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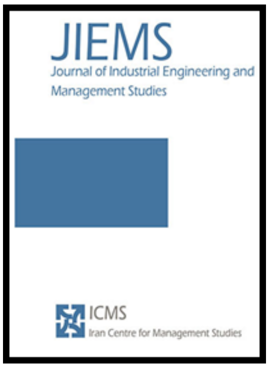

Evaluation of Iranian electronic products manufacturing industries using an unsupervised model, ARAS, SAW and DEA models

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Abstract

Iranian electronic products supplier industries are developing day by day and modern techniques and facilities are assigning as well as many promotions about green products supply chain as input materials introduced into the generation cycle of industries. Current cluster study of Iranian Electronic Products Manufacturing Industries (IEPMI) comprised a technical and hierarchical evaluation carried out as the objective of current research. It was used SPSS and Excel Software to classify and analysis about 33 IEPMI via an unsupervised model, Additive Ratio Assessment (ARAS), Simple Additive Weighting (SAW) and Data Envelopment Analysis (DEA) models. Finally, a hierarchical cluster classification has developed for the 33 industries pertaining to 5 main criteria as well as the total inventory of input, output materials and facilities employed. It was found that the ranking systems based on ARAS and SAW presented the same results for IEPMI. DEA model was also classified IEPMI in terms of efficiency score.

Keywords: Electronic equipment; Hierarchical cluster; Industries; SAW; ARAS.

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1. Introduction

The power sector is one of the prominent pillars of growth of the country. Actually, these days we cannot imagine the world without power energy. Both private and government companies are dealing with the power supply and its equipment supply sectors. To ascertain this purpose variety of industries implemented in Iran. According to the database of Iranian industries organization, lots of industries are active with electronic products manufacturing which classified into 33 types of industries as a cluster. Every year, the demand for electric equipment goes on increasing and the required materials are expanding and becoming more complex (Tash and Nasrabadi 2013).

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Green manufacturing is defined as generation practices which utilize inputs with slightly low environmental impacts, which are highly efficient, and produce little or no waste containing lower raw material outlays, generation efficiency acquires, reduced environmental and occupational safety expenses, and promoting a corporate image. Green distribution besets green packaging and green logistics. Packaging characteristics such as size, shape, scheme, and materials have an impact on distribution because of their effects on the transport characteristics of the product. Better packaging, along with rearranged loading patterns, can reduce materials usage, rise space utilization in the accommodation operations and in the trailer, and reduce the amount of handling required. Green procurement is an environmental purchasing program consisting of some involvements in activities that comprise the reduction, reuse and recycling of materials in the process of purchasing. Besides green procurements are a solution for environmentally concerned and economically conservative business and the concept of acquiring a selection of products and services that minimizes environmental impact (Sheats 2014; Jonidi et al., 2013; Hu 2010).

To understand the environmental impact of industrial projects we need to traverse the required steps of preliminary studies, initial screening, data collection for energy consumption, output and input materials flow and location selection possessing the eligible licenses for water supply program of industries, etc. Therefore the raw data can be the best channel to pass through the decision making systems and project assessment aims. The evaluator teams are composed of a variety of experts to conduct the project to the outsourcing steps. But in Iran, our experts tried to release the raw data regardless of decision-making practices. So, the present study encompassed all the data processing stages for industries in order to weight and rank them in a certain cluster in parallel with sustainable development purposes. However, we clearly know that one of the important points of sustainable development studies of industries is related to environmental impact assessment, so the internal ventilation equipped to electrical plasma reactors is a cost-effective method to pollution removal to zero levels. Also assigning plasma reactors (hot reactors) are the best method to remove all liquid and solid pollutants in this regard. Therefore, the classification of industries using decision-making models provides the next levels of project assessment and its maturation to reach the sustainability media. The classification based on both efficiency score and main criteria claims lots of statistical, mathematical and empirical procedures supported and followed by relations and tests (Jonidi et al., 2013).

The Friedman test is one of the statistical tests used to compare several groups in terms of the average rankings of the groups, indicates whether these groups can be of a community or not? The scale in this test must be at least a rating. This test is a non-parametric test of the F test and is usually used in rating scales rather than F and replaces them. In the F test, there should be the homogeneity of variances that are less stringent in rating scales. The Friedman test is used for two-way analysis of variance (for non-parametric data) by the ranking method and also used to compare the average rankings of different groups. Each sample assigns a score to several groups (object or person or etc). In both of these tests, the variables are taken by the samples, but the difference is that they are repeated in a sample of variances in the analysis of variances, but in the Friedman test, the values are given by a sample. In the Friedman test, the assumption of H0 is based on the homogeneity of the average rank among the groups. The rejection of the zero assumption means that at least two groups are significant in the groups (Eisinga et al., 2017). Clustering methods are different with decision trees which assign a class to an instance (supervised method), clustering practice is an unsupervised method. Many different ways developed to compose clusters such as (1) Exclusive; any instance belongs to only one group. (2) Probabilistic or fuzzy; an instance belongs to each group to an especial probability or level. (3) Hierarchical; it is a raw division of instances allocated into groups in which arranged top to down levels up to individual ingredients (Fan et al., 2011). Many types of researches performed in this case can be mentioned to Lai et al (2009), Okazaki (2006), Wallace et al (2004). This study aimed at technical and hierarchical evaluation of IEPMI. The main objectives of this research included two important ways. In the first place, results yield a favourable diagram depiction of industries and input materials introduced into industries cycles, output products, and energy consumptions values. Secondly, the results of this study provided insight to select a proper classification pattern for industries in hierarchical and ranking structure and system of industries via ARAS, SAW, DEA and unsupervised models individually.

2. Literature review

Saini (2018) evaluated the Indian power sector so it resulted that this sector needs more development to pave the way for further boosting the economic development of the country. Eshkeiti et al (2015) developed screen printing of multilayered hybrid printed circuit boards on different electronic substrates as a new achievement in this case.

Doolen and Hacker (2005) have done a cross-section study of electronic manufacturers to investigate criteria associated with the implementation of lean practices in the Pacific Northwest. Results revealed that electronic manufacturers implemented a wide range of lean practices such as economic, operational and also organizational aspects. Edgington and Hayter (2000) studied Matsushita Electric Industrial Co. Ltd in terms of evolving geography of Japanese electronics firms in Asia-Pacific.

Hsu and Hu (2008) used the analytic hierarchy process technique to prioritize the relative importance of 4 criteria and 20 approaches among 9 enterprises in electronic industry and ranked them from 1 to 20. Yeung et al (2005) completed a survey based on quantitative and qualitative surveys of around 225 electronics firms in Hong Kong. Hassanpour (2017, 2018) evaluated 6 different types of Iranian recycling industries and 4 kinds of brick manufacturing industries using SPSS analysis so results had shown significant differences among parameters such as initial feed, employees, power, water, fuel, and land ($p_{\text{-value}} \leq .016$ and 0.023) and ($p_{\text{-value}} \leq .001$) respectively. Rahimi et al (2013) used a hierarchical cluster classification for clustering high and mid production poultry firms based on the type of chicken, employee number, feed, full auto system, eggs, produced chicken and manure factors. Zoryk-Schalla et al (2004) used a normative method for hierarchical planning using advanced software. The findings asserted that the hierarchical classification placed on the most planning processes which are difficult to capture in an advanced planning system.

A study assessed a warehouse for transportation of commodities with using the forklift in terms of efficiency and fast moving the materials stream. ARAS and SAW models used to rank and weight criteria (Fazlollahtabar et al 2019). A study included some criteria and options to prioritize in the railway management via ARAS and SAW models in Bosnia and Herzegovina (Veskovic et al 2018). ARAS and SAW models applied for assessing the 9 transportation companies embosoming 20 performance indicators by Radovic et al (2018). SAW model used by Rezaei et al (2015), Jaberidoost et al (2015) and Zolfani et al (2012) to assess some trace elements in the soil of Copper Mine in Kerman Province, Iran, classification of 85 main risk factors of pharmaceutical supply chain and weighing and ranking of 3 rural ICT institutes in Golestan, Iran respectively.

Rezaee and Ghanbarpour (2017), Rahimi et al (2017), Sinha 2015, Saranga and Nagpal (2016), Amini and Alinezhad (2016), Lu et al (2014), Ahmadi and Ahmadi (2012) and Keramidou et al (2011) used DEA model for evaluating 59 Iranian industry, for investigating the performance for about 22 Iranian poultry companies, for distinguishing the efficiency score of around 15 insurance companies from 2005 to 2012, to realize the efficient and inefficient Indian airline companies, for prioritizing 15 Iranian industries, to determine the efficiency of industries, to obtain efficiency scores for around 23 Iranian industries and finding the technical and scale efficiency of the Greek meat products industry in a period of 1994 to 2007 respectively.

3. Methodology

The proposed projects need to pass through many steps to get the acceptance for construction in Iran. Iranian evaluator team composed of lots of experts to screening the projects. By the way, we processed the information to the ultimate steps of decision making systems and approval of industrial projects to implement. Figure 1 shows the steps integrated with our procedure from initial screening (by Iranian evaluator team) to decision making systems (our procedure).

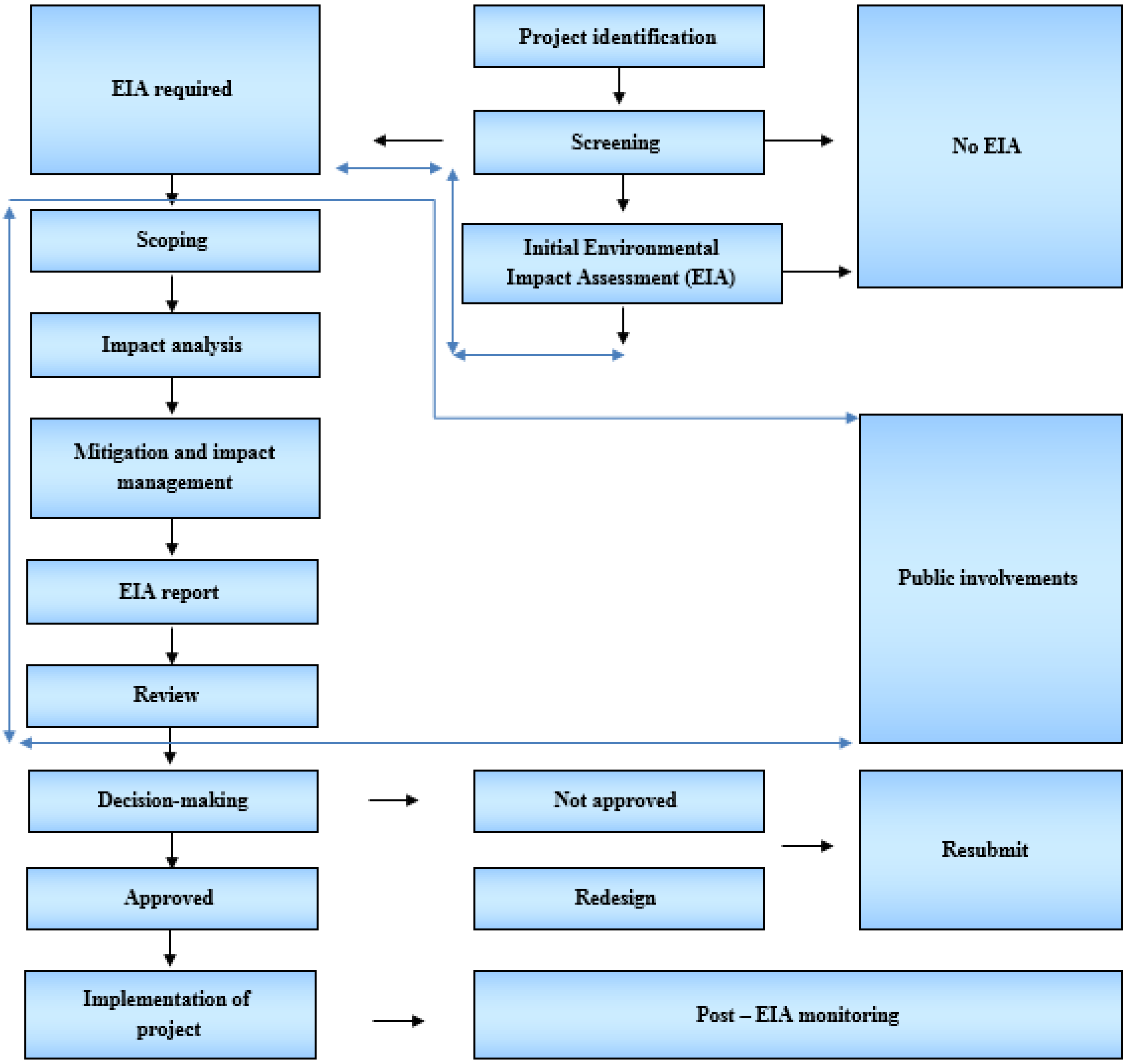


Figure 1. Environmental Impact assessment program in Iran (This study)

3.1. Friedman test

Current cluster study encompasses data of about 33 IEPMI. Data related to industries extracted from database released by Iranian industries organization along with the participation of Iranian environmental agency once before designing industries to construct. IBM SPSS Statistic 20 software was used to analyze the data of Iranian electronic products manufacturing industries.

Based on ranking values and hierarchical cluster diagram developed by software has done a classification among 33 industries. In the Friedman test analysis available data $[Xij]\ n*k$ actually is a matrix with n rows, k columns within each block. It replaces the data with a new matrix $[rij]\ n*k$ where the entry rij is the rank of Xij within block i according to equations 1 to 6. The test statistic is given by equation 5.

$$a.j = \frac{1}{n}\sum_{i=1}^{n} rij \tag{1}$$

$$b = \frac{1}{nk}\sum_{i=1}^{n}\sum_{j=1}^{k} rij \tag{2}$$

$$SSt = n\sum_{j=1}^{.}(a.j - b)^2 \tag{3}$$

$$SSe = \frac{1}{n(k-1)}\sum_{i=1}^{n}\sum_{j=1}^{k}(rij - b)^2 \tag{4}$$

$$Q = \frac{SSt}{SSe} \tag{5}$$

When n or k is large (i.e. $n > 15$ or $k > 4$), the probability distribution of Q can be approximated by that of a chi-squared distribution. In this case, the p-value is given by equation 6.

$$P = (X^2, k = 1 \geq Q) \tag{6}$$

If n or k is small, the approximation to chi-square becomes poor and the p-value should be obtained from tables of Q specially prepared for the Friedman test (Eisinga et al., 2017).

3.2. Additive model based on ARAS method to calculate DEA

Mixing ARAS method with DEA equations is the one the best procedure to find the DEA values with regard to various input and output variables. After designing a matrix of input and output variables based on different scales the composed matrix needs to come through the normalization and weighting methods according to equations 9 to 11. In the designed matrix Xij indicates the performance of option i on the basis of j and Xjo, the optimal value of the j criterion. Equations 12 to 16 explain the procedure to figure out the DEA amounts.

$$Xoj = max\,Xij\ if\ max\,Xij \quad is\ preferable \tag{7}$$

$$Xoj = min\,Xij\ if\ min\,Xij \quad is\ preferable \tag{8}$$

$$pij = \frac{Xij}{\sum_{i=1}^{m} Xij} \tag{9}$$

$$\square = pij \times Wj, \quad i = o, m \tag{10}$$

$$Si = \sum_{j=1}^{n} normalized\ values\ of\ Xij, \qquad i = o, m \tag{11}$$

$$DEA = \frac{\sum_{r=1}^{S} Ur\,Yrj}{\sum_{i=1}^{m} Vi\,Xij} \tag{12}$$

$$Max\ Z = \frac{\sum_{r=1}^{S} Ur\,Yrj}{\sum_{i=1}^{m} Vi\,Xij} \tag{13}$$

$$= \frac{\sum_{r=1}^{S} Ur\, Yro}{\sum_{i=1}^{m} Vi\, Xio}, \quad j = 1,2,3, \dots . n \tag{14}$$

$$Ur, Vi \ \geq 0 \tag{15}$$

$$DEA = \frac{Output\ (1)\ \times Weight\ (1) + Output\ (2) \times Weight\ (2) + \cdots}{Iutput\ (1)\ \times Weight\ (1) + Iutput\ (2) \times Weight\ (2) + \cdots} \tag{16}$$

3.3. Ranking system of ARAS

To conduct a ranking system for classifying IEPMI was used equations 7 to 11 plus 17. Equation 17 was employed to demystify the degree of utility of each option.

$$Ki = \frac{Si}{S.}\ ; \qquad i = o, m \tag{17}$$

3.4. Ranking system of SAW

Equations 18 and 19 introduce Xij and W as the values and weighted values respectively. Normalization of the decision matrix was accomplished based on Equation (18). To compute the ultimate weights the special vector composed by Freidman test was conducted to sum the weights.

$$Pij = \frac{Xij}{\sum_{i=1}^{n} Xij} \qquad i = \Gamma, m; \ \ j = \Gamma, n \tag{18}$$

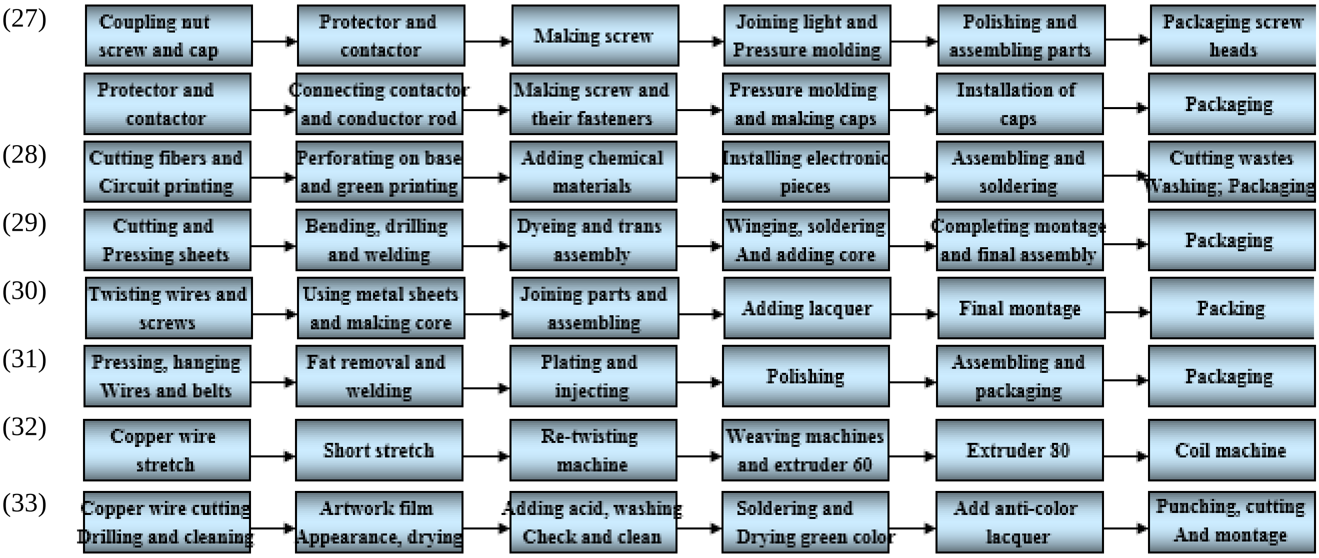
$$Pij = \frac{Xij\ .W}{\sum_{i=1}^{n} Xij} \qquad i = \Gamma, m; \ \ j = \Gamma, n \tag{19}$$

4. Results and discussion

4.1. Flowdiagram and input materials stream of IEPMI

These findings present an elaborate analysis and finding of the research based on the primary data gathered. Figure 2 displays IEPMI and their generation processes. Hereby, we tried to represent a full diagram of industries processes plus all details of energy consumption and existing facilities. Tables 1 and 2 show the input materials injected into IEPMI, their output materials and energy consumptions based on the nominal capacity and their input materials respectively.

(1)	Feeding unit; 8 mm copper wire	Large, medium and Tension machine	Big and small Tension machine	Checking unit	Vertical, horizontal Lacquer machines	Final checking and packaging
(2)	Pressing various sheets	Scraping wires and pipes	Drilling and perforating	Polishing machine	Assembling parts	Packaging
(3)	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
(4)	Cutting and Scraping pipe	Perforating pipe; adding phosphate	Twin lever and actuator cap	Scraping and Perforating + rebar	Connecting parts and montage	Packaging
(5)	Printed circuit Board assembly	Adding tin, control Wiring and fixing	Test and electronic fix	Montage keys and Other elements	Framework montage and final checking	Packaging
(6)	Poly amid; Poly ethylene injection	Dynamo sheet cutting	Winding	Pressing	Montage	Packaging
(7)	Cutting Al sheets	Pressing and dyeing	ABS plastic injection	Cylindrical base assembly	Joining and Connecting parts	Products
(8)	Polyethylene PVC granules	Cutting	Pressing	First and second assembling	Final assembling	Product
(9)	Cutting fibers	Primary circuit printing	Diving at acid Washing by thinner	Perforating and Dyeing by green	Adding tin, soldering And joining parts	Packaging
(10)	Rebar and sheet cutting	Polishing and pressing	Drilling and cutting	Drilling and hanging	Plating	Montage and dyeing
(11)	Pre-montage stator	Pre-assembled winding coil	Connecting shaft	Pre-assembled holder	Final assembly all parts	Testing and packaging
(12)	Checking materials	Shaping, initial montage and test	Adding tin, test and layout	Final montage, test and check	Joining partitions	Packaging
(13)	Electronic pieces	Forming, montage and test	Soldering, test and check	Installing plastic and metal pieces	Calibration and test	Packaging
(14)	Cutting fiber and Circuit printing	Washing, carrying And separating	Attaching parts on Fibers and tin bath	Plastic parts and Boxes montage	Packaging and Injecting at boxes	Plastic injection And separating
(15)	Thermos plastic injection	Polishing	Cutting and pressing sheets	Drilling and hanging	Montage	Packing
(16)	Polypropylene injection	Cutting, pressing twisting	Scraping, drilling And hanging	Drilling and hanging	Plating	Montage and Packing
(17)	Brass sheets	Pressing metal Sheets and Platinum	Thermosetting Press	Framework assembly	Final montage	Testing and Packaging
(18)	Cutting fibers	Circuit printing	Perforating base and dyeing green	Adding tin, joining Parts; soldering	Cutting wastes and cleaning	Circuit assembly and Packaging
(19)	Cutting metal rebar	Surface sanding	Perforating and Polishing blocks	Plastic injection machine; brass rebar	Final assembling	Packaging
(20)	Wire and core	Adding lacquer and Drying	Connecting wires and assembling parts	Adding tin, control and test and check	Final assembling parts	Packaging
(21)	Cutting plastic paste and cover printing	Drying; corrosion Protection	Check and test perforating board	Cutting and Shaping pieces	Installing pieces; Adding tin and test	Assembling and packaging
(22)	Contactor partition assembly	Main body installation	Final montage	Control and check	Test	Packaging
(23)	Pressing Silica and Steel Sheets	Perforating and joining	Twisting wires and soldering	Kernel and insoles assembly	Installing cap and screw connection	Labelling and packaging
(24)	Poly ethylene Plastic injection	Printing and Cutting Al wires	Forming and shaping	Adding bone fiber and capsule lamp	Adding capacitor and montage	Packaging
(25)	Cutting and shaping sheets	Plating, winding and produce coil	Wire and coil assembly	Cutting; producing diaphragm	By using plastic and texture	Final montage by Adding cone paper
(26)	Melting initial materials	Cutting and Pressing sheets	Molding machine; Perforating; hanging	Preparing for Packaging; grading	Dyeing and assembly	Packaging



Flux wire (1), Thermostat samovar (2), Automatic starter (3), Automotive starter (4), Automatic selector (5), Adapter (6), Amperemeter, voltameter (7), Alarm (8), Desktop phone device (9), Electrical connector (10), Electro-Motor (11), Electronic thermostat (assembly) (12), Electronic laboratory devices (13), Electronic encoder lock (14), Electric key and socket (15), Soldering iron (16), Sockets and rods (17), Flashing device (18), Home electric drill (19), Household Emergency Light (20), Gas torch relay (21), Limit Switch (22), Moonlight ballast (23), Moonlight Starter (24), Paper loudspeakers (25), Projector and spotlight (26), Plugs and screws head (27), Pocket radio (28), Trans-amplification (29), Trans moonlight (30), Thermal relay (31), Coaxial cables (32), Electronic boards and printed circuits (33).

Figure 2. IEPMI and their generation processes

Table 1. Input materials entered into IEPMI

Industry	Initial materials
(1)	Cu wire 99.9%, diameter of 8 mm (1100t); Polyurethane; linear PS and PP (150t); PS spool (170000 No)
(2)	Brass wires, d= 6 mm (1700 kg); Galvanized sheets, 1.5 and 0.9 mm (1528 and 654 kg); St-37, thickness of 0.2 mm (925 kg); St- 37, thickness of 0.6 mm (250 kg); C_{75} sheets, thickness of 0.2 mm (393 kg); St-37 pipes, internal and external d=4 and 5 mm (435 kg); Brass pipes, thickness of 1 and d= 6 mm (320 kg); Gasket with internal and external d= 9 and 13 mm, L= 4 mm (600000 No); Screw coupling, D= 3 mm, L= 11 mm, (200000 No); Connector, d= 3.3 mm, L=11.5 mm (200000 No); Bolts, L=10 and d=4 mm (400000 No); Cu contactor, d= 4 and L= 3 mm (400000 No); Adjustment bunch, 8 g (200000 No); Cardboard boxes with dimensions of 30*40*40 cm^3 (677 No)
(3)	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-sides metal lever (20000 No); Piece of hoof (80000 No); Plastic lever piece (20000 No); Coal boxes (20000 No); Scuttle (40000 No); Coal (80000 No); Coal coil (40000 No); Automatic start (20000 No); Bolts and nuts M4 (120000 No); Warhead plates. Thickness of 2 mm (20000 No); Coil (20000 No); Start gear (20000 No); Tall screw L and 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)
(4)	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 bottles 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)

(5)	Integrated circles of SN 7432, DM 74476 N, C-7408, DM 74 IS244 and CD 4078 (163620, 163620, 109080, 109080 and 163620 No); Transformator 7.5; 220 (54270 No); Press key (272700 No); Contactor D25 (54108 No); Sentronix contactor (108216 No); Metal cap (54270 No); Paired contactor (162324 No); Multicore wire (540000 m); Fiber circuit R_3 (54540 N0)
(6)	Dynamo sheets, thickness of 0.5 mm (73600 kg); Poly amid 6,6 (1053 kg); PP (2292 kg); Lacquer wire, d= 1.4, 1.7 and 1.2 mm (7750 kg); One way key (100000 No); Three-phase linear key (100000 No); PE wire protector (200000 No); Bolts and nuts M_3 (200000 No); Labels (100000 No); Boxes of 8.5*6.5*6.5 cm^3 (100000 No); Three layers cartons in sizes of 18*20*20 cm^3 (5556 No); Lacquer wire, d=0.29 mm (12000 kg)
(7)	AL sheets with thickness of 1 and 2 mm (9380 kg); ABS (7577 kg); AL cylindrical base (400000 No); Triangular base deadlock bolt (400000 No); Polycarbonate plate cover (200000 No); Terminal bolts (400000 No); Filters of 1.5 mm (200000 No); Resistance of 100 and 150 ohm (400000 No); Main base (200000 No); Magnet (200000 No); Bobbin (200000 No); Bobbin connector (200000 No); Insulating tape (20000 No); Fence wire, L= 10 cm (400000 No); Box of sizes about 10*10*6 cm^3 (200000 No); Three layers cartons with dimensions of 41*51*25 cm^3 (200000 No); Various bolts of 3 and 4 mesh (2200 No)
(8)	PE (9506 kg); PVC (854 kg); St-37 sheets of thickness around 2 mm (7579 kg); Steel sheets, thickness 0.3 mm (533 kg); Boobin induction 50-300 rpm, 250 hz (100000 No); Hammer, d=5 mm, L=3.5 mm (100000 No)
(9)	Phone base box and its door (20000 No); Cell boxes and its door (20000 No); Cell key board having 12 keys (2000 No); ABS buttons (60000 No); Three-way keys (20000 No); Push bottun (20000 No); Capacitive microphone (20000 No); Cell 32 ohm (20000 No); Cell choke (20000 No); Fibers of reprinted circuit (200 m^2); Volume 1 kg ohm (20000 No); Bicuspid push bottuns (20000 No); socket (80000 No); Wirehead (32000 pairs); Two and 4 strings cables, L=2*0.75*1.5 m^3 (30000 and 20000 No); Three-pin electrical connections (20000 No); Dye (20000 No); IC (40000 No); Transistor 25, C940C2; N 5401 (20000 No); Electronic capacitor, 100 and 637 micro farenhite (40000 No); Ceramic capacitor (120000 No); Resistance (40000 No); Diode IN4001-IN4148 (160000 No); LDPE bases of key board (40000 No); ABS Switch off key (20000 No); PVC base of cell (80000 No); Tin (445 kg); Oily dye (445 kg); Thinner dye (900 kg); Silk (50 No); Acid perchloroform (400 kg); Thinner (1000 kg); Boxes of about 20*15*7 cm^3 (20000 No); Cartons of around 40*60*35 cm^3 (500 No)
(10)	Steel sheets of St-37, thicknesses of 4, 3, 5 mm (42.1, 121, 69.35t); St-37 rod, thickness of 34 mm (35.33t); St-37 rebar, d= 8 and 6 mm (279 and 351 kg); Cu sheets of 3, 15 and 18 mm thicknesses (8.2, 127.8 and 16.2t); Brass sheet, thickness of 3 mm (853 kg); St-37 hexagonal rods (934 kg); Insulators (30000 No); Reed bushes of M10, M16 and M6 (15000, 1500 and 30000 No); Interface wires of insulators (5000 No); Flat washers of A16, A14, A6, A13 and A10 (30000, 30000, 30000, 5000 and 30000 No); License plate (5000 No); Circular washer (30000 No); Flexible washers of A10, A16, M12 and A6 (5000, 30000, 30000 and 30000); Bolts of M 10, M 10 and M 12 (80000, 25000 and 30000 No); Hexagonal bolts of M 10, M 16, A 6, A 13 and M 12 (5000, 30000, 30000, 65000 and 60000 No); Compressive coils (60000 No);
(11)	Lacquer wire, d= 0.32 mm, thermal class of B (35640 kg); Feeder system VDI 293 Nylhy (50400 kg); Solder DIN LSN60 (27 kg); Pipe, d= 2mm (49920 m); Polyester tape, width and thickness of 28 mm and 100 micron (25200 m); Cu wire, road DIN4 6H31, D=2.8 mm (2520 kg); AL 99.99 R DIN 7 (5184 kg); Sintered bush (249600 No); Poly amid injection moulding as pipe bush (124800 No); Bolts, L=249600 No); Plastic spools (126000 No); Various sheets with rolled oriented magnetic V800, DIN 50 (1776 No); Injected Al (126000 No); Steel shaft G 4303SVS 420 (126000 No); Body holder ZAMAK3 (259200 No); Cardboard boxes (124800 No); Cartons in dimensions of 40*25*10 cm^3 (20600 No)
(12)	AC TA 750 2P (42000 No); Transistor 2 SC945 (62000 No); Diode IN4004, IN 4148 (168000 No); Diode 6.2 and 15 V (63000 No); Diodes LED red and green (42000 No); Relay, 24 V (21000 No); Resistance devices 0.5 and 1 watt (40000 and 63 No); Volum wires of 500 ohm (21000 No); Polyester capacitor of 1,10 and 22 nano farad (105000 No); Electrolite capacitor, 1,22,47,50 and 100 micro farad (105000 No); Resistance device of 0.5 watt and 1% (84000 No); Trans 19 V and 5 amper (21000 No); Power supply terminal 12 ways (252000 No); Montage wire (42000 m); Printed circuit board, 9*9 cm^2 (1700000 cm^2); Coverage pieces (1050 kg); Steel boxes of about 10*10*10 cm^3 (21000 No)
(13)	Transistor BC177, 2N3819 BC107 (115500 No); Diode IN 4148, IN 4002 (105000 No); AC 7815 (21000 No); Volum 50 k ohm (20400 No); Potentiometer, 470 ohm (61200 No); Capacitor (61200 No); Electrolyte and polyester capacitors (265200 No); Resistance 0.25 watt (510000 No); Selector key (20400 No); Switch on and off key (20400 No).

(14)	Keys of key board (100000 No); Rubber conductor of below keys (100000 No); Fiber of printed circuit (1000 m^2); Fiber maker materials (1000 m^2); AC 82-51 of micro computers (100000 No); Crystal of watch 4 MH_2 (100000 No); AC memory 93C46 (100000 No); Miniature key (100000); Transistor (200000 N0); Protective diode (100000 No); Battery boxes of plastic injected (100000 No); Packaging bolts and nuts (100000 No); External boxes of apparatus made of AL plated (100000 No)
(15)	Phenolic resin (103t); Brass sheet, thickness of 0.3, 1.2, 0.4 and 0.8 mm (680, 1500, 3150, 2240 kg); Galvanized sheet (2410 kg); Brass hexagonal sheet, d= 6 mm (3600 kg); Galvanized sheet, thickness of 0.5 mm (480 kg); Quad brass sheet of 6*6 cm^2 (1600 kg); Oily plate, thickness of 1 and 1.2 mm (2070 and 700 kg); Brass rebar, d= 4.5 mm (1300 kg); Various steal screws, M 3*6 cm^2 and M 3*15 cm^2 (3540 No); Various metal washers, d= 3-7 mm (1000 No); Brass rivets, d and L of 4 and 8 mm (600000 No); Rubber washers with d= 55, 17, 20 mm and thicknesses of 2, 2 and 8 mm respectively (100000 No); Spring bolts and pins (300000 and 300000 No); Cardboard washer, d= 3 mm (800000)
(16)	PP (9t); Metal sheet, thickness of 0.5 mm (1650 kg); Metal and Cu wires, d= 4 and 10 mm (1000 and 950 kg); Fireproof sheets, thickness 0.1 mm and 0.6*1 m^2 (116 kg); Wire cover of PE (16.5 kg); Galvanized wire 25% (45 kg); Bolts and nuts with grade of 2 (660 and 330 kg); Plastic molds of polycarbonate (110 kg); Packaging cardboard (110 m^2); Insulator sheet, thickness of 1 mm (110 kg); Element 40 w, with wire of 1 mm (340 No); Electrical resistance, 150 Kilo ohm and 0.5w (110 No); Signal light, 220 V (110000 No); PE wire bush (110 kg); Twin wires (110 kg)
(17)	Bakalite and urea formaldehyde (225t); Brass sheets, thickness of 0.5-0.6 mm (40t); Steel sheets with thickness of 0.75-1.5 mm (100t); Contactor 16 A, 220 V (4200000 No); Bolts and nuts (15000 No)
(18)	PP boxes of about 15*10*8 cm^3 (20000 No); PP caps of around 15*10*2 cm^3 (20000 No); Transformator, 220 V (20000 No); Device containing 5 V (80000 No); Fibers of reprinted covers, sizes of 7*8 cm^2 (230 m^2); IC 555 for oscillator (20000 No); IC 7805 for regulator voltage (40000 No); Capacitor 470 microfarad, 35 V, (40000 No); IC 7474 (20000 No); Diode (20000 No); Other pieces (400000 No); IC sockets of 8 and 16 bases (20000 and 40000 No); Twisted pair (80000 No); 2.5 split wire, L= 5 cm (8000 No); Wires of 7.5, L=5 cm (14000 No); Optical diode (80000 No); LED Frame (80000 No); Reprinted silk (100000 No)
(19)	Brass rebar, d= 12 mm (388 kg); St-44-2, d= 20 mm (3200 kg); Poly amid 6,6 (3960 kg); Gear, z= 27, 24 and 12 (10000, 10000 and 10000 No); Wrench of three systems (10000 No); Drill of three systems, 0.8-10 mm (10000 No); Gasket, d=5-1.5 mm (40000 No); Bolts of Din 7983 (180000 No); Blocks of istalled bush made from AL (10000 No); Electric motor, 23019 (10000 No); Power wire, split 2.5 (6000 m); Ball bearings, Din 625 (20000 No); Perforated Spiral Din 471 (20000 No); Switch on and off keys (100-240 V (10000 No); Needle bearing, internal d= 8 mm and L= 12 mm (20000 No); Axle and bearing placement blocks made from Al (10000 No); Graphit coal (10000 pairs); Power wire fastener (10000 No); Electrical wires with twin plugs (10000 No); Labels of drill (20000 No); PVC rubber wrench (10000 No); Brass wirehead (80000 pairs); Caoutchouc (10000 No); Cardboard boxes (10000 No); Carton (1250 No)
(20)	I and E core sheets DIU 46400 (17.62t); Trans spool (20400 No); Steel holder of trans (21000 No); Lacquer wire 0.8 and 0.25 (4200 kg); Lacquer flux (147 kg); Split wire grade of 4 (33 km); Insulating tape (22km); Tape (22000 m); Printed circuit board (220 m^2); Power transistor (21000 No); Semi-power transistor (21000 No); Ordinary transistor (63000 No); Relay, 12 V (21000 No); Ordinary diode (189000 No); Resistance, 0.5 watt (336000 No); Electrolite capacitor (21000 No); LED optical diode (84000 No); AL (56.7 kg); Battery fastener (42000 No); Switch on and off keys (21000 No); Output pin (42000 No); Fuse holder (22000 No); Glass fuse (22000 No); Boxes (20000 No); Lamp, reflector and holder (60000 No); Twin connector wire of grade 6 (42000 No); Bolts and nuts grade 2.5 (42000 and 126000 No); Carton and plastic for packaging (22000 series)
(21)	Boards of reprinted circuits (441 m^2); Plastic pieces (250 No); Resistance device, 1 and 0.25 watt (157500 and 2100 No); Electrolyte capacitor (525000 No); Plate capacitor (105000 No); Transistor (420000 No); Diode (1680 No); Brass wires (52500 m); Transformator (52500 No); AC (52500 No); Miniature relay, 10 A (157500 No); Connection pin (472500 No); Ferric chloride (400000 No); Tall bolts of M_3 type (52500 No); Tin (270 kg); Labels (52500 No); Boxes (52500 No)
(22)	Lead molds and plastic framework (70000 and 70000 No); Screw and metal and plastic caps (70000, 70000 and 70000 No); PE washer (70000 No); Plastic roller 2.2 g (70000 No); Metal pin with diameter of 6 and 8 mm (70000 No); Metal bar in d= 12 mm and 26.5 g (70000 No); Circular rubber washer 6 g (70000 No); Contactor body 16.5 g (70000 No); Contactor pieces 7 g (70000 No); Brass holder pieces 4.5 g (70000 No); Main brass contactor 7 g (70000 No); Flat Cu coils 2.2 g (70000 No); Coil holders 3.2 kg (70000 No); Contactor lever 6g (70000 No); Contactor lever 6 g (70000 No); Caps 4 g (70000 No); Bolt, nuts and washers (70000 No); Boxes (70000 No)

(23)	Silica Iron Sheets (191413.3 kg); 20 and 40 watts floor sheets (27439 kg); Lacquered flux wire (39360.4 kg); Caps (867368 No); Terminal, grade of 6 (433684.2 No); Bolts (433684.2 No); Wire head (867368 No); Dye (4.5 kg); Tin (43.3 kg); Packaging cartons (21237 No); Insulation (24985 No); Lacquer flux (2629.8t)
(24)	Plastic materials (21052.6 kg); Bone fiber (4445 kg); Al wire, d= 2.5 cm (2105.56 kg); Capacitor holding 225 picopharads (2000 No); Induction capsule bulb (2000 No); Cardboard boxes with sizes of 0.25*0.1*0.12 m^3 (100000 No); Cartons in dimensions of 0.5*0.5*0.6 m^3 (2000 No)
(25)	Magnet (500000 No); Loudspeaker paper (530000 No); Lacquer wire, d=0.1-0.2 mm (2750 kg); Especial gum (9000 kg); Cast iron sheets and wires (208500 kg); Linen fabric (3600 m^2); Plastic diaphragm (8250 kg); Zn Cyanide (320 kg); NaOH (320 kg); Sodium hydroxide (1900 kg); Cyanide (540 kg); Potassium dichromate (320 kg); Zn (180 kg); HCl (1500 kg); H_2SO_4 (1800 kg); Carton (10600 No)
(26)	Al ingots (69.2t); St-37 sheets, thickness of 2 and 0.7 mm (18.05 and 0.5t); Al sheets, thickness of 0.3 mm (5920 kg); Glass, thickness of 5 mm (2412 m^2); Base of lamps (200000 No); Poly amid and PVC terminals (100000 No); Gasket framework, EPDM and 20 g (100000 No); Lamp wire connection (40000 No); Brass wirehead (200000 No); Al punch, d=2 mm (200000 No); Various bolts (1000 No); Various nuts (400000 No); Various gaskets (200000 No); Covers of about 9*22*21 cm^3 (100000 No); Cardboard paper, 79*21 cm^2 (100000 No); Carton in dimensions o 55*22*43 cm^3 (16667 No)
(27)	Brass sheet, thickness of 0.5 mm (6120 kg); Brass sheet, thickness of 0.8 mm (880 kg); AL wire, d= 14.5 mm (2000 kg); Brass wire, d= 5 mm (4000 kg); Plastic (26.5t); PE wire fastener, 1.5 g (400000 No); Wire connector (800000 No); Spirals, 0.5 mm and d= 4 mm (400000 No); Various coils (3200 No); Boxes of around 10*21*6 cm^3 (80000 No)
(28)	PP and PS radio boxes of about 15*103 cm^2 (40000 No); Door of radio box, PP or PS in dimensions of 15*10*1 cm^3 (40000 No); PVC radio band frame (40000 No); Radio wave transducer 455 kh (120000 No); Noise volume device, resistance of 5 kilo ohm (40000 No); PP and PS buttons of noise handling (40000 No); Conversion key (40000 No); PP and PS buttons of tune wave (40000 No); Variable capacitor with PVC boxes (40000 No); Ferrite core transducer with five centimeters in diameter and one inches in wraped silk (40000 No); Reprinted silk (100000 No); Cardboard boxes of around 15*10*4 cm^3 (40000 No); Transistor OC 6.2 and OC_{72} (120000 and 120000 No); Dye (900000 No); Other electronic devices (120000 No); Circuit board, thickness of 0.5 mm (336000 No); Speaker, 0.5 watt and 18 ohm (40000 No); Dye (180 kg); Connection wires of 0.75 (12245 m); Battery molds, 1.5 V (40000 No); Antenna, steel and 40 cm (40000 No); Thinner 2000 (2400 No); Three layer cartons in dimensions of 40*4045 cm^2 (334000 No); Tin (900 kg); Perchlorophen Acid (600 kg)
(29)	Lacquer wire, grade 1 and 0.7 (7500 and 30000 kg); Steel core (60000 kg); Steel sheets of grade 1, 1-2 m (13500 kg); Cardboard 60*80 cm^2 (3752 sheets); 10 and 13 amper relay, 10-24 V (15000 and 15000 No).
(30)	Lacquer wire, d= 0.28 mm (24225 kg); Dynamo sheets (156750 kg); Fine iron sheets, 1.25 mm (12375 kg); PE terminal (4505 No); Lacquer flux (54200 kg); Labels (252500 No); Trans caps (500000 No); Cardboard boxes (22500 No)
(31)	Flexible steel straps, thickness of 1.2, 0.1 and 1 mm (2290, 460 and 600 kg); Non metal strap, thickness of 1 mm (320 kg); Unsaturated polyester resin (3290 kg); Poly amid resin (30.3 kg); Pigment (41 kg); Ni-Ag wires with thicknesses of 3 and 1 mm (12 and 6 kg); Cu wires of d= 5 mm (24 kg); Thermal element (18000 m); Industrial trichloroethylene (200 kg); Refractory paper (384 m^2); Polishing powder (1t); Prefabricated pieces (60000 No)
(32)	Cu wire with d= 8 mm, 99.96% (760t); PE with specific gravity of 0.89-0.98 g/cm^3 (200t); PVC with specific gravity of 1.38-1.41 g/cm^3 (920t); Tension oil (12 barrels); Cardboard (408000 No)
(33)	Single layer fiber (13650 m^2); Double layer fibers of Cu (7350 m^2); White dye (0.5t); Solder mask (800 kg); Protective lacquer (300 kg); Perchlorat (4600 kg); NaOH (500 kg); Thinner (2t); Tin protective thinner (200 kg); Ordinary thinner (0.5t); Lace (250 m^2); Sensitive materials (50 kg); Small knife (10 No); Drill (10000 No); Fat removal of metallization operation (250 kg)

PP= Polypropylene, Hp= horse power, D=diameter, L= length, w=width, m= meter, mm= millimeter, Low Density Polyethylene= LDPE, High Density Polyethylene= HDPE, Polypropylene= PP, Polyvinylchloride= PVC, Polystyrene= PS, Poly Ethylene Terephthalate= PET.

Table 2. IEPMI, their energy consumptions based on nominal capacity

No	Nominal capacity (No)	Employees	Power (kw)	Water (m^3)	Fuel (Gj)	Land (m^2)
1	2000	48	818	25	5	3200
2	200	12	30	3	3	1600
3	100000	36	37	7	5	2500
4	20000	23	66	8	4	2300
5	5400	39	29	7	4	2200
6	100000	26	55	7	2	1400
7	200000	26	51	7	3	1600
8	100000	15	39	4	2	1600
9	20000	20	36	5	3	2000
10	5000	29	191	11	8	4800
11	120000	20	33	4	3	1600
12	20000	24	83	5	2	1300
13	10000	25	24	6	4	2000
14	100000	23	54	8	4	2000
15	500000	68	337	31	7	4100
16	110000	26	72	9	4	2500
17	2000	93	178	16	5	3400
18	20000	17	33	5	3	1600
19	10000	18	58	6	3	1900
20	20000	23	31	6	3	2300
21	50000	28	20	5	3	1800
22	70000	17	40	4	2	1000
23	200000	65	68	12	3	1900
24	2000000	27	56	6	4	2600
25	500000	91	289	18	10	6100
26	100000	27	61	8	12	2800
27	800000	29	84	5	3	1900
28	40000	18	45	5	2	11600
29	100000	89	110	15	5	3200
30	450000000	20	151	8	20	2400
31	60000	35	145	9	5	2900
32	408000	104	682	31	10	5700
33	20000	30	79	16	17	2900

The t-test analysis revealed that there is no significant difference among parameters (in Table 2) such as employees, power, water, fuel, and land for 33 industries. It was found the highest correlation between both criteria of water and power around 0.837 according to Pearson correlation sig. (2-tailed).

4.2. An unsupervised ranking model

Unsupervised classification technique does not require the user to specify any information about the features contained in the images. While supervised samples can be used in training aims. Figure 3 displays flow-diagram developed based on the hierarchical cluster of IEPMI as an unsupervised image depicted by SPSS software.

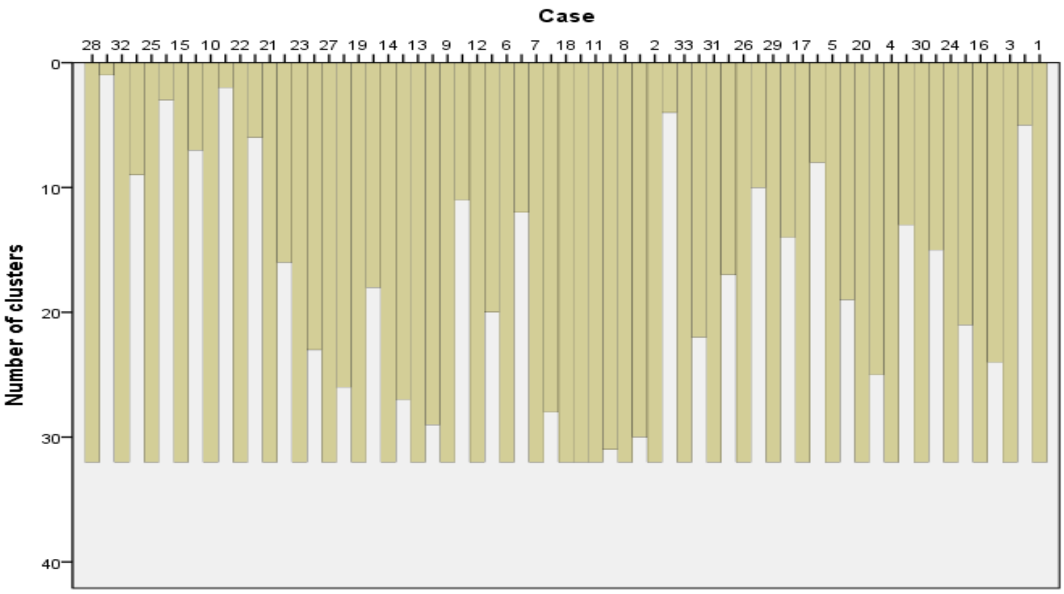


Figure 3. Flow diagram developed based on the hierarchical cluster from 33 industries as an unsupervised method

According to Figure 2, the hierarchical cluster classification for 33 industries was obtained as below pattern based on five main factors values such as land, power, employees, water, and fuel. The obtained results were revealed the ranks values for land (5.00) > power (3.91) > employee (3.08) > water (1.89) > fuel (1.12) by Friedman test respectively. Therefore, obtained results have displayed by R1 to R5.

R1	1> 30 > 24>16> 3> 4
R2	23> 14>19>27>13>9>2>8>11=18
R3	28>32>25>15>10> 17 > 29 >31>33>26>5>20
R4	21>12>7>6
R5	Minimum rate for 22 and maximum rate for 28

Based on the hierarchical cluster diagram, the information available for industries of 5, 20, 22, 26, 29, 31, and 33 does not follow a specific pattern internally not hierarchically. Therefore, considering the existing ranking for the parameters and the comparison with the data in the above table, the aforementioned pattern has developed R3 (High) > R1 (Medium) > R2 (Low) > R4 (very low) > R5 (Poor= only industry No 22).

4.3. Ranking system based on ARAS and SAW models

By Tables 3 and 4, we tried to rank the IEPMI based on both system SAW and ARAS models. The normalization, weighing procedure follow the equation mentioned in the methodology section. The special vector was used to integrate the normalized values in the rows and sorts out IEPMI from the most top to the lowest one according to below.

Table 3. The ranking system in SAW model for IEPMI

Industries	Employees	Power	Water	Fuel	Land	Pij	Rank
1	0.0403	0.2002	0.0776	0.0289	0.0345	1.2587	2
2	0.0100	0.0073	0.0093	0.0173	0.0172	0.1830	32
3	0.0302	0.0090	0.0217	0.0289	0.0269	0.3368	15
4	0.0193	0.0161	0.0248	0.0231	0.0248	0.3195	17
5	0.0327	0.0070	0.0217	0.0231	0.0237	0.3142	18
6	0.0218	0.0134	0.0217	0.0115	0.0151	0.2494	26
7	0.0218	0.0124	0.0217	0.0173	0.0172	0.2628	22
8	0.0125	0.0095	0.0124	0.0115	0.0172	0.1988	31
9	0.0167	0.0088	0.0155	0.0173	0.0215	0.2428	27
10	0.0243	0.0467	0.0341	0.0462	0.0517	0.6330	7
11	0.0167	0.0080	0.0124	0.0173	0.0172	0.2125	29
12	0.0201	0.0203	0.0155	0.0115	0.0140	0.2539	25
13	0.0209	0.0058	0.0186	0.0231	0.0215	0.2566	24
14	0.0193	0.0132	0.0248	0.0231	0.0215	0.2918	20
15	0.0570	0.0824	0.0962	0.0404	0.0442	0.9468	4
16	0.0218	0.01762	0.0279	0.0231	0.0269	0.3497	14
17	0.0780	0.04357	0.0496	0.0289	0.0366	0.7205	6
18	0.0142	0.00807	0.0155	0.0173	0.0172	0.2106	30
19	0.0151	0.01419	0.0186	0.0173	0.0204	0.2591	23
20	0.0193	0.0075	0.0186	0.0173	0.0248	0.2678	21
21	0.0235	0.00489	0.0155	0.0173	0.0194	0.2374	28
22	0.0142	0.0097	0.0124	0.0115	0.0107	0.1726	33
23	0.0545	0.0166	0.0372	0.0173	0.0204	0.4255	12
24	0.0226	0.0137	0.0186	0.0231	0.0280	0.3247	16
25	0.0764	0.0707	0.0559	0.0578	0.0658	1.0113	3
26	0.0226	0.0149	0.0248	0.0693	0.0302	0.4038	13
27	0.0243	0.0205	0.0155	0.0173	0.0204	0.3066	19
28	0.0151	0.0110	0.0155	0.0115	0.1251	0.7575	5
29	0.0747	0.0269	0.0465	0.0289	0.0345	0.6284	8
30	0.0167	0.0369	0.0248	0.1156	0.0258	0.5021	10
31	0.0293	0.0354	0.0279	0.0289	0.03128	0.4709	11
32	0.0873	0.1669	0.0962	0.0578	0.0614	1.4758	1
33	0.0251	0.01933	0.0496	0.0982	0.03128	0.5135	9

Table 4. The ranking system in ARAS model for IEPMI

Industries	Employees	Power	Water	Fuel	Land	Si	Ki	Ranks
1	0.0403	0.2002	0.0776	0.0289	0.0345	1.2587	0.85291	2
2	0.0100	0.0073	0.0093	0.0173	0.0172	0.1830	0.12404	32
3	0.0302	0.0090	0.0217	0.0289	0.0269	0.3368	0.22821	15
4	0.0193	0.0161	0.0248	0.0231	0.0248	0.31956	0.21652	17
5	0.0327	0.0070	0.0217	0.0231	0.0237	0.3142	0.21293	18
6	0.0218	0.0134	0.0217	0.0115	0.0151	0.2494	0.16900	26
7	0.0218	0.0124	0.0217	0.0173	0.0172	0.2628	0.17810	22
8	0.0125	0.0095	0.0124	0.0115	0.0172	0.1988	0.13473	31
9	0.0167	0.0088	0.0155	0.0173	0.0215	0.2428	0.16452	27
10	0.0243	0.0467	0.0341	0.0462	0.0517	0.6330	0.42894	7
11	0.0167	0.0080	0.0124	0.0173	0.0172	0.2125	0.14398	29
12	0.0201	0.0203	0.0155	0.0115	0.0140	0.2539	0.17205	25
13	0.0209	0.0058	0.0186	0.0231	0.0215	0.2566	0.17387	24
14	0.0193	0.0132	0.0248	0.0231	0.0215	0.2918	0.19777	20
15	0.0570	0.0824	0.0962	0.0404	0.0442	0.9468	0.64154	4
16	0.0218	0.0176	0.0279	0.0231	0.0269	0.3497	0.23695	14
17	0.0780	0.0435	0.0496	0.0289	0.0366	0.7205	0.48821	6
18	0.0142	0.0080	0.0155	0.0173	0.0172	0.2106	0.14270	30

19	0.0151	0.0141	0.0186	0.0173	0.0204	0.2591	0.17561	23
20	0.0193	0.0075	0.0186	0.0173	0.0248	0.2678	0.18148	21
21	0.0235	0.0048	0.0155	0.0173	0.0194	0.2374	0.16086	28
22	0.0142	0.0097	0.0124	0.0115	0.0107	0.1726	0.11695	33
23	0.0545	0.0166	0.0372	0.0173	0.0204	0.4255	0.28831	12
24	0.0226	0.0137	0.0186	0.0231	0.0280	0.3247	0.22005	16
25	0.0764	0.0707	0.0559	0.0578	0.0658	1.0113	0.68526	3
26	0.0226	0.0149	0.0248	0.0693	0.0302	0.4038	0.27365	13
27	0.0243	0.0205	0.0155	0.0173	0.0204	0.3066	0.20777	19
28	0.0151	0.0110	0.0155	0.0115	0.1251	0.7575	0.51331	5
29	0.0747	0.0269	0.0465	0.0289	0.0345	0.6284	0.42582	8
30	0.0167	0.0369	0.0248	0.1156	0.0258	0.5021	0.34023	10
31	0.0293	0.0354	0.0279	0.0289	0.0312	0.4709	0.31907	11
32	0.0873	0.1669	0.0962	0.0578	0.0614	1.4758	1	1
33	0.0251	0.0193	0.0496	0.0982	0.0312	0.5135	0.34798	9

According to Tables 3 and 4, the ranking system offered was obtained the same for both models of SAW and ARAS. The highest rank belongs to industry 32 and the lowest one to industry 22. While the highest one in the unsupervised model belongs to industry 28.

4.4. DEA

One of the most effective tools for measuring and evaluating productivity is DEA, which is used as a non-parametric method to calculate the efficiency of decision-making units. Today, the use of DEA techniques is rapidly expanding and is being used to evaluate organizations and industries such as the banking industry, post offices, hospitals, educational centers, power plants, refineries, and more. Many theoretical and applied aspects of the DEA model have taken place, which recognizes different aspects of it for more precise, unpredictable use. The use of DEA models, in addition to determining the relative efficiency, determines the organization's weaknesses in different indices and, by presenting their optimal level, outlines the organization's policy towards improving efficiency and productivity. Also, effective models that evaluate inefficient units based on them are introduced into inefficient units. Effective patterns are units that, with the same inputs, produce more outputs or outputs using fewer inputs. This is a huge variation in the results, which has led to the use of this technique with increasing speed. This has led to a growing theoretical dimension of the technique and to become one of the most active branches of research in operations. To find the DEA values for our research, it was surveyed the annual requirements of IEPMI by Table 5.

Table 5. Annual requirements of IEPMI

Industry	Nominal capacity (No)	Nominal capacity (t)	Nominal capacity (crank)	Nominal capacity (m^2)	Initial feed (No)	Initial feed (t)	Initial feed (m^2)	Initial feed (m)
(1)	0	2000	0	0	170000	1250	0	0
(2)	0	200	0	0	2000677	6205	0	0
(3)	100000	0	0	0	880000	34.04	0	0
(4)	20000	0	0	0	2762875	13.158	0	0
(5)	5400	0	0	0	35700000000	0	0	540000
(6)	100000	0	0	0	805556	12	0	0
(7)	200000	0	0	0	4000000	17	0	0
(8)	100000	0	0	0	200000	18.473	0	0
(9)	20000	0	0	0	1172550	3.19	200	0
(10)	5000	0	0	0	721500	422397	0	0
(11)	120000	0	0	0	1408376	93.771	0	75120
(12)	20000	0	0	0	1047063	1.050	170	42000
(13)	10000	0	0	0	1200300	0	0	0
(14)	100000	0	0	0	1200000	0	2000	0
(15)	500000	0	0	0	2104540	122.73		
(16)	110000	0	0	0	110450	14.2075	110	0
(17)	2000	0	0	0	4215000	365	0	0
(18)	20000	0	0	0	742000	0	230	0
(19)	10000	0	0	0	441250	7.548	0	6000
(20)	20000	0	0	0	1256400	78.667	220	77000
(21)	50000	0	0	0	2504030	0.27	441	52500
(22)	70000	0	0	0	1470000	0	0	0
(23)	200000	0	0	0	2648326.4	2935.8123	0	0
(24)	2000000	0	0	0	106000	27.60	0	0
(25)	500000	0	0	0	1040600	235.38	3600	0
(26)	100000	0	0	0	1657667	93.67	2412	0
(27)	800000	0	0	0	1683200	39.5	0	0
(28)	40000	0	0	0	2684645	1.68	0	0
(29)	100000	0	0	0	33752	111	0	0
(30)	450000000	0	0	0	779505	106.47	0	0
(31)	60000	0	0	0	60000	262733	384	0
(32)	0	0	408000	0	408000	1880	0	0
(33)	0	0	0	20000	10010	9.7	21250	0
Employee	**Power (Kw)**	**Water (m^3)**	**Fuel (Gj)**	**Land (m^2)**	**Initial feed (Barrels)**	**Initial feed (L)**	**Initial feed (Pairs)**	**Industry**
17280	294480	9000	1800	3200	0	0	0	(1)
4320	10800	1080	1080	1600	0	0	0	(2)
12960	13320	2520	1800	2500	0	4000	0	(3)
8280	23760	2880	1440	2300	0	0	0	(4)
14040	10440	2520	1440	2200	0	0	0	(5)
9360	19800	2520	720	1400	0	0	0	(6)
9360	18360	2520	1080	1600	0	0	0	(7)
5400	14040	1440	720	1600	0	0	0	(8)
7200	12960	1800	1080	2000	0	0	32000	(9)
10440	68760	3960	2880	4800	0	0	0	(10)
7200	11880	1440	1080	1600	0	0	0	(11)
8640	29880	1800	720	1300	0	0	0	(12)
9000	8640	2160	1440	2000	0	0	0	(13)
8280	19440	2880	1440	2000	0	0	0	(14)
24480	121320	11160	2520	4100	0	0	0	(15)
9360	25920	3240	1440	2500	0	0	0	(16)
33480	64080	5760	1800	3400	0	0	0	(17)

6120	11880	1800	1080	1600	0	0	0	(18)
6480	20880	2160	1080	1900	0	0	90000	(19)
8280	11160	2160	1080	2300	0	0	0	(20)
10080	7200	1800	1080	1800	0	0	0	(21)
6120	14400	1440	720	1000	0	0	0	(22)
23400	24480	4320	1080	1900	0	0	0	(23)
9720	20160	2160	1440	2600	0	0	0	(24)
32760	104040	6480	3600	6100	0	0	0	(25)
9720	21960	2880	4320	2800	0	0	0	(26)
10440	30240	1800	1080	1900	0	0	0	(27)
6480	16200	1800	720	11600	0	0	0	(28)
32040	39600	5400	1800	3200	0	0	0	(29)
7200	54360	2880	7200	2400	0	0	0	(30)
12600	52200	3240	1800	2900	0	0	0	(31)
37440	245520	11160	3600	5700	12	0	0	(32)
10800	28440	5760	6120	2900	0	0	0	(33)

According to t-test, there was no significant difference among criteria such as nominal capacity (No), nominal capacity (t), nominal capacity (crank), nominal capacity (m^2), Initial feed (No), Initial feed (t), Initial feed (m^2), Initial feed (m), Initial feed (barrels), Initial feed (L), Initial feed (pairs) employees, power, water, fuel and land. But paired samples test was manifested significant differences about 0.005 and 0.001 between both criteria of employees-power and water-fuel. It was found weight values of around 13.17, 4.59, 4.61, 4.56, 15.66, 8.45, 6.09, 6.2, 4.38, 4.5, 4.97, 12.89, 14, 11.28, 9.77 and 10.88 for nominal capacity (No), nominal capacity (t), nominal capacity (crank), nominal capacity (m^2), Initial feed (No), Initial feed (t), Initial feed (m^2), Initial feed (m), Initial feed (barrels), Initial feed (L), Initial feed (pairs) employees, power, water, fuel and land with (N= 32), Chi-Square 378.825 and the significant difference (0.00). In this section, to calculate the DEA score the existing data in Table 5 come through the normalization process according to Table 6.

Table 6. Normalized matrix based on ARAS model and DEA score for IEPMI

Industry	**Nominal capacity**	**Nominal capacity**	**Nominal capacity**	**Nominal capacity**	**Si (for outputs)**	**Initial feed**	**Initial feed**	**Initial feed**	**Initial feed**
(1)	0	0.9090	0	0	4.1727	4.75E-06	0.0017	0	0
(2)	0	0.0909	0	0	0.4172	5.59E-05	0.0088	0	0
(3)	0.0002	0	0	0	0.0028	2.46E-05	4.87E-05	0	0
(4)	4.39E-05	0	0	0	0.0005	7.73E-05	1.88E-05	0	0
(5)	1.18E-05	0	0	0	0.0001	0.9988	0	0	0.6812
(6)	0.0002	0	0	0	0.0028	2.25E-05	1.71E-05	0	0
(7)	0.0004	0	0	0	0.0057	0.0001	2.43E-05	0	0
(8)	0.0002	0	0	0	0.0028	5.59E-06	2.64E-05	0	0
(9)	4.39E-05	0	0	0	0.0005	3.28E-05	4.56E-06	0.0064	0
(10)	1.09E-05	0	0	0	0.0001	2.01E-05	0.604	0	0
(11)	0.0002	0	0	0	0.0034	3.94E-05	0.0001	0	0.0947
(12)	4.39E-05	0	0	0	0.0005	2.92E-05	1.50E-06	0.0054	0.0529
(13)	2.19E-05	0	0	0	0.0002	3.35E-05	0	0	0
(14)	0.0002	0	0	0	0.0028	3.35E-05	0	0.0644	0
(15)	0.0010	0	0	0	0.0144	5.88E-05	0.0001	0	0
(16)	0.0002	0	0	0	0.0031	3.09E-06	2.03E-05	0.0035	0
(17)	4.39E-06	0	0	0	5.78E-05	0.0001	0.0005	0	0
(18)	4.39E-05	0	0	0	0.0005	2.07E-05	0	0.0074	0
(19)	2.19E-05	0	0	0	0.0002	1.23E-05	1.08E-05	0	0.0075
(20)	4.39E-05	0	0	0	0.0005	3.51E-05	0.0001	0.0070	0.0971
(21)	0.0001	0	0	0	0.0014	7.00E-05	3.86E-07	0.01421	0.0663
(22)	0.0001	0	0	0	0.0020	4.11E-05	0	0	0

(23)	0.0004	0	0	0	0.0057	7.40E-05	0.0042	0	0
(24)	0.0043	0	0	0	0.0578	2.96E-06	3.94E-05	0	0
(25)	0.0010	0	0	0	0.0144	2.91E-05	0.0003	0.1160	0
(26)	0.0002	0	0	0	0.0028	4.63E-05	0.0001	0.0777	0
(27)	0.0017	0	0	0	0.0231	4.70E-05	5.65E-05	0	0
(28)	8.78E-05	0	0	0	0.0011	7.51E-05	2.40E-06	0	0
(29)	0.0002	0	0	0	0.0028	9.44E-07	0.0001	0	0
(30)	0.9881	0	0	0	13.014	2.18E-05	0.0001	0	0
(31)	0.0001	0	0	0	0.0017	1.67E-06	0.3759	0.0123	0
(32)	0	0	1	0	4.61	1.14E-05	0.0026	0	0
(33)	0	0	0	1	4.56	2.80E-07	1.38E-05	0.6851	0
Employee	**Power**	**Water**	**Fuel**	**Land**	**Initial feed**	**Initial feed**	**Initial feed**	**Si (Inputs)**	**DEA**
0.0403	0.2002	0.0776	0.0289	0.0345	0	0	0	4.8718	0.85649
0.0100	0.0073	0.0093	0.0173	0.0172	0	0	0	0.7709	0.54127
0.0302	0.0090	0.0217	0.0289	0.0269	0	1	0	5.838	0.00049
0.0193	0.0161	0.0248	0.0231	0.0248	0	0	0	1.2525	0.00046
0.0327	0.0070	0.0217	0.0231	0.0237	0	0	0	21.116	7.39E-06
0.0218	0.0134	0.0217	0.0115	0.0151	0	0	0	0.9928	0.00291
0.0218	0.0124	0.0217	0.0173	0.0172	0	0	0	1.0605	0.00545
0.0125	0.0095	0.0124	0.0115	0.0172	0	0	0	0.7371	0.00392
0.0167	0.0088	0.0155	0.0173	0.0215	0	0	0.2622	2.2625	0.00025
0.0243	0.0467	0.0341	0.0462	0.0517	0	0	0	7.4769	1.93E-05
0.0167	0.0080	0.0124	0.0173	0.0172	0	0	0	1.4162	0.00245
0.0201	0.0203	0.0155	0.0115	0.0140	0	0	0	1.3472	0.00042
0.0209	0.0058	0.0186	0.0231	0.0215	0	0	0	1.024	0.00028
0.0193	0.0132	0.0248	0.0231	0.0215	0	0	0	1.5680	0.00184
0.0570	0.0824	0.0962	0.0404	0.0442	0	0	0	3.855	0.00375
0.0218	0.0176	0.0279	0.0231	0.0269	0	0	0	1.3845	0.00229
0.0780	0.0435	0.0496	0.0289	0.0366	0	0	0	2.8647	2.01E-05
0.0142	0.0080	0.0155	0.0173	0.0172	0	0	0	0.8749	0.000661
0.0151	0.0141	0.0186	0.0173	0.0204	0	0	0.7377	4.7098	2.62E-06
0.0193	0.0075	0.0186	0.0173	0.0248	0	0	0	1.6517	0.00035
0.0235	0.0048	0.0155	0.0173	0.0194	0	0	0	1.4257	0.00101
0.0142	0.0097	0.0124	0.0115	0.0107	0	0	0	0.6921	0.00292
0.0545	0.0166	0.0372	0.0173	0.0204	0	0	0	1.7859	0.00323
0.0226	0.0137	0.0186	0.0231	0.0280	0	0	0	1.2257	0.04718
0.0764	0.0707	0.0559	0.0578	0.0658	0	0	0	4.5967	0.00314
0.0226	0.0149	0.0248	0.0693	0.0302	0	0	0	2.263	0.00127
0.0243	0.0205	0.0155	0.0173	0.0204	0	0	0	1.170	0.01976
0.0151	0.0110	0.0155	0.0115	0.1251	0	0	0	1.999	0.00057
0.0747	0.0269	0.0465	0.0289	0.0345	0	0	0	2.5249	0.00114
0.0167	0.0369	0.0248	0.1156	0.0258	0	0	0	2.4269	5.36231
0.0293	0.0354	0.0279	0.0289	0.0312	0	0	0	5.066	0.00034
0.0873	0.1669	0.0962	0.0578	0.0614	1	0	0	10.185	0.45260
0.0251	0.0193	0.0496	0.0982	0.0312	0	0	0	6.6287	0.68790

According to the last column of Table 6 the DEA score for IEPMI is recommended as 30 > 1 > 33 > 2 > 32 > 24 >27> 7 > 8 > 15 > 23 > 25 > 22 > 6 > 11 > 16 > 14 > 26 > 29 > 21> 18 > 28 > 3 > 4 > 12 > 20 > 31 > 13 > 9 > 10 > 17 > 19 > 5.

The collection of an inventory for available facilities is a prominent aspect of a simple economic estimation of industries to find the breakeven point shortly in the establishment of the industry as well as management aspects and knowledge in parallel with industry 4.0 purposes. Therefore, by Table 7 we presented the availability.

Table 7. All available facilities of IEPMI

Industry	Facilities
(1)	Medium, delicate and very delicate tensile machines, with 19 stretching steps, 60 kw (individually 1 No); Vertical and horizontal lacquer machines, for d>0.6 and 0.7 <mm (1 and 1 No); Lab (1 unit)
(2)	Impact press machine of 40 tons (1 No); Automatic cutting machine (1 No); Guillotine, w= 2 m (1 No); Drill MS 20, 1 kw (1 No); Polishing machine, 1 kw (1 No); Manual press machine of MP2, pressure of 2000 kg (1 No); Manuall scissor (1 No); Assembly table in size of 1.5*3 m^2 (1 No); Packaging table, 1*2 m^2 (1 No); Frames (6 No)
(3)	Conveyor, L and W= 25 and 3.4 m, 5 m/min (1 No); Table, L and d= 25 and 0.4 m (1 No); Drill, 0.5 kw (2 No); Martin Boiling Point Machine, 5 kw (1 No); Coil, 500 rpm (1 No); Penomatic press machines of 0.5 and 2 tons, 20 and 30 L/min (1 and 1 No); Manual press of 100 kg (1 No); Screw tightening machine, 2 tons, 30 L/min (1 No); Soldering System, 100 watts (2 No); Welding machine, 250 A, 6 kw (1 No); Manual device and tools (1 pack); Plastic sewing machine, 0.8 kw (1 No); Mold (1 No); Fitted lab (1 unit); Transportation equipments (1 pack)
(4)	Conveyor, L and d= 25 and 3.4 m, 5 m/min (1 No); Table, Land d= 25 and 0.4 m (1 No); Martin Boiling Point Machine machine, 5 kw (1 No); Drill, 0.5 kw (2 No); Coil, 500 rpm (1 No); Penomatic and manual press machines, 0.5 ton and 20 kg (1and 1 No); Penomatic press machine of 2 tons and 30 L/min (1 No); Tightening machine, 2 tons, penomatic and 30 L/min (1 No); Soldering System, 100 watts (2 No); Welding machine, 250 A, 6 kw (1 No); Manual device (1 pack); Sewing machine, 0.8 kw (1 No); Frame of main body (1 No); Fitted lab, repapir workshop and transportation facilities (individually 1 unit)
(5)	Conveyor, L= 14 m, W= 0.5 m, 4 kw (1 No); Assembling table, L, h and W= 15, 0.8 and 1 m (1 No); Worktable, L, h and d= 1.5, 0.8 and 1 m (15 No); Pots made of tin (15 No)
(6)	Injection machine, 150 g (1 No); Impact guillotine, 10 tons (2 No); Screw bobbine machine, 1 kw (3 No); Molds (4 No)
(7)	Impact press machine of 6 tons, 3 kw (1 No); Penomatic press machine, 2 tons (1 No); Guillotine, w= 2m, 3 kw (1 No); Injection machine,150 g, 20 kw (1 No); Dyeing room (1 No); Compressor, 150 L, 2 kw (1 No); Drill, 1 kw (1 No); Molds (7 No); Roll flattening machine, 1 kw (1 No); Transformator (1 No)
(8)	Plastic injection machine, 200 g, 12 kw, 1800 bar (1 No); Impact press machine of 15 tons (1 No); Guillotine, w= 2 m (1 No); Manual press, 2 tons (2 No)
(9)	Drill, d= 1 mm (1 No); Compressor, 200 L/min (1 No); Transmission boxes, 20 holes (2 No); Fan, 3000 rpm, 0.5 kw (1 No); Hot acid chamber equipped to thermal elements (1 No); Tin chamber in size of 16*12*5 m^3 (1 No); Generator signal AF, 20-20000 Hz (1 No); Oscilloscope, double channel, 20 mege hertz (1 No); Fitted lab (1 No); Washing chamber in size of 0.5*0.5 m^2 (4 No)
(10)	Automatic cutter (1 No); Guillotine (1 No); Impact presses of 53, 40 and 12 tons (individually 1 No); Hydraulic press, 40 tons (1 No); Universal scraping machine (1 No); Pillar drill (1 No); Welding machine (1 No); Compressor 550 L/min (1 No); Electrical rectifier, 400, 2500 and 7500 A (3 No); Small chamber (7 No); Saw (1 No)
(11)	Penomatic press, 30 L/min, 500 kg (2 No); Manual press, 100 kg (1 No); Welding machine, 12 kw (1 No); Coil machine, 1200 rpm, 0.85 kw (1 No); Digital ohm meter (1 No); Hydraulic press, 4 tons, 1.5 kw (1 No); Conveyor, w and L= 40 cm and 40 m (1 No); Tightening machine with compressed air 40 L/min (1 No); Digital multimeter (1 No); Dielectric test, 2500 V (1 No); Fitted lab and repair workshop (1 and 1 unit); Compressor, 500 L, 4 kw (1 No); Worktable, in size of 0.6*1*2 m^2 (20 No)
(12)	Oscilloscope, 20 meg h (2 No); Oil bath, d= 165 mm (1 No); Printer (1 No); Plotter, 8 series (1 No); Air blowing devices (2 series); Computer, 486 SX (1 No); Testing equipment (1 serie); Soldering equipment, 2 kw (1 serie)
(13)	Tin bath, 3 kw (1 No); Tin maker machine, pedal type (1 No); Axial and redial forming machine (2 No); LCR meter C = IPF 1100 μ F (1 No); HM 250 model (1 No); Molti meter DL 712 and digital type (3 and 10 No); Oscilloscope 100 and 20 MHZ (2 and 3 No); Function generator of 2 and 10 MHZ (2 No); Frequency measurement machine , 100 and 250 MHZ (5 and 1 No); Generator signal, 1 mega Hz, (1 No); Printer and computer 10386 and 1060 Dx (1 No); Plotter, 8 No (1 No); Air user equipment (2 series); Repair workshop (1 unit)

(14)	Fiber cutting machine (1 No); Quality control equipment (2 series); Fiber perforating machine CNC (1 No); Silk printing machine (1 No); Conveyor, L= 10 m (2 No); Plastic injection machine, 100 g (1 No); Fitted warehouse (1 No); Automatic soldering machine (1 No); Compressor, 500 L(1 No); Impact press, 100 tons (1 No); Fitted lab (1 unit); Transmission wire and power panel (1 serie); Al and plastic mold (1 serie); Manual forklift (1 No); Miscellaneous equipment (1 serie)
(15)	Thermoset injection machine, 150 and 100 tons (3 and 4 No); Polishing device (1 No); Guillotine (1 No); Impact press, 63 and 35 tons (1 and 2 No); Drill (4 No); Automatic cutting machine (3 No); Thermoset and steel molds (1 and 1 series); Conveyor, L= 8 m, 3 m/min (1 No); Compressor, 10 bar, 440 l/min (1 No)
(16)	Injection machine, 100 g (1 No); Scraping machine (4 No); Press machine, 10 tons (1 No); Guillotine, w = 2 m (1 No); Pillar drill (2 No); Roll machine (1 No); Plating machine (1 No)
(17)	Hydraulic press, 100 tons, 20 kw (4 No); Impact press, 40 tons, 15 kw (2 No); Metal frames (20 No)
(18)	Transmission boxes containing 20 holes, in size of 45*32 cm^2 (4 No); Fan, 3000 rpm, 0.5 kw (1 No); Hot acid chamber in size of 60*40*30 cm^3 with element (1 No); Tin chamber in size of 5*10*15 cm^3 (1 No); Funnel control table with test circuit (1 No); Oscilloscope (1 No); Drill, d= 1 mm (1 No); Compressor with capacity of 200 L (1 No); Fixture and shablon (1 No)
(19)	Plastic injection machine, 200 g (1 No); Norton system (1 No); Cutting machine of TN50 (1 No); Pilar drill MS 20 (1 No); Fitted lab (1 unit); Manual press, 2 tons (1 No); Dryer, 25 kg/h (1 No)
(20)	Screw bobbine machine, 500 w (2 No); Drying furnace, 200 ℃, 1500 w (1 No); Hot steam boiler, W= 25 cm, 2 kw (1 No); Test machine, 150 w (1 No); Winding screwdriver (1 No); Jack and fixer (1 No); Switching off and forming station (1 No); Electronic balance, 1 kg (1 No)
(21)	Print machine (1 No); Corrosion Equipment for production of 500 m^2 of printed circuit board (1 No); Impact press, 15 tons, 2.5 kw (1 No); Cutting and forming tools in series (1 No); Tin machine, 2.2 kw (1 No); Control tools, back layout and serial repair (1 No); Electronic wiring test system, 100 w (1 No); Test machine of device life time, for 45 relay machines, 200 w (1 No); Penomatic screwdriver (2 No); Components of assemblies and manual tools in series (2 No); Osciloscope, 20 mega hertz (2 No); Digital multi meter, 6 DM, 392 (4 No); Feeder resource, 0-30 V, 3 A (2 No); LCR meter, R=0.001Ω-110Ω, L:0.1H -1100H C=1PF-1100 µF (1 No); Full performance check and test station, 200 w (1 No); Test device for insulation (1 No)
(22)	Canwire machine, 5.5 kw (1 No); Various frames (16 No); Assembly equipment (1 unit); Test and check equipment (1 unit); Packaging equipments (2 No); Repair workshop (1 No)
(23)	Press machines of 15 and 20 tons (1 and 2 No); Drill (2 No); Manual bobbin machine (6 No); Drying furnace (1 No); Fat removal tanks, 1 m^3 (4 No); Assembling table (3 No)
(24)	Plastic injection machine, 100 g, 8 kw (1 No); Automatic fixture (10 No); Worktable (10 No); Conveyor, L= various, W=1-20 cm (2 No); Automatic packaging machine (1 No); Manual press machines, 1 ton (5 No); Machine making base connections, 1000 No/h (1 No); Printing machine (1 No)
(25)	Diaphragm machine, 3 kw (6 No); Coils, 5 kw (4 No); Magnittazer 5.5 kw (3 No); Gluing Machine, 3 kw (3 No); Cutting machine (2 No); Tension machine, 25 tons (1 No); Impact press, 40 and 63 tons (2 and 2 No); Lathe, size 50/1000 (3 No); Soldering machine (5 No); Assembly equipment (1 No); Frames (24 No); Fiberglass chamber, 100 L (8 No); Power trans, 12 V, 1500 A (1 No); 10 kg roller (6 No); Lab (1 unit); Other plating facilities (1 No)
(26)	AL melting furnace, capacity of 400 kg (1 No); Dye cast, capacity of 750 g (1 No); Impact press, 15 tons (1 No); Drill (3 No); Drill M 620, 130 MM (1 No); Guillotine, W= 2 m (1 No); Compressor, 1.5 kw (1 No); Bending machine (1 No); Manual forklift (1 No); Dyeing equipment (1 Pack)
(27)	Guillotine (1 No); Impact press, 6 tons (1 No); Bakalite press (2 No); Hydraulic press, 2 tons (1 No); Automatic cutting machine (1 No); Manual press (2 No); Penomatic punch machine (2 No); Drill (2 No); Rolling machine (1 No); Buffing machine (1 No); Compressor, 550 L/min, 5 Kw (1 No); Assembling table (1 No); Packaging table (1 No)
(28)	Drill (1 No); Compressor, 200 L (1 No); Fixer and Shablon, 20 rows (2 No); Fan, 300 rpm, 0.5 kw (1 No); Hot acid tank equipped to thermal element, 70*30*45 cm^3 (1 No); Reflex and tin chamber, in size of 5*10*15 m^3 (2 No); Osciloscope, 20 mega hertz (1 No); AF and RF generators, 1 ohm meter (1 No); Machines of producing radio box framework (2 No)
(29)	Guillotine, 3 and 1.2 m (1 and 1 No); Acid spray compressor (1 No); Impact press, 10-30 tons (3 No); Bending manually (1 No); Automatic screw bobbine machine (2 No); Assembly table (17 No); Press machine mold (6 No)
(30)	Drill (2 No); Manual press, 2 tons (3 No); Automatic screw bobbine machine (3 No); Lacquer machine (1 No); Conveyor dryer (1 No)

(31)	Impact press, 25 tons (1 No); Injection machine, thermoplast, 100 g, 50 tons (1 No); Injection machine, thermoset, 294 cm^3, 932 KN (1 No); Welding machine, 11 kw (1 No); Automatic slot machine (2 No); Polishing machine (2 No); Fat removal machine (1 No); Plastic molds (24 No); Assembling machine (2 No); Test and control machine (1 No); Repair workshop (1 unit)
(32)	Large and fine tension machines (1 and 40 No); Extruder 60 (1 No); Weaver (24 No); Screw duct (30-40 No); Extruder 80 (1 No); Skein machine (1 No)
(33)	Designing, sampling and lithograph machine, 375 mm, 60000 rpm, 5 kw (1 No); Cutting machine, 5-8 m/min, 7 kw, containing 200 L/min compressed air (1 No); Drill machine, 11000-10000 rpm, 6 kw (2 No); Screen printing, 400*400 and 250*220 mm, 4 bar and 1 kw (3 and 31 No); Metallized machine, 1 kw (1 No); Acid spray machine (1 No); Press machine of 10 bar, 2.5 kw (1 No); Infrared dryer, containing 4 thermal spots, 600 ℃ (1 No); Hot air drier with 13 thermal spots, 60 cm/min (1 No); Tin machine, 2.5 m/min, 6.5 kw (1 No); Penomatic assembling machine, 5 kw (1 No); Automatic feeder table, 3 kw (1 No); Softwares such as Cad, Libraries Desi, isotate cad link (individually 1 No); Compressor, 5 atm, 1 m^3/min (1 No); Special ventilator (3 No); Lab (1 unit)

L=Length, d=Diameter, H= Height, W=Width

4. Conclusion and outlook

Iranian industries are trying to select practices and approaches to promote product quality and escalate productivity in parallel with Sustainable Development (SD) purposes and pave the way towards industrial ecology connections. The difficulties unearthed in developing industrial ecology get back to challenge associated with materials and energy stream networks and scarcity of a useful database to design and execute them. Therefore, this data can be used as a reference for above-named industries globally as well as simplicity in the economic estimation of industries in SD assessment. According to recent studies, there is no similar research published across all IEPMI to cover energy demand, materials streams, the flow-diagram of industries and existing facilities. There is no database about the preliminary screening of IEPMI prior to constructing them, ranking and weighing the industries and their criteria. The current data encompassed the most authoritative database for IEPMI, which is the first report in English in this regard.

By the present study, the evaluation of IEPMI passed through a certain framework in accordance with the model presented in Figure 1. The public involvements of the IEPMI paved the possibility of passing to the next stages and further evaluation. Depending on the available data (data obtained from the screening step), decision-making systems were provided the final step for directing the projects. Although the unsupervised method had released a poor outcome but contains high similarities with supervised systems. The supervised systems were followed in the same results for the ranking of the industries, which conducted a new method for classifying and comparing industries based on common criteria. For future work suggestions, all inventory of industries can be reported and shifted on currency values to distinguish the efficiency of industries using the DEA model. But in this study, this trend was examined in DEA based on additive models in order to classify IEPMI according to an inventory of input and output values. The hierarchical cluster and DEA model were also offered a new classification for IEPMI. Also, the present study used all raw data to complete the initial screening of Iranian evaluator team to final steps of decision-making systems in EIA discussion.

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