0.01116	0.07516	0.01255	0.03829	0.01949
(25)	50000	0.01529	0.03164	0.01936	0.12597	0.01942
(26)	100000	0.02121	0.02856	0.02322	0.05901	0.02218
(27)	20000	0.01209	0.04393	0.01749	0.08297	0.02506
(28)	1000	0.02519	0.01637	0.02452	0.05984	0.02343
(29)	100000	0.01891	0.05049	0.019157	0.04868	0.01715
(30)	1600	0.02053	0.02120	0.029953	0.03582	0.02524
(31)	100000	0.02595	0.01186	0.025553	0.07421	0.02179
(32)	200000	0.02872	0.01618	0.029090	0.03942	0.01852
(33)	20000	0.01778	0.02270	0.031327	0.06368	0.02150
(34)	50000	0.01975	0.04283	0.022917	0.04235	0.01840
(35)	20000	0.02010	0.02900	0.022006	0.06710	0.02299
(36)	100000	0.01389	0.05245	0.018090	0.06538	0.02016
(37)	1260000	0.01831	0.02762	0.027147	0.03679	0.02647
(38)	50000	0.01444	0.02759	0.024379	0.11661	0.01986
(39)	9600	0.01493	0.01749	0.020159	0.09221	0.03370
(40)	100000	0.02062	0.03096	0.026109	0.05307	0.01974
(41)	100000	0.01894	0.02612	0.021581	0.04874	0.02977
(42)	150000	0.01680	0.04369	0.019632	0.05321	0.02266
(43)	100000	0.02005	0.04303	0.022841	0.04127	0.01818
(44)	100000	0.01840	0.03876	0.024855	0.05052	0.01929
(45)	50000	0.02267	0.02544	0.019970	0.06089	0.02503
(46)	52000	0.02090	0.02687	0.023526	0.06376	0.02247
(47)	80000	0.01792	0.03883	0.020491	0.05951	0.02237
(48)	1620	0.00755	0.02736	0.027883	0.12309	0.02397
(49)	100000	0.02001	0.01669	0.025339	0.06868	0.02723
(50)	100000	0.00884	0.01356	0.013892	0.31381	0.01069
(51)	120000	0.02079	0.02604	0.023402	0.06343	0.02328
(52)	850	0.00731	0.01516	0.012648	0.33978	0.00819
(53)	250000	0.01150	0.04748	0.014566	0.13622	0.01704
(54)	100000	0.02565	0.02749	0.026566	0.04800	0.01621
(55)	200000	0.02102	0.02658	0.022413	0.06834	0.02274
(56)	120000	0.01992	0.03058	0.021440	0.09743	0.01746
(57)	100000	0.01827	0.03252	0.027762	0.06271	0.01841
(58)	100000	0.02170	0.01930	0.031393	0.06382	0.01874
(59)	100000	0.01705	0.02529	0.023988	0.07802	0.02520
(60)	100000	0.02662	0.01838	0.023246	0.05671	0.02220
(61)	100000	0.01745	0.03531	0.019952	0.04635	0.02790
(62)	769230	0.01263	0.05874	0.015995	0.06503	0.01986
(63)	100000	0.01639	0.03960	0.020758	0.06028	0.02337
(64)	50000	0.02094	0.03699	0.022499	0.05227	0.01919
(65)	200000	0.01429	0.03062	0.036195	0.04905	0.01888
(66)	200000	0.01296	0.05203	0.022832	0.07542	0.01533
(67)	40000	0.02359	0.03534	0.027660	0.03578	0.01501
(68)	40000	0.01019	0.04873	0.019125	0.03888	0.03060
(69)	20000	0.02082	0.03320	0.030759	0.03573	0.01679
(70)	350000	0.00990	0.01991	0.009180	0.34457	0.00455
(71)	40000	0.01962	0.02561	0.026502	0.05387	0.02373

Table 5. Ranking system.

Industry	Nominal capacity	$S-$j	$S+$j	Qj	Nj	% Nj	Rank
1	100000	0.0435	0.1054	0.1394	0.2929	29.2980	54
2	400	0.0236	0.2945	0.3570	0.7501	75.0137	4
3	500	0.0361	0.2588	0.2997	0.6298	62.9824	5
4	100000	0.0479	0.0999	0.1308	0.2748	27.4843	63
5	350 tons+100000	0.0386	0.1350	0.1733	0.3642	36.4219	19
6	100000	0.0453	0.1041	0.1367	0.2873	28.7306	60
7	70000	0.0462	0.0876	0.1196	0.2514	25.1405	69
8	100000	0.0435	0.1122	0.1462	0.3071	30.7189	43
9	100000	0.0374	0.1116	0.1510	0.3173	31.7382	36
10	300000	0.0366	0.1197	0.1600	0.3362	33.6280	25
11	100000	0.0481	0.1113	0.1420	0.2984	29.8413	49
12	1350	0.0414	0.1058	0.1414	0.2972	29.7240	51
13	21600	0.0393	0.1731	0.2107	0.4428	44.2832	11
14	320000	0.0444	0.1139	0.1471	0.3091	30.9180	39
15	24000	0.0471	0.1306	0.1619	0.3403	34.0332	22
16	100000	0.0507	0.0942	0.1233	0.2591	25.9165	68
17	300	0.0215	0.1313	0.1998	0.4198	41.9893	13
18	200000	0.0464	0.1090	0.1408	0.2959	29.5969	52
19	16200	0.0305	0.1677	0.2161	0.4540	45.4099	9
20	1200	0.0488	0.1080	0.1383	0.2905	29.0557	56
21	30000+60000 pair	0.0437	0.1183	0.1520	0.3195	31.9532	33
22	150000	0.0470	0.0975	0.1290	0.2710	27.1053	65
23	100000	0.0478	0.1136	0.1446	0.3037	30.3788	46
24	60000 m^2	0.0306	0.1260	0.1742	0.3661	36.6130	18
25	50000	0.0347	0.1769	0.2195	0.4613	46.1321	8
26	100000	0.0433	0.1107	0.1448	0.3043	30.4386	45
27	20000	0.0371	0.1444	0.1842	0.3870	38.7008	16
28	1000	0.0486	0.1007	0.1311	0.2755	27.5576	62
29	100000	0.0360	0.1183	0.1593	0.3347	33.4753	27
30	1600	0.0457	0.0869	0.1192	0.2506	25.0624	70
31	100000	0.0477	0.1116	0.1426	0.2996	29.9612	48
32	200000	0.0472	0.0847	0.1160	0.2437	24.3719	71
33	20000	0.0392	0.1177	0.1553	0.3263	32.6399	29
34	50000	0.0381	0.1081	0.1468	0.3085	30.8557	40
35	20000	0.0430	0.1181	0.1524	0.3202	32.0264	32
36	100000	0.0340	0.1359	0.1793	0.3768	37.6807	17
37	1260000	0.0447	0.0915	0.1245	0.2617	26.1756	67
38	50000	0.0343	0.1685	0.2117	0.4447	44.4772	10
39	9600	0.0486	0.1298	0.1602	0.3367	33.6727	24
40	100000	0.0403	0.1101	0.1467	0.3084	30.8402	41
41	100000	0.0487	0.0964	0.1268	0.2664	26.6422	66
42	150000	0.0394	0.1165	0.1540	0.3235	32.3599	30
43	100000	0.0382	0.1071	0.1458	0.3063	30.6399	44
44	100000	0.0377	0.1141	0.1533	0.3222	32.2242	31
45	50000	0.0477	0.1063	0.1373	0.2884	28.8470	58
46	52000	0.0433	0.1141	0.1482	0.3114	31.1485	38
47	80000	0.0402	0.1188	0.1555	0.3267	32.6792	28
48	1620	0.0315	0.1783	0.2252	0.4732	47.3256	7
49	100000	0.0472	0.1107	0.1420	0.2983	29.8386	50
50	100000	0.0195	0.3412	0.4170	0.8760	87.6070	3
51	120000	0.0440	0.1128	0.1464	0.3076	30.7645	42
52	850	0.0155	0.3675	0.4629	0.9725	97.2580	2
53	250000	0.0285	0.1982	0.2500	0.5253	52.5379	6

Industry	Nominal capacity	S−j	S+j	Qj	Nj	% Nj	Rank
54	100000	0.0418	0.1020	0.1373	0.2886	28.8656	57
55	200000	0.0437	0.1173	0.1511	0.3175	31.7525	34
56	120000	0.0373	0.1494	0.1890	0.3970	39.7090	14
57	100000	0.0366	0.1229	0.1633	0.3430	34.3090	20
58	100000	0.0404	0.1145	0.1510	0.3174	31.7435	35
59	100000	0.0422	0.1273	0.1623	0.3409	34.0994	21
60	100000	0.0488	0.0983	0.1286	0.2702	27.0236	64
61	100000	0.0453	0.1016	0.1342	0.2820	28.2007	61
62	769230	0.0325	0.1397	0.1852	0.3892	38.927	15
63	100000	0.0397	0.1206	0.1578	0.3316	33.1607	26
64	50000	0.0401	0.1117	0.1486	0.3122	31.2238	37
65	200000	0.0331	0.1158	0.1604	0.3370	33.7081	23
66	200000	0.0283	0.1502	0.2025	0.4255	42.5558	12
67	40000	0.0386	0.0987	0.1371	0.2880	28.8058	59
68	40000	0.0408	0.1067	0.1429	0.3004	30.0408	47
69	20000	0.0376	0.0996	0.1390	0.2920	29.2054	55
70	350000	0.0144	0.3736	0.4759	1.0000	100.0000	1
71	40000	0.0433	0.1059	0.1401	0.2943	29.4348	53

4.1. Statistical Analysis

T-test analysis was run to figure out a significant difference among existing factors of employee, power, water, fuel, and land, so it was manifested a (p-value ≤.000). The study by Hassanpour [23, 24] presented a significant difference among parameters such as feed, initial feed, employees, power, water, fuel, and land area used (p-value ≤ 0.009) for 21 Iranian plastic industries and about (p-value ≤ .000) among factors of employee, power, water, and land except fuel for around 57 Iranian food manufacturing and processing industries. The categories of water and fuel have occurred with equal probabilities via one sample chi-square test around 0.000 so the decision was made to reject the null hypothesis. The distribution of employee, power, and land were obtained to be normal with mean values and standard deviation about 38.69 and 22.30, 172.76 and 135.03, 3897.18, and 2463.27, respectively. The one-sample Kolmogorov-Smirnov test was observed to be around 0.009, 0.030, and 0.051 for employee, power, and land, respectively. Therefore, the null hypothesis was rejected for employee and power values but it was retained for land values. The distribution of employee, power, and land were found the same, so the null hypothesis was rejected according to related samples Friedman's two-way analysis of variance by ranks around 0.000. Pearson correlation sig. (2-tailed) proved that the highest correlation was between data of land and water around 0.82.

4.2. Input Materials Stream

Industrial ecology emerged for the first time in 1989 as a new discipline in the world of science. It focuses on the environment, technology and economy, and the interplay between these three categories. Industrial ecology involves studying the flow of materials and energy in social and economic systems and taking into account the optimization of their use. Therefore, in industrial ecology, efforts are being made to discover and operate a structured and organized way of interacting with the industrial and environmental world. Experts in industrial ecology believe that by improving the state of production from linear mode to a closed cycle system, both the environment and the economy aims can be achieved. The reduction of industrial waste in the source of production is also a change in the production process, which involves process optimization, proper product storage, change in product composition, input materials and change in technology, or separation of waste streams. The best and easiest way to reduce pollutants (creating an industrial ecology system) in each unit is to change process variables, change in feed inputs, use of newer processes and new technologies, and change in equipment [25]. Therefore, the present study tried to pose the way for introducing input materials of automotive industries by Table 6 in the appendix.

5. Conclusions

Considering this fact that the current study is the findings of the evaluation team of Iran's prestigious organizations before the construction of the industries, we mentioned the most important conclusions such as compliance with the international standards for the classification of industries in the country and abroad, establishing synergies with other relevant organizations regarding the provision of industry-specific information needs, providing statistical requirements for reporting, applying precisely the policies adopted by relevant organizations on various industry groups and helping to design tariffs, determining energy consumption in different industries in the country and provinces and comparing it with the use of the same industries at the international levels, creating a database for public use and exploiting it to determine executive strategies to guide industry stakeholders to optimize consumption rates, respond to the needs of the case, creating the necessary data for the input and output stages in terms of energy consumption of industries in the country and provinces, and step by step, determining the optimal consumption pattern of energy and material flow in industries.

6. Acknowledgement

This research was conducted as part of corresponding author PhD research work.

References

[1] Abedini, J., & Péridy, N. (2009). The emergence of Iran in the world car industry: An estimation of its export potential. *World economy*, *32*(5), 790-818.

[2] Database of Iranian industries organization. (2018). Retrieved from http://www.mimt.gov.ir/

[3] Zavadskas, E. K., Kaklauskas, A., & Kvederytė, N. (2001). Multivariant design and multiple criteria analysis of a building life cycle. *Informatica*, *12*(1), 169-188.

[4] Vilutienė, T., & Zavadskas, E. K. (2003). The application of multi-criteria analysis to decision support for the facility management of a residential district. *Journal of civil engineering and management*, *9*(4), 241-252.

[5] Zavadskas, E. K., Kaklauskas, A., Banaitis, A., & Kvederyte, N. (2004). Housing credit access model: The case for Lithuania. *European journal of operational research*, *155*(2), 335-352.

[6] Kaklauskas, A., Zavadskas, E. K., & Raslanas, S. (2005). Multivariant design and multiple criteria analysis of building refurbishments. *Energy and buildings*, *37*(4), 361-372.

[7] Kaklauskas, A., Zavadskas, E. K., Raslanas, S., Ginevicius, R., Komka, A., & Malinauskas, P. (2006). Selection of low-e windows in retrofit of public buildings by applying multiple criteria method COPRAS: a lithuanian case. *Energy and buildings*, *38*(5), 454-462.

[8] Zavadskas, E. K., & Turskis, Z. (2008). A new logarithmic normalization method in games theory. *Informatica*, *19*(2), 303-314.

[9] El Mkhalet, M. O. U. N. A., Aziz, S., & Saidi, R. (2018). The application of Entropy-rov methods to formulate global performance for selecting the automotive suppliers in morocco. *Journal of theoretical and applied information technology*, *96*(16).

[10] Danaei, J. (2017). Prioritization of kish airport projects using multi-criteria decision-making (weighting: shannon Entropy). *Amazonia investiga*, *6*(11).

[11] Ozturk, D. (2017). Assessment of urban sprawl using Shannon's Entropy and fractal analysis: a case study of Atakum, Ilkadim and Canik (Samsun, Turkey). *Journal of environmental engineering and landscape management*, *25*(3), 264-276.

[12] Hashemzadeh, G., Khoshtarkib, M., & Hajizadeh, S. (2014). Identification and weighting factors influencing the establishment of a single minute exchange of dies in plastic injection industry using VIKOR and Shannon Entropy. *Management science letters*, *4*(5), 977-984.

[13] Zolfani, S. H., & Zavadskas, E. K. (2013). Sustainable development of rural areas' building structures based on local climate. *Procedia engineering*, *57*, 1295-1301.

[14] Popović, G., Stanujkić, D., & Stojanović, S. (2012). Investment project selection by applying copras method and imprecise data. *Serbian journal of management*, *7*(2), 257-269.

[15] Medineckienė, M., Turskis, Z., & Zavadskas, E. K. (2011). Life-Cycle analysis of a sustainable building, applying Multi-Criteria Decision Making method. *The 8th international conference environmental engineering* (pp. 957-961). Vilniaus Gedimino technikos universitetas.

[16] Vujičić, M., Blagojević, M., & Papić, M. (2016). Application of COPRAS MCDM method for choosing the best compact fluorescent lamp. *International science conference*, 18-19

[17] Jamali, G., Farrokhnejad, K., & Mohammadi, M. (2015). Decision making on analyzing advanced manufacturing systems dimensions: SWARA and COPRAS G integration (Case study: automotive industry). *Buletin teknologi tanaman*, *12*(2), 266-274.

[18] Pamučar, D., Božanić, D., Lukovac, V., & Komazec, N. (2018). Normalized weighted geometric bonferroni mean operator of interval rough numbers–application in interval rough dematel-copras model. *Facta universitatis, series: mechanical engineering*, *16*(2), 171-191.

[19] Zarbakhshnia, N., Soleimani, H., & Ghaderi, H. (2018). Sustainable third-party reverse logistics provider evaluation and selection using fuzzy SWARA and developed fuzzy COPRAS in the presence of risk criteria. *Applied soft computing*, *65*, 307-319.

[20] Hassanpour, M. (2019). Evaluation of Iranian textile and leather industries. *Journal of applied research on industrial engineering*, *6*(1), 33-51.

[21] Hassanpour, M. (2018). Hierarchical cluster classification of Iranian food manufacturing and processing industries. *Journal of food safety and hygiene*, *4*(1/2), 27-40.

[22] Gabriel, M., & Pessl, E. (2016). Industry 4.0 and sustainability impacts: Critical discussion of sustainability aspects with a special focus on future of work and ecological consequences. *Annals of the faculty of engineering hunedoara*, *14*(2), 131.

[23] Hassanpour, M. (2018). Evaluation of Iranian plastic industries. *Jornal of waste recycling*, *3*(2), 11.

[24] Shailaja, K., & Hassanpour, M. (2018). Iranian food manufacturing and processing industries. *Rheol: open access*, *2*(111).

[25] Giljum, S., Bruckner, M., & Martinez, A. (2015). Material footprint assessment in a global input-output framework. *Journal of industrial ecology*, *19*(5), 792-804.

Appendices

Table 6. Input materials entered into IAI.

Industry	Initial materials
(1)	Poly amid 6,6 (212 kg); Polycarbonate (256 kg); ABS (264 kg); Metal sheets with thickness of 0.6 and 1.2 mm, st-37 (572 and 194 kg); Bone fiber 0.8 mm (667 kg); Cu (133 kg), phosphor and brass (67 kg) sheets of 0.2 mm (total 334 kg); Brass wire of 2 mm (137 kg); Head lamp automatic of 12 volt (100000 No); Lamps of 12 volt and 3 watts (100000 No); Fuse 30 A (100000 No); Fuse framework (PP 100000 No); Ballbearings with d= 4.7 mm (100000 No); Coil with thickness of 0.2 and 3.5 mm C-75 (100000 and 100000 No); Concrete bonding T shape, 4 mm (800000 No).
(2)	NBR-SBR-NR-CR, Poly butadiene butile (230820 kg); Accelator (2780 kg); Stearic acid 95% (5960 kg); ZnO (9t); Anti oxidant BLE 25 (248 kg); Anti anzanan DPPD (3470 kg); Kumarone Resin (4620 kg); Soot and filler (119.3t); DOP oil (23t); Sulfur (4570 kg); Mgo (1550 kg); Talk powder (2t); cardboard (15t); plastic bags of PE (8t).
(3)	Metal powder (27500 kg); Rubber powder (15000 kg); Dolomite (37500 kg); Barite (32500 kg); $CaCO_3$ (60000 Kg); Dyeing oxides (15000 kg); Other additives (5000 kg); Packaging cartons (7500 kg); Phenolic resin (110000 kg); Azbestous (130000 kg); Binder (97500 kg).
(4)	Gray cast iron (100000 No); Covers (25000 No); Cartons (25000 No).
(5)	Cast iron rebar 36 MN5-11/1167 DIN (635t); Brass bushing gig pins (400000 No); Wood box with dimensions of 58*45*83 cm^3 (1000 No); Cardboard with dimensions of 11*8.5*20 cm^3 (100000 No).
(6)	Dynamo sheets with and without lacquer of 0.4 mm (17100 and 90 kg); Al sheets of 1 mm (10667 kg); Cu wires of 0.1 and 0.6 mm (10000 and 12000 kg); Waxy paper containing width and thickness of 0.5 and 65 mm (200 kg); Paper with width and thickness of 0.2 and 65 mm (300 kg); cardboard with d= 16 and 32 mm (13334 mm); Insulation base 50 g (100000 No); Washer NBR (100000 No); Cap (100000 No); Screw 4 mesh (100000 No); Transformator oil (8000 l); Cover of products (5000 No); Carton with dimensions of 38.5*30.5*15.5 cm^3 (5000 No).
(7)	Al-Si pipe with d= 12.5 mm (424 kg); Al pipe with d= 9.5 mm (145 kg); 4 strings extruded AL pipe (122000 kg); AL sheets with thickness of 0.1 mm (30t); AL sheet, 0.1 mm (6150 kg); Metal sheets of steel-37, thickness of 1.5 mm (9400 kg); Potassium salt of fluorine aluminum (1920 kg); N_2 gas (460.6 t); Metal bead SW20 (140000 No); pipe cap (140000 No); Plastic base (140000 No); Horny shape AL pipe (140000 No); Oily dye (1850 kg); Carton with dimensions of 400*800*100 mm^3 (70000 No).
(8)	Rebar with d=14 mm and metal of 9520 (1865 kg); Rebar with d= 17 mm and metal of 45520 (8725075 kg); Rebar with d= 50 mm and metal of 4552 (178052 kg); Rebar with d= 8 mm and metal 9520 (12559030 kg); Rebar with d= 5 mm and metal of 9520 (725 kg); Rebar with thickness of 1 and 2 mm St-12-05 (3770 and 2070 kg); Metal sheet with thickness of 2 mm (31.1t); Metal sheets of St-52 (16t); Metal sheets of St-44-3 with thickness of 2 mm (1900 Kg); Plastic spool (100000 No); Coil containing 4.625 rings, wire with d= 1.6 mm, external d= 36 mm (100000 No); Light PE 25*35 cm^2 (100000 No); Cardboard with thickness of 1 mm (100000 No); Metal belt St-37-2 (18t).
(9)	Poly amid 6,6 (2646 kg); Brass wire with d= 3 mm (367 kg); ABS granule (1087 kg); Cu wire with d= 3 mm (370 kg); Brass rebar with d= 6 mm (500 kg); Brass sheets with thickness of 0.5 and 0.7 mm (34 and 150 kg); C_{75} sheets with thickness of 0.3 mm (15 kg); St-37 wire with internal d= 1.5 mm (200000 No); V shape coil with length of 20 mm and d= 0.2 mm (400000 No); Circular spring DS with d= 0.25 mm (100000); Plastic bags of 8*8 cm^2 (100000 No); Cardboard box with dimensions of 4*7*8 cm^3 (100000 No); Carton with dimensions of 65*65*25 cm^3 (232 No).
(10)	Rubber with d= 9 cm and thickness of 3 mm (300000 No); Rubber ring (300000 No); Dye furnace (15000 No); Gum (3000 No); Sheets with thickness of 0.5 and 1 mm (90 and 45 No); Galvanized sheets with thickness of 2.5 mm (30 No); Soft fiber (15 No); Nail punch (600000 No); Punch (300000 No); Packaging box (300000 No); Carton (13000 No); HClO (2400 No).

(11)	Metal sheets of St-2-03 with thickness of 1 mm (7.8t); Metal sheets of St-37-02 with thickness of 0.2 mm (370 kg); Metal sheets of St-37 with thickness of 1.5 mm (4.6t); Metal sheets of St-37 with thickness of 1 mm (900 kg); Rubber sheets with thickness of 1.5 mm (34 m^2); Ingot SW-17 (6t); Phenol resin (100 kg); Nail punch, AL with d= 1 mm (100000 No); Brass and iron screws (200000 No); Iron or brass terminals (200000 No); Rubber caps (200000 No); Tensile and compression springs (300000 No); Various bolts and nuts (900000 No); Fibers (100000 No); AL base (100000 No); Box with dimensions of 8.5*5*5 cm^3 (100000 No); Carton with dimensions of 43*21*26 cm^3 (100000 No).
(12)	Natural rubber (244500 No); Sulfur (8200 Kg); Soot (131400 kg); Accelerator (4100 Kg); Aromatic oils DAP (116400 kg); Astearic acid (12300 kg); ZnO (2460 kg); Anti oxidant (2870 kg); Anti ozonat (2870 No); Retardant (500 Kg); Coil (8t); Naylon, cardboard and carton for packaging (276700, 276700 and 16470 No); Labels (23000 No).
(13)	Poly ester textile (130000 m^2); Fireproof fabric (3200 m^2); PVC sponge (56000 m^2); Linen (58000 m^2); Rebar with d= 25 mm (166t); Iron metal, 1 and 2 mm (84 and 11 t); Iron pipe St-44 (286t); Chair rails (86400 No); Dye (8.5t); Rears of seats (43200 No); Musaic wire with length of 29 mm, d= 0.9 and width 7 mm (43200 No); Polyurethane foams (172800 No); Coils of floor seats (86400 No); Carpet (10500 m^2); Nylon for packaging (43200 No); Tape (43200 No); Stainless materials (8.5t).
(14)	Metal sheet of St-37-2, 1 and 1.5 mm (179.5 24.1 t); PE bags (4800 No); Sacks of 30 kg (315 No).
(15)	Brass with grade of 70-30 (15000 kg); Metal bar (2000 kg); Plastic materials (1t); Rubber (200 kg); Circular magnet (24000 kg); Coil, 3 mm (240000 No); Oring (144000 No); Diaphragm (24000 Kg); Iron sheets (15000 No); Washer (48000 No); Electronic components (24000 No); Other pieces (24t); Packing supplies (24000 No); Brochure (24000 No).
(16)	Steel pipes of St-52-3, d= 76.5 and external d= 63.5 mm (450 and 65t); Shaft Ck 45-G (100000 No); Steel Ck-Z5 (200000 No); Four-hinged alloy steel (200000 No); Needle ball bowl (800000 No); Seal or rubber NBN (800000 No); Needle ballbearings (24800 No); Four pieces steel of Ck-Z5 (100000 No); Rings (800000 No); Circular rubber pieces, thickness of 4 mm (200000 No); Grease (8.2t); Liquid dye (4.1t).
(17)	Iron sheets of 1*1.1, 5*1, 3*6 m^2 (300000 No); Asbestouse 35.7% and 15.3% (7 and 30 t); AlO, 25% (8t); Barit (16t); Calcite 1.3% (6t); Iron oxide 1.3% (6t); Powder black carbon (6t); Graphite powder of 3.1% (36t); Liquid dye (12t); Folic powder (30.300 kg); Friction powder, 6% (3.03 kg); Packaging box (30300 No); Carton (3030 No).
(18)	Iron sheet, thickness of 1.5 mm (34t); Packaging box (2500 No); Boxes (200000 No).
(19)	Cost iron (220t); Steal (60t); CO_2-141, CO-191 (202.5t and 202.5t); Gas CO_2 (8100 kg); Silicate (3214t).
(20)	Steel ingot SW (36t); Flexible coil (1200 No); Steel shot SP= 2.5 mm (132 kg); Nylon bags of 15*15 cm^2 (1200 No).
(21)	PVC cover (28t); Cu wire with d= 3 mm (5.3t); Metal sheets with thickness of 1 mm, Kc-30 (350 kg); Metal rebar with thickness of 9 mm, Kc-15 (2.7t); PE foam (3t); Mirror with dimensions of 4*10 cm^2 (30000 No); Artificial leather (39t); Fiber with thickness of 3 mm (15000 No); DOP gum (3t); Shoe adhesive (1.5t); Punch, 100 No per package (1500 package); PP connector pieces (60000 No); wooden palette in dimensions of 60*125*155 cm^3 (600 No); Cartons with dimensions of 36*26*37 cm^3 (1500 No).
(22)	Hub of lock (7900 kg); Brass pipe, d=12 mm (300 kg); Steel-37 sheets in 2 mm thickness (1380 kg); Flexible sheet in 1 mm thickness (1815 kg); Tin sheets of 0.2 mm (26 kg); Brass wires, d=2.5 mm (281 kg); Cu wires, d=2mm (57 kg); Metal raw key (2670 kg); Coil DIN 2098 (600000 No); St- 37 DIN 94 (150000 No); Cardboard boxes (75000 No); Three layer carton (1563 No); Plastic bags (75000 No).
(23)	Metal sheets, C75 and St-42 thicknesses of 0.5 and 2 mm (18 and 53.5t); Asbestos linings (200000 No); Metal washer (200000 No); Flexible washer (100000 No); Asbestos paper washer (100000 No); Fender coil (600000 No); Metal busch (10000 No); Metal punch (620000 No); Carton with dimensions of 47*17*24 cm^3 (10000 No).
(24)	Cellulose (60000 m^2); Flat glass, thickness of 2 mm (120000 m^2); Packaging paper (120000 m^2); Wood containing dimensions of 5*5 cm^2 (13606.8 m); Wooden lining with thickness of 0.4 cm (4155.14 m^2).
(25)	St-42 sheets of 2 and 3 mm (30.5 and 7.55t); Stainless steel, thickness of 3 mm (14300 kg); Ingot with size of 50*10*10 cm^3 (11t); Poly amid 6,6 (2700 kg); PP (3300 kg); St-37 rebar, d=8mm (3000 kg); Wire, d=4mm (244 kg); St-42 wire, d=4mm (700 kg); St-42 rebars, d=5,10,12,22 mm (7727 kg); Metal cable, d=5.4 mm (1516 kg); Textile tape with width of 47.5 mm (159000 m); PVC cover, thickness of 15 mm (12500 m); C-75 sheets with thickness of 0.4 and width of 8.7 mm (175000 m); Various coils (150000 No); Metal plates C-75, thickness of 0.4 mm (50000 No); T shape pieces St-42, d= 12mm (50000 No); Screws, L= 40 mm SW16, M10 (150000 No); Car bolts (500000 No); Bolts and nuts of plugs SW10 (50000 No); Various washers, d= 11 mm (150000 No); Plastic bags having sizes of 10*19, 36*60 cm^3 (100000 No); Cardboard boxes in size 10*15*8 cm^3 (50 No); Cartons in dimensions of 31*31*25 and 40*5*80 cm^3 (2778 and 1389 No).

(26)	Steel sheets, thickness of 2 and 3 mm (123 and 2.5t); Galvanized sheets, thickness of 0.5 mm (2.5t); St-42 rebar, thickness of 10 mm (3/4t); Bone fiber, thickness of 1.5 mm (386 m^2); Poly amid 6,6 (2t); Grease (900 kg); Epoxy gum (1t); Coil 15 A, 12 volt (100000 No); Engine cap (100000 No); Magnet (200000 No); Coal for some cases (100000 No); Circular bush st-37 (100000 No); Porous and U shape bushes (100000 No); Plastic gearshift bush ST-42, d=10 mm (200000 No); Moving axis of ST-37, d= 10 mm (100000 No); SW10 Nuts (100000 No); Bolts SW6 small and big (300000 and 200000 No); Bolts of 2.5 mm (300000 No); Bolts and nuts of grade 10 (100000 No); Washer ST-37, thickness 1 and d=10 mm (100000 No).
(27)	Polyurethane foam (12.6t); PVC (379 kg); Plastic poly amid 6 (211 kg); ABS (1411 kg); PS (156 kg); Steel sheets-37, thickness of 1 mm (11 kg); Metal pipes, d=14 mm (25600 m); Metal pipe, internal d= 1.5 cm (613 m); St-37 coil (60000 No); Bolts (20000 No); Plastic bags (4000 No).
(28)	SW16 wires (9 kg); Cu sheet, thickness of 0.5 mm (7500 kg); Brass wires, d= 7 mm (890 kg); Brass sheets, thickness of 0.8 mm (167 kg); SW6 brass hexagonal wires (1166 kg); Resistant tablets (100000 No); Torsion coil, L and d =30 and 4.8 mm (100000 No); Rubber and plastic washers (100000 and 100000 No); Crdboard boxes having dimensions of 20*20*55 mm^3 (100000 No); Three layers cartons of 100*100*220 mm^3 (1000 No).
(29)	Al ingot LM-24 (3.6t); Thermoset resin (4.4t); Cardboard boxes with dimensions of 15*13*10 cm^3 (100000 No); Big cartons in sizes of 330*65*50 cm^3 (2000 No); Nylon bags in size of 20*300 cm^2 (100000 No); Al wheels of pumps (100000 No); Bush (100000 No); Barb (100000 No); Seal (100000 No); Ballbearing (100000 No); Paper washers (100000 No).
(30)	PVC C65 (673.7t); Cu wire (10105.5t); Printing ink (825 kg); PVC Spools (32000 No).
(31)	Iron pipes having internal and external d=80 and 95 mm (33.8t); Iron rebar, d=6 mm (230 kg); AL caps (20000 No); Two-side metal lever (20000 No); Piece of hoof (80000 No); Plastic lever pieces (20000 No); Coal boxes (20000 No); Scuttle (40000 No); Coal (80000 No); Coal coil (40000 No); Automatic start (20000 No); Bolts and nuts of M4 (120000 No); Warhead plates. Thickness of 2 mm (20000 No); Coil (20000 No); Start gear (20000 No); Tall screw Land d= 145 and 2 mm (40000 No); Coil washer (100000 No); Ring barbs (40000 No); Bush on gear (20000 No); Brass bush (40000 No); Cushions having Cu wires (20000 No); Screw of hoof with d and L= 5 and 9 mm (80000 No); Packaging cartons having dimensions of 220*100*160 mm^3 (20000 No); Plastic plasters of 440*240 mm^2 (20000 No); NaOH, 50% (2000 L); Phosphoric acid (2000 L).
(32)	Al sheets, thickness of 1 mm (1075 kg); Bone fibers, thickness of 2 mm (179 m^2); Greasy cardboard (13 kg); Galvanized sheets, thickness of 1 mm (1020 kg); Cu sheet, thickness of 1 mm (21 kg); Cu punch (400000 No); Metal plastes of C75, thickness of 8 mm (57 kg); Chromium element wire (20000 No); Tin plates, thickness of 0.2 mm (33 kg); Boxes having dimensions of 34*34*34 mm^3 (200000 No); Three layers cartons having sizes of 350*275*175 mm^3 (800 No); AL sheets, thickness of 0.5 mm (80 kg).
(33)	Galvanized iron with L and d= 39 and 10.7 mm (103000 No); Body with external d=45.5 mm (104000 No); Pyramid piece d=21 mm (104000 No); Piece below the body, thickness and d=4.1 and 3/4 mm (104000 No); Caps, thickness of 3 mm (104000 No); Brass pipe, internal and external d =21 and 21.8 mm (103000 No); The main body of the warhead (103000 No); Galvanized bolts, 5.5 mm (204000 No); Lacquer wire, d=3.5 and 1 mm (13125 kg); Solder (33 kg); Various washers (1000000 No); Copper blade, thickness of 22 mm (102000 No); Small coils, d= 1 and 1.5 mm (410000 No); Plastic bags, L= 18 mm (103000 No); Cardboard boxes containing sizes of 7.5*7.5*17 cm^3 (103000 No); Carton in sizes of 17*15.5*30.5 cm^3 (12875 No); Other devices such as tape, punch, bolts and nuts etc (103000 No).
(34)	St-37, thickness of 1 mm (173.5t); St-37, thickness of 4 mm (5t); St-32, external d=41 mm (244t); Glass wools having rolls of 1*6 m, thickness 2.5 cm (5450 m^2); Oily dye (12.5t).
(35)	Pipe of 3.8 inch DIN 115 CrV3 (1570 kg); Rebars of DIN 115 CrV3, ECN-200, C35 (680 kg, 9750 and 4740 kg); St-37, thickness of 1 mm (2750 kg); Steel Grating Sheet, wire thickness 0.5 mm (400 m^2); AL LM-20 (60800 No); M6 connecting nut (40800 No); M6 connecting bolts (100000 No); Flexible washer, internal and external d=6 and 10 mm (100000 No); Metal FCPAS-208 (40000 No); Relief valve spring, L= 43 mm (20000 No); Caps of L and d=40 and 2 mm (20000 No); Victoria washer (20000 No); PE plastic, L= 30-40 cm (20000 No); Boxes in sizes of 20*20*40 cm^3 (20000 No).
(36)	Seven copper wires with silver plated strings each of them, 0.6 mm (1570 kg); PP with 2% soot (2820 kg); Hinged interface made of lead (100000 No); Lead plates (100000 No); Poly amid granules, nylon 6 (26 kg); Steel -37 rebars, d=1480 kg (1480 kg); Asbestous fibers, d=0.6 mm (550 kg); Polyster resin (2200 kg); Titan powder (1650 kg); Bolts of SW-8-M4, L=30 mm (100000 No); Two-side bolts M_4, L=18 mm (100000 No); Iron cast washer, thickness of 0.8 mm, internal and external d= 5.5 and 11 mm (100000 No); Cu washer, thickness of 0.4 mm (100000 No); Hexagon Nuts SW 8-M4 (100000 No); Cu washer, thickness of 0.4 mm (100000 No); Resin hardner (100000 No); Dye (200 kg); LDPE boxes of size around 90*50 and 10*5 cm^2 (100000 and 100000 No); Cardboard boxes with dimensions of 90*20*30 cm^3 (100 No); Packaging boxes with dimensions of 25*4*30 cm^3 (100 No).

(37)	Glass (54430 m^2); Ag (95 kg); First grade thinner (23814 l); Dye (4763 kg); Nylon (12852 kg); Small cartons (1272600 No); PE (323870 kg); Lacquer liquid (1905 kg).
(38)	St-37 with thicknesses of 0.8, 1.5 mm (297.7t); C75 sheets, thickness of 1.5 mm (315 kg); St-37 and St-42 wires, d= 6 and 15.6 mm (8368 and 3550 kg); Alkaline materials (3240 kg); Zinc phosphate solution, pH=1.8-2.5 (4500 kg); Dye (5632 kg); Radiator (50000 No); Hose, 1 inch (50000 No); Lumber fastener, 1 and 0.25 inch (100000 No); AL lever stand (100000 No); Flexible wire, d= 23 mm (50000 No); Tap bolt with grade of 4 (100000 No); Punch bolts (250000 No); ABS buttons (100000 No); Channel cap (100000 No); Bolts and nuts of M4, M5 (300000 and 300000 No); Connector of stove levers, T shape, St-42 (50000 No); Wire fastener C75, thickness of 0.6 mm (200000 No); Wire containing cover, L= 40 and 70 cm (100000 No); Congress thorns (100000 No); Engine, 12 V DC (50000 No); Tap washer, d= 30 mm (50000 No); Body and stove washers (50000 No); Hatch cover (2000 No); Washers of engine door made of Polyurethane (100000 No); St-42 wires, d=6 mm (212 kg); AL stove taps (50000 No).
(39)	Electrical engine of fan, 12 V DC (9600 No); ABS and Poly amid pieces (9600 No); Pressed sheets of thicknesses, 0.5, 0.6, 0.7, 1 and 1.2 mm (9600 No); Brass pipes of thickness and d= 1 and 12 mm (9600 No); Cu-brass sheets (9600 No); Other pieces (9600 No).
(40)	Steel sheets, thickness of 0.8 mm (1060 sheets); Strips Fe, thickness of 2 mm, w=7mm (2.5t); PP with filler of carbon black (2320 kg); polyester (2410 kg); Black dye (2500 kg); Connection base of AL (100000 No); Rubber blade of SBR and EPDM (40000 m); Flexible thorn (100000 No); Small and large pins (400000 No); Small punch (100000 No); Helix coil (100000 No); Thorn guarantor (100000 No).
(41)	St-37 rebar, d=8 mm (6.1t); Brass rebar, d=16 mm (4.5t); St-37 sheets, thickness of 1.8 and 1 mm (867 and 14.4t); St-37, external d=9.5 mm (1.6t); Casting pieces (100000 No); Air springs and valves DIN-2098T (100000 No); Filter (100000 No); Rubber gaskets (500000 No); Rubber pipes (100000 No); Slotted screws DIN-24 (500000 No); Rubber air diaphragm (100000 No); Plastic diaphragm base DIN-7728T (100000 No); Bolts (300000 No); Filter caps DIN-963 (100000 No); Air caps (100000 No); Gaskets (100000 No); Cast iron hydraulic piston DIN 7210 (100000 No); Rubber pan pieces (100000 No); Cast iron holder pins DIN 1621 (100000 No); Rubber gaskets (100000 No); plastic bearings (100000 No); Cast iron pin DIN 1621 (100000 No); Rubber diaphragm (100000 No); Piston (100000 No); Flexible coil (100000 No); Bolts DIN-931 (300000 No); Cast iron connector DIN-17111 (100000 No); Bolts and nuts (100000 No).
(42)	ABS (10t); Urea (36t); Bone fiber, thickness 1 of mm (6.5t); Brass strip, thickness of 0.5 mm (3.3t); Cast iron sheet, thickness of 2 mm (82.5t).
(43)	St-12 sheets of thickness of 1.5 mm (60t); St-380 sheets of thickness 7 mm (225t); Pipe, thickness of 1 mm, external d=16mm (8000 kg); St-3730, external d=22 mm (13t); St-380, thickness of 1mm (3580 kg); Bolts and nuts, mesh of 15, L=130 mm (100000 No); Gaskets (200000 No); Bolts of M 21*6 and 8*22 mm^2 (600000 and 400000 No); Dye (3400 kg); Phosphate and alkaline materials (800 kg).
(44)	Poly amid 6,6 (27t); Packaging carton in sizes of 38*38*75 cm^3 (5000 No).
(45)	Cylinder body (50000 No); Cast iron rebar, d= 18 mm (6t); St-37 rebar, d= 12.5 mm (3t); St-37 metal sheets, 2.5 mm (850 kg); LDPE caps (50000 No); Oil chamber made of LDPE (50000 No); External cap (50000 No); Control valve, 1.15 atm (50000 No); Flexible coils (50000 No); Base of coil made of LDPE (50000 No); NBR rubber (50000 No); St-37 gaskets, thickness of 1 mm (100000 No); St-37 gasket distance, thickness of 3.5 mm (50000 No); Ring thorns, d= 20 mm (50000 No); U shape rubber duster (50000 No); PE cover made of LDPE (100 kg); Cardboard boxes in dimensions of 7*14*16 cm^3 (50000 No); Cardboard cartons, sizes of 32.5*28.5*28.6 cm^3 (3225 No).
(46)	Iron sheets, thickness of 2 mm (200 kg); Galvanized sheets, thickness of 1, 4 and 0.6 mm (14.5, 4.4 and 1.8t); Steel gasket, thickness of 1.25 mm (52000 No); Cast iron wires, d= 12 mm (52000 No); Cast iron wires of d= 7 and 9 mm (470 and 1287 kg); Cast iron rebar, d= 22 mm (3700 kg); Main body made from Al alloy (52000 No); Galvanized pipes (104000 No); Plastic pieces and pipes (52000 and 52000 No); Plastic plates (52000 No); Optical frame (52000 No); Rubber rings (52000 No); Steel wire coils (52000 No); Cast iron bolts (52000 No); Plastic gaskets (52000 No); Sealant gaskets (104000 No); Diaphragm coil (52000 No); Coil valve (104000 No); Rubber diaphragm (52000 No); Cardboard boxes of about 10*20*10 cm^3 (52000 No); Cartons of around 50*40*40 cm^3 (1300 No).
(47)	St-44-3D in sizes of 1.5*1000*2000 mm^3 (49t); Cast iron wire, CK-60, d= 55 mm (3t); Cu alloy containing Silicon 1.5%, Mn 25%, Cu 98.25% (0.9t); Plastic bags of about 20*30 cm^2 (80000 No); Carton in dimensions of 300*300*600 and 275*275*350 mm^3 (2000 No).
(48)	Steel rebar (1700t); Sacks of around 40*10*30 cm^3 (54000 No); Oil (13.5t); Fat removal materials (580 kg); H_2SO_4, 98% 540 kg); Zinc phosphate salt (5800 kg); Cyanide alkaline solution (2100 kg); Pure Zn (24300 kg); Organic compound (6800 L); Chromate Salt (260 kg); H_2SO_4 (325 L).

(49)	Core lamina (137.7t); Steel sheets, thickness of 1 mm (27.058t); Lacquer wire (20.15t); PE spool (212000 No); Split cable (3*1.5)(37000 m).
(50)	St-42 and St-37 sheets of around 5 and 1.25 mm thickness (58.3t and 69.3t); St-37 wires, d= 4 mm (3.2t); Coils, d= 11 mm,1.5 kg (10000 No); HDPE buttons (100000 No); PE caps (100000 No); Gaskets, thickness of 0.5-2 mm (500000 No); Steel rivet, d= 6 mm (200000 No); Dye (2.2t); Packaging cartons of about 15*15*45 cm^3 (10000 No); LDPE, 15*45 cm^2 (100000 No).
(51)	Brass sheets, DIN Cuzn 30, thickness of 1 and 2 mm (9780 and 4330 kg); Rebar DIN; Cuzn 30, thickness of 16 mm (2890 kg); St-37, thickness of 1 mm (770 kg); Expandable materials (300 kg); Thermostat coil, d= 22 mm, L= 40 mm (120000 No); EPDM rubber (120000 No); Piston capsule, L= 28 mm, d= 3mm (120000 No); Balancing valve, L= 5 mm, d= 3 mm (120000 No); Gaskets of balancing valve (120000 No); Adjusting screw, d= 5 mm (120000 No); Packaging boxes, sizes of 6*6*6 cm^3 (120000 No); Packaging carton in dimensions of 36*24*24 cm^3 (1255 No).
(52)	SBR (229t); Natural rubber (229t); ZnO (18.3t); Stearic acid (9.2t); Sulfur powder (10.3t); MBT accelator (5.7t); N 330 soot (137.3t); Anti oxidant (4.5t); Natural rubber (50t); Polyester yarn (58.7t); Cotton fiber (118.7t); Ink (1t); Paper with sizes of 5*12 cm^2 (3 million tons); Three layers carton (17000 No).
(53)	Waxy sheets of about 2000*1000*0.8 mm^3 (407t); Light bulb, 770 g (275000 No); AL wire, d= 5 mm (300 kg); Epoxy base resin (840 kg); NaOH (400 kg); H_2SO_4, 5% (110 kg); Silicon gum (12.5t); Electrical fat removal, 120 g/L (270 kg); Bolts and nuts (1250 No); Packaging materials (250000 No).
(54)	ABC granules (16t); PVC granules (9.5t); Pigment (300 kg); Red and Orange Polymethyl Methacrylate Pigments (600 kg); Polymethyl Methacrylate (31.5t); St-37 sheets, thickness of 0.8 mm (9t); Brass sheets, thickness of 0.5 mm (2t); Silver dye with Al mesh (315 kg); Bubbly films of around 155*400 mm^2 (100000 No); Three layers boxes of about 155*40*95 cm^3 (100000 No); Cartons with sizes of 390*40*320 cm^3 (100000 No).
(55)	St-13, thickness of 0.25 and 1 mm (1296 and 800 kg); Cellophane, thickness of 0.02 mm as roll (245 kg); Insulation, thickness of 2 mm (534 kg); AL sheets, thickness of 0.1 mm (1380 kg); Circular connection fastener (200000 No); Wire, grade of 1.5 (1600 kg); Cardboard insulator, d=15 mm (3674 m); Cardboard boxes, in dimensions of 2*2*4 cm^3 (200000 No); Large cardboard boxes of about 12*12*18 cm^3 (2000 No).
(56)	St-37 sheets of thickness 0.8 and 1.2 mm (840 and 135t); ABS Granules (154t); PE or ABS foam (124 m^3); Dye (25t); Lock (124000 No); Jack (124t); Bolts (240t); Linen (123t); Cartons (123t).
(57)	St-37, thickness of 1.5 mm (5300 kg); St-37, thickness of 1 mm (3524 kg); Steel pipes of internal and external d= .5 and 8 mm (307 kg); Pipes with internal and external d= 4.5 and 6.5 mm (2858 kg); St-13, thickness of 0.8 mm (3612 kg); Brass sheets of thickness around 0.8 mm (404 kg); Brass sheets of thickness, 0.5 mm (176 kg); Brass sheets, thickness of 0.25 mm (91 kg); St-37, d=2 mm (460 kg); PP (1847 kg); Bakalite plastic (409 kg); NBR plastic (358 kg); SW15 bolts (100000 No); Punch, height of 4 mm and d=2.5 mm (200000 No); Pins (100000 No); Floating arm axis (100000 No); Circular coil (100000 No); Paper gaskets (100000 No); Chromium wires (100 kg); Poly amid networks (50 kg).
(58)	Poly amid granules (1350 kg); Brass sheets, mesh of 60, thickness of 1 and 0.5 mm (1900 and 480 kg); Tin sheets with white cover, thickness of 1 mm (72 kg); Brass wire, d=3 mm (54 kg); AL wire, d= 4 and 3 mm (40 and 40 kg); Steel rebar, thickness of 1.2 mm (105 kg); Brass sheets, thickness of 0.2 and 0.5 mm (25 and 96 kg); St-50, thickness of 0.4 mm (45 kg); Tin (500 kg); Brass wire, d= 4 mm (34 kg); Connection pin (200000 No); PVC (100000 No); Lacquer wire, 0.1 mm (1000 kg); Lacquer (204 kg); Boxes with sizes of 55*55*60 cm^3 (100000 No); Carton with sizes of 55*300*275 cm^3 (667000 No); Nylon, 55*60 mm^2 (100000 No).
(59)	St-42, d=15 mm (41.6t); Poly amid 6,6 (2250 kg); Connection pin, d=6 and L= 40 mm (100000 No); Spherical ball, d= 4 mm (100000 No); Push coils, d= 4 mm (100000 No); LDPE 40*10 cm^2 (100000 No); Three layer cartons of around 60*40*40 cm^3 (1000 No).
(60)	St-37 pipes, internal and external d= 4 and 5 mm (760 kg); St-37 Galvanized sheets, thickness of 1.5 mm (1460 kg); Cu sheets of thickness 0.5 mm (677 kg); Steel sheets, thickness of 0.4 mm (650 kg); Brass rebar, d= 6 mm (1745 kg); Brass rebar, d= 6 mm (320 kg); ABS plastic (890 kg); Plastic poly amid 6 (2t); Wires of grade 1.5 and 1 (480000 and 272000 m); Circular coils, d= 8 mm, L=30 mm (100000 No); Circular coil, d= 6 mm, L= 15 mm (10000 No); Terminal made from poly amid 6,6 and 6,3 (100000 and 100000); Circular brass platinum (200000 No); Connection base (200000 No); Steel connection, d= 1 mm (100000 No); Base deployment, 50 g (100000 No); Punch, L=10, d= 2.5 mm (700000 No); Brass pin, d=20, L=17 mm (100000 No); Bolts, d= 3, L=12 mm (200000 No); Wirehead (1700000 No); PVC covers of lever, internal d=5 and L= 85 mm (100000 No); PVC covers of internal d=14.5 mm, L= 550 mm (100000 No); PVC covers of pipes, internal d=3 and L= 14 mm (100000 No); Brass wireheads (100000 No); Nylon bags (100000 No); Cardboard boxes of about 70*70*255 mm^3; Covers of wireheads (20000 No); Three layer cartons of about 36*36*52 cm^3 (2000 No).

(61)	St-42 rebar, thickness of 18 and 14 mm (11 and 18.5t); St-37, thickness of 2.5 mm (11t); Galvanized sheets of thicknesses about 1.5, 2 and 0.8 mm (7.1, 7.7 and 0.3t); Caps of delco (100000 No); Power hammer (100000 No); Pelatinum (100000 No); Delco capacitor (100000 No); Vacuum apparatus (100000 No); Delco frame (100000 No); Counterweight and its holder (200000 and 200000 No); Coils (200000 No); Delco bars joiner (100000 No); Steel pin (100000 No); Cu gasket (100000 No); Plastic gasket (100000 No); Rubber oring (100000 No); Delco cap fastener (200000 No); Pin fastener (200000 No); Various bolts (500000 No); Bushes (300000 No); Orifice fastener (100000 No); St-42 bases of coils (400000 No); Platinum base (100000 No); Packaging covers (100000 No); Cartons for packaging purposes (10000 No).
(62)	Brass powder (46.92t); Graphite powder (1.53t); Lead powder (2.55t); Stearic acid (0.51t); Propane (27.4t); N_2 (4.4t); Packaging boxes with dimensions of 5*7.5*7.5 cm^3 (19230 No); Packaging cartons of about 30*30*25 cm^2 (2400 No).
(63)	Cast iron ingot (347t); Casting sand (330t); Coal powder (11.5t); Bentonite, mesh below 200 (22.5t); PE bags of 25*25 cm^2 (100000 No); Cardboard boxes, in sizes of 250*250*30 mm^3 (100000); Cartons in dimensions of 27*27*32 cm^3 (10000 No).
(64)	St-50 and CK-50 sheets of thickness 2.5 and 2 mm (110.3 and 30t); St-42 wires of d= 18 and 4 mm (18.5 and 4.8t); St-50 sheets of thickness about 1.5 and 1 mm (2.5 and 1t); Clutch disc as casting, weight of 2.66 kg and external d=218 mm (50000 No); Steel pieces containing weight of 190 g and internal d=35 mm (50000 No); Woody boxes in dimensions of 275*280*290 mm^3 (12500 No); Punches of 6 mm (300000 No).
(65)	Steel sheets, thickness of 1.5 and 2 mm (174 and 750 t); Galvanized wire, thickness of 2 and 3 mm (30.2 and 35 t); Fat removal materials (4850 kg); H_2SO_4 (1600 kg); Sodium cyanide (165 kg); Cyanide copper (300 kg); $CuSO_4$ (1450 kg); Plating materials (5020 kg); Cu plates (1650 kg); Ni sheets (2300 kg); Polishing materials (1250 kg); Hub (200000 No); Special bolts for motorcycle and bike winding (3600 and 4000 No); Cartons in dimensions of around 65*65*10 and 49*49*18 cm^3 (50000 and 50000 No).
(66)	Steel DIN 1.7 220, thickness of 3.75 and 2.25 mm (1134 and 185.5t); Electrostatic dye (13045 kg); Phosphate materials (4t); Sodium triphosphate (1t).
(67)	Natural rubber with tensile strength of 220 PSI (38t); Styrene butadine N (5.76t); Zno (1.43t); Sulfur (1.254t); Baking accelerators (0.46t); Baking activator (1.678t); Soot N330 (2.88t); Aromatic oil (0.67t); Anti oxidation (0.44t); Anti O_3 (0.44t); St-37 bars, d= 5, 4 and 3 mm (0.75, 6.62 and 9.77t); St-37 in dimensions of 2*4 mm^2 (7.33t); St-37 straps of around 1*1 mm^2 (6.74t); Hose, d= 8 mm (3.27t); Iranian viscozer yarn (2.11t); Plastic bags, 28*45 cm^2 (40t); Metal boxes of around 39*34*19 cm^3 (20t).
(68)	Plastics, PP 80% and EPDM 20% (211t); St-42, thickness of 1 mm and 12*10 cm^2 (40000 No); Front and rear bumper shaft, W= 12 mm, L= 160 cm (40000 No); St-42 Snapper, thickness of 1 mm (80000 No); Steel wire, d= 5 mm and L= 21 cm (40000 No); Plastic bags of around 140*35 cm^2 (40000 No); Cardboard cartons in dimensions of 140*35 cm^2 and h=85 and 45 cm (40000 No).
(69)	Dry lead of 45 g (11250 kg); St-37 sheets of 1.5 and 0.6 mm (600 and 210 kg); AL sheets of 1 mm (1t); Galvanized sheets of 0.8 mm (4000 kg); Brass wires of 40 mm (500 kg); Silver steel, 1.5 mm (167 kg); Copper sheet, bronze phosphor, 0.1 mm (42 kg); Brass rebar, 5 and 6 mm (200 kg and 250000 No); Axis of the actuator made of silver steel (200000 No); Magnet, thickness of 0.2 mm (200000 No); Al punch (200000 No); Odometer (200000 No); Plastic bags in dimensions of 8*10 cm^2 (200000 No); Cardboard boxes of 7*8*6 cm^2 (200000 No); Three layers cartons of 42*44*32 cm^3 (1334 No); AL plates of odometer (200000 No).
(70)	Steel wires, d= 22, 16, 30, 28 and 40 mm (11.2, 25, 23.4, 102 and 65t) respectively; Steel sheets, thickness of 2 and 3 mm (3.2 and 2.9t); Polyurethane gaskets of internal and external d=44 mm (300000 No); Polyurethane gaskets of internal and external d=14 and 17 mm (300000 No); Steel sheets of thickness about 1 mm (250 kg); Plastic thermoplastic dampers, 4.5 g (300000 No); Upper and lower chassis interface made of nylon 11 and sulfur molibdone (100000 No); Bolts and nuts of sibak (50000 No); Thorn BS19701070A78 (50000 No); Upper and lower sibaks interface made of nylon 11 and sulfur molibdone (600000 No); Steel bolts (350000 No); Packaging cartons of about 110*70*66 mm^3 (350000 No); Woody boxes in dimensions of 450*90*175 mm^3 (7292 No).
(71)	Relay 12 V (40000 No); Transistor B236 (40000 No); Alarm (40000 No); Micro switch (160000 No); Switch on and off keys (40000 No); PE boxes (40000 No); Fiber (295 m^2); Split wires of grade 1.5 (615 m); Other electronic pieces (40000 No); Packaging boxes of around 2*10*5 cm^3 (40000 No); Oily and thinner dyes (445 and 88 kg); Acid perchlorophen (600 kg); Reprinted silk (100 No); Thinner (200 kg); PE doors of boxes (40000 No); Tin (680 kg).

d= diameter, St= Steel, PVC= Polyvinylchloride, ABS=Acrylonitrile butadiene Styrene, PS= Polystyrene, LDPE= Low density polyethylene, PE= Polyethylene,
PP= Polypropylene, HDPE= High density polyethylene, W= width, L= Length.