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ENVIRONMENTAL PERFORMANCE EVALUATION OF SOME INDUSTRIAL FIRMS DUE TO ISO 14031 STANDARD

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Abstract: This research aims to evaluate six of Baghdad Industrial firms in different sectors in Baghdad due to ISO 14031 Standard in order to know the effects of factories on the environment, create a database for comparison with certain time periods, continuous improvement of environmental performance, and increasing environmental awareness. Environmental Performance Evaluation (EPE) includes two types of indicators, Environmental Performance Indicators (EPIs) and Environmental Conditions Indicators (ECIs). The research focus on (EPIs) which includes two types of indicators, Management Performance Indicators (MPIs) and Operation Performance Indicators (OPIs). (MPIs) includes performance and infrastructure Indicators and Training Indicators, and (OPIs) include Industrial and occupational safety indicators and an environmental control indicators.
In this research, a questioner list with a five Likert Scale level was suggested. The questionnaire lists were answered by employees specializing in environmental aspects in the Middle Refineries Company, South Baghdad thermal power station, General Company for Textile and Leather, Battery Factory, General Company for Food Products, and The Cotton Factory. The data of questionnaire lists were converted to information by statistical equations, SPSS program used to calculate ANOVA table to compare averages of differences between indicators that have been subjected to different treatments in order to arrive at the indicator that makes average is different from other averages.

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1. Introduction

The International Organization for Standardization (ISO) is an organization that has members from all over the world, regardless of the state of the country they work for, whether it is large industrial development countries or under-developed countries, the organization has over 18,000 standards regarding the social, economic as well as environmental aspects of sustainable development [1].

ISO standards can be applied for any organization, irrespective of its complexity, location, size or type. In an organization, implementing ISO standards can assist in providing supervisory assistance on the use as well as the design of the (EPE) [2].

(EPE) was developed by ISO/TC 207 Sub-committee (SC4). EPE can be defined as a management tool that gives industry managers acquaintance and data about how good an industry's environmental system is performing

and whether or not the goals of the environmental policy are being achieved. EPE is an auditing tool for measures whether the environmental, goals, objectives, aspects and other environmental performance criteria are being met[3][4].

For that, EPE is considered as an ongoing process that guarantees any changes to an industry's products, activities, and services that might affect environmental performance are accounted for in its environmental management system.[2].

(SC4) and its Working Groups (WGs) have worked together to prepare International Standard ISO 14031. ISO 14031 is considered as the key performance indicators (KPIs) of an industry's managers to recognize, assess, and communicate the area of improvement in EPE. [3][4] Figure 1 shows the relationship between the ISO 14000 series of Standards.

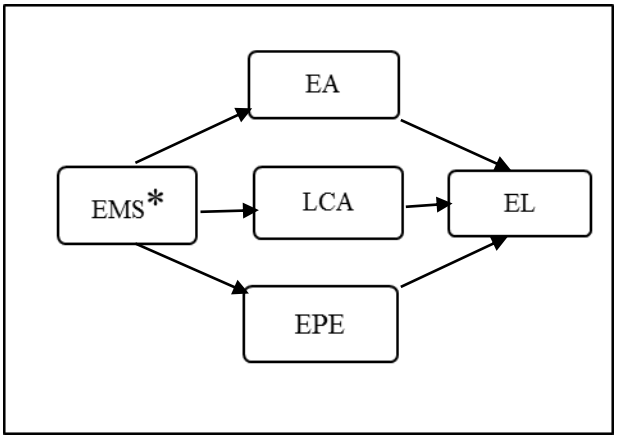

Figure 1. Relationship between the ISO 14000 series of Standards[3]. *EMS: Environment Management System, EA: Environmental Auditing, LCA: Life Cycle Assessment, EL: Environmental Labels and Declarations, EPE: Environmental Performance Evaluation.

2. ISO14031 Standards Definition

ISO 14031 describes EPE as "a process to facilitate management decisions regarding environmental performance by selecting indicators, collecting and analyzing data, assessing information against environmental performance criteria, reporting and communicating, and periodic review and improvement of this process" [3][5].

ISO 14031 can work as a monitoring tool that provide the industry with data/information for[4][6]:

- identifying environmental aspects,
- relating environmental impacts and determine which are significant,
- tuning criterial for environmental performance,
- pointing out environmental performance easily,
- identifying inter-relationships of different management functions,
- producing concerns and requirements,
- supporting any review process.
- identifying areas for action and risk analysis.

Additional tools like environmental1reviews and life1cycle assessment (LCA) are giving additional data for EPE. LCA is estimating the environmental aspects and potential impacts associated with the life cycle of products[5].

(EMS) involves the consideration of all factors that have an influence on the environment. This includes the extraction of raw materials, supplies to factories for manufacturing, supplies to packing industries and finally supplies to places for sales. It is worth mentioning that waste is produced at every step of this cycle[7].

The design of EMS ensures the maintenance of all environmental features regarding an organization, where this process simply involves adequate management of organizing and distributing data on the monitoring documents [5][7].

The organizations which do not have EMS should consider the following factors;

- the possibilities of incidents,
- conditions of the environment,
- risks,

- emiss

- the scale of material and energy usage along with the legal and regulatory requirements [8].

The evaluation of corporate environmental performance can have two real uses. First, to decrease the pressure on the Earth's ecosystem from a sustainability point of view, as enterprises are doubtlessly huge contributors. Second, to reach better market positions and optimize the organization [6][9]. Figure 2 shows an interrelationship among an organization's environmental conditions and its operations as well as management [3].

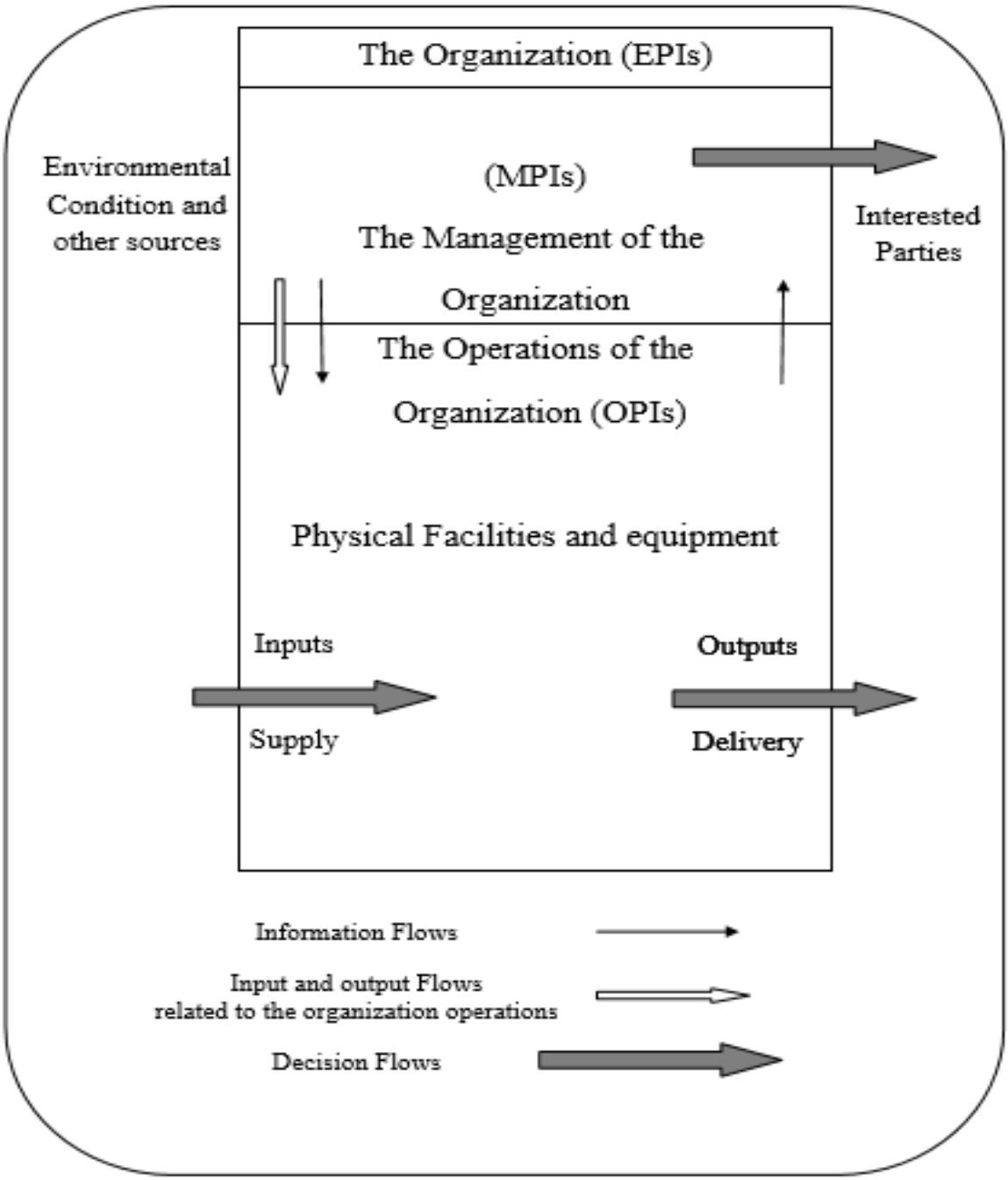

Figure 2. Interrelationships among an organization's environmental conditions and its operations as well as management [3]

EPE of ISO 14031 states that in the universal categorization to ECI and EPI indicators, EPIs are commonly used which are divided to MPIs and OPIs, and ECIs offer data regarding the environmental conditions which might be at the local, regional, national or global levels and may contribute to the evaluation of EP within an organization [10].

The use of (EPIs) is needed for monitoring as well and evaluating the impacts of any development plan. This helps in ensuring that the plan or the desired project consists of the required positive impact[10].

In addition, EPIs can also be used for monitoring the chances of any probable opposing events that may take place and hence can assist in the overall protection against such events by motivating the users to take necessary actions [10][11].

Furthermore, as previous works show, EPIs are helpful in several decision-making procedures, which require selecting environmental viewpoints as well as aspects that are required to be managed. In addition, EPIs can help with the scrutinization of the environmental performance items, which are needed to be enhanced [12].

3. Performance Indicator Calculation

In order to calculate the indexes of the appreciation, the researcher chooses four indicators as an example of calculation and used the following steps :

3.1 The researcher chooses five-level Likert scale questioners to facilitate the process of collecting information from employees, as shown in Table 3(a)

Table 3(a). Categories of likret scale

Types of Range	Scale	Categories	Importance Level	Weight
1st range	100-80	Strongly Applied	Very Importance	5
2nd range	80-60	Applied	Importance	4
3rd range	60-40	Undecided	Moderate Importance	3
4th range	40-20	Not Applicable	Little Importance	2
5th range	20-0	Strongly Not Applicable	Non Importance	1

3.2 Cronbach's Alpha tests used to evaluate the consistency of the questioner lists to ensure the instrument is capable enough to provide same results for the tests even if repeated multiple times under similar conditions, where the Cronbach's Alpha value must be more than 0.5 to have strong reliability, by SPSS program: Cronbach's Alpha = 0.942 > 0.5, the questioners has high reliability

Where:

f: frequency of classification

n: total number of factories

(F) = 1/6 = 0.167 for each factory

(RF) = [f/ n] *100% Eq. (2)

(RF3)= (1/6)*100% = 16.7 for Battery Factory answer Undecided (W=3).

3.3 Take the criteria (4.1) as an example of calculation.

3.3.1 Calculate the Frequency (F) and Relative Frequency (RF), of questionnaire lists, answer using equations (1) and (2) for criteria (4.1) for each factory as shown in Table 3(b). for frequency calculation [15].

Frequency (F) = [f/ n] Eq. (1)

(RF4)= (5/6)*100% = 83.3 for Middle Refineries Company, General Company for Food Products, South Baghdad Thermal Power Station, General Company for Textile and Leather, and The Cotton Factory answer Applied (W=4).

These calculations can be easily calculated by SPSS program .

Table 3(b). Frequency of criteria (4.1)

Factory name	Questionnaire answer	Frequency (F)	Relative Frequency (RF)
South Baghdad thermal power station	Applied	1 from 6	16.7
Middle Refineries Company	Applied	1 from 6	16.7
General Company for Textile and Leather	Applied	1 from 6	16.7
The Cotton Factory	Applied	1 from 6	16.7
Battery Factory	Undecided	1 from 6	16.7
General Company for Food Products	Applied	1 from 6	16.7

3.3.2 Calculation of the Appreciation Weight (AW) for criteria (4.1) using equation (3) for all industrial factories [15].

(AW) = [(RF* W)/100] Eq.(3)

Where:

$AM_{(\text{for criteria } 4.2)} = 3.84$

$AM_{(\text{for criteria } 4.3)} = 3.67$

$AM_{(\text{for criteria } 4.4)} = 3.67$

3.3.4 Calculation the Appreciation Rate (AR)%

W : weight of likert classification

AW_3 = [16.7*3)/100] = 0.50 for Battery Factory

AW_4 =[(83.3*4)/100] = 3.33 for Middle Refineries Company, General Company for Food Products, South Baghdad Thermal Power Station, General Company for Textile and Leather, and The Cotton Factory.

3.3.3 Calculation the Appreciation Mean (AM)

$$AM = \sum AW \quad \text{Eq. (4)}$$

$AM_{(\text{for criteria 4.1})}$ = 3.3 +.5 = 3.83, and

$$(AR)\ \% = \frac{AM}{no.of\ likret\ classification.} \quad \text{Eq. (5)}$$

$AR\%_{(\text{for criteria 4.1})}$ = [3.83/5]*100% =76.6%, and
$AR\%_{(\text{for criteria 4.2})}$ = 76.7%
$AR\%_{(\text{for criteria 4.3})}$ = 73.3%
$AR\%_{(\text{for criteria 4.4})}$ = 73.4%

Table 3(c). shown the result of calculation . and Tables 3(d) and 3(e) shows the Summary of (AM) and (AR %) once for All Factories and once for each factory.

Table 3(c). Appreciation Rate (AR) % for criteria 4.1

IN4.1) The organization works by control on the quantity of effluent	F	RF%	AW	AM	AR%
Undecided (W=3)	1	16.7	0.50		
Applied (W=4)	5	83.3	3.33	3.83	76.6%
Total	6	100.0	-		

Table 3(d). Summary of (AM) and (AR %) for each criterion and all factories

Criteria no.	Indicator One		Indicator Two		Indicator Three		Indicator Four	
	AM	AR%	AM	AR%	AM	AR%	AM	AR%
1	4.00	80	4.01	80.1	4.00	80	3.83	76.6
2	3.84	76.6	4.17	83.3	3.83	76.6	3.84	76.7
3	4.01	80.1	4.34	86.7			3.67	73.3
4	4.01	80.1					3.67	73.4
5	3.93	76.6						
6	3.83	76.6						

Table 3(e). Summary of (AM) and (AR %) for each indicator and each factory

Indicator No.	South Baghdad thermal power station		Middle Refineries Company		General Company for Textile and Leather		The Cotton Factory		Battery Factory		General Company for Food Products	
	AM	AR%	AM	AR%	AM	AR%	AM	AR%	AM	AR%	AM	AR%
1	4.0	80.0	4.2	83.3	3.8	76.7	3.3	66.7	4.0	80.0	4.2	83.3
2	4.3	86.7	5.0	100.0	4.0	80.0	3.7	73.3	4.0	80.0	4.0	80.0
3	3.5	70.0	4.5	90.0	4.0	80.0	3.0	60.0	4.0	80.0	4.5	90.0
4	4.0	80.0	4.0	80.0	4.0	80.0	3.0	60.0	3.0	60.0	4.0	80.0

4. Result and Discussion

Iraqi environmental legislation does not oblige factories to comply ISO 14031 standards, therefore, there's not acceptance rate to evaluate the result with it , so the researcher assumes rate 80% to compare AR% with it, once for each criteria and all factories and other for each indicator and each factory, Tables 4(a) and 4(b) shows the comparison with assumption rate 80%,to determine if the AR are applied or unapplied to ISO 14031.

Table 4(a) Comparison for each criterion and all factory with limit 80%

Criteria No.	*IN (1)	IN (2)	IN (3)	IN (4)
1	App.**	App.	App.	Unapp. ***
2	Unapp.	App.	Unapp.	Unapp.
3	App.	App.		Unapp.
4	App.			Unapp.
5	Unapp.			
6	Unapp.			

*IN(1) refers to indicator noumber,*AR%>80% ,*** AR%<80%

Table 4(b). Comparison for each indicator and each factory with limit 80%

Indicator No.	South Baghdad thermal power station	Middle Refineries Company	General Company for Textile and Leather	The Cotton Factory	Battery Factory	General Company for Food Products
1	App.	App.	App.	Unapp.	App.	Unapp.
2	App.	App.	Unapp.	Unapp.	App.	App.
3	Unapp.	App.	App.	Unapp.	App.	App.
4	App.	App.	App.	Unapp.	Unapp.	App.

The result of the AR% calculations showed that the factories can be arranged from better to worse depending on best apply of ISO 14031 standards, once for each indicator and other for all indicators as shown in Figures 4(a,b,c,d,e).

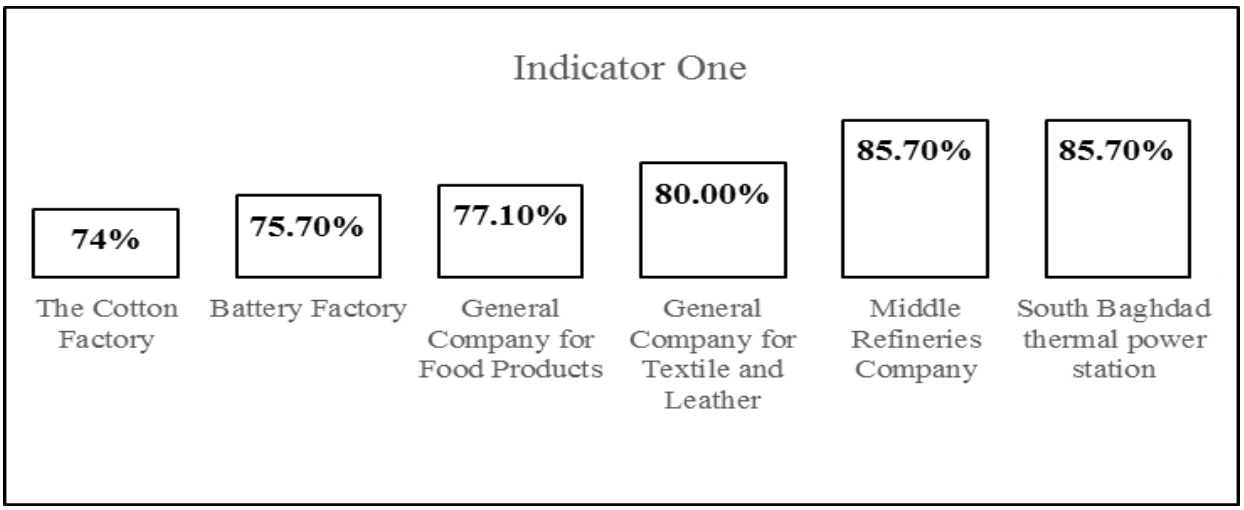

Figure 4(a). Arrange Factories According to Indicator One

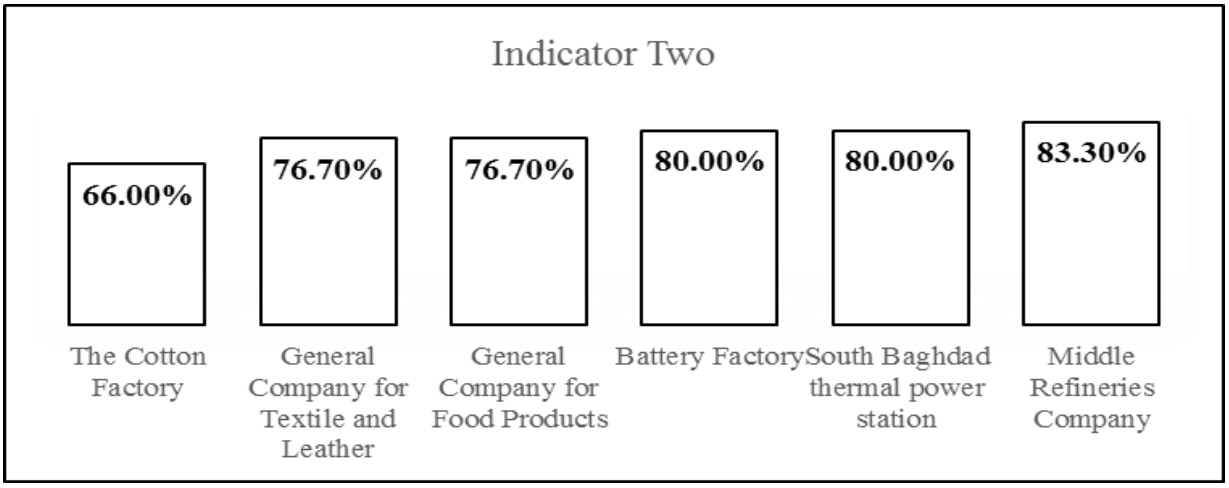

Figure 4**(b).** Arrange factories according to indicator two

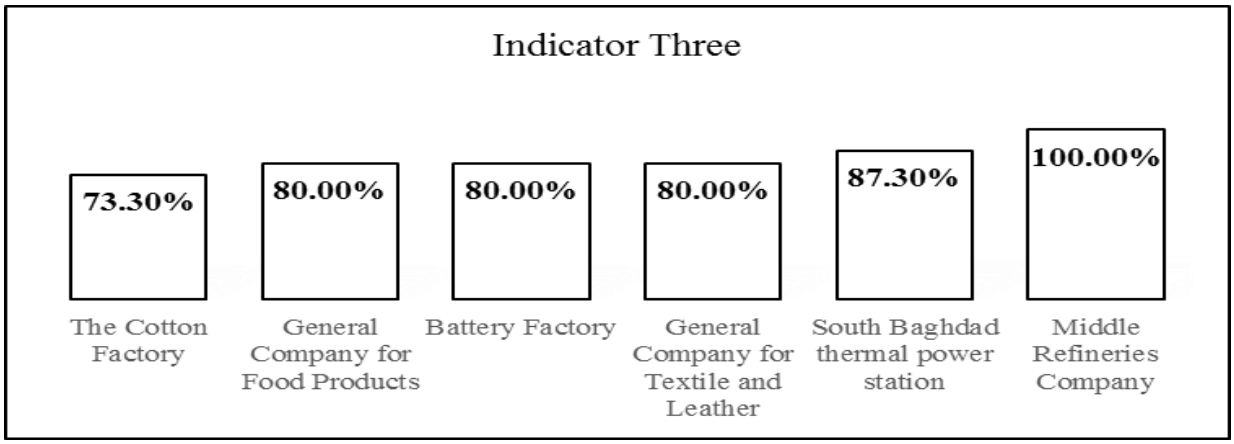

Figure 4(c). Arrange factories according to indicator three

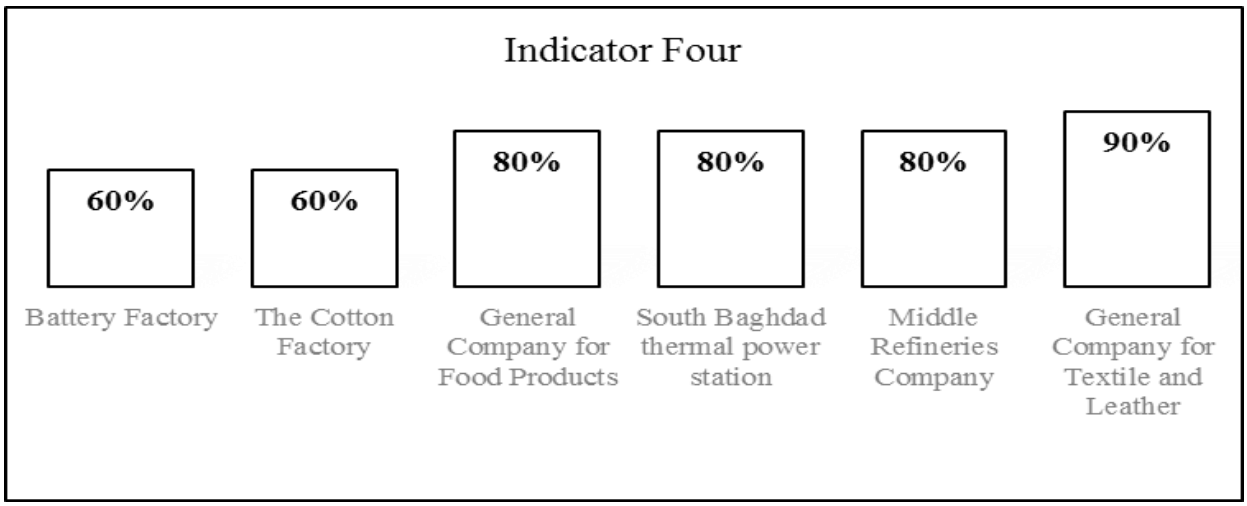

Figure 4(d). Arrange factories according to indicator four

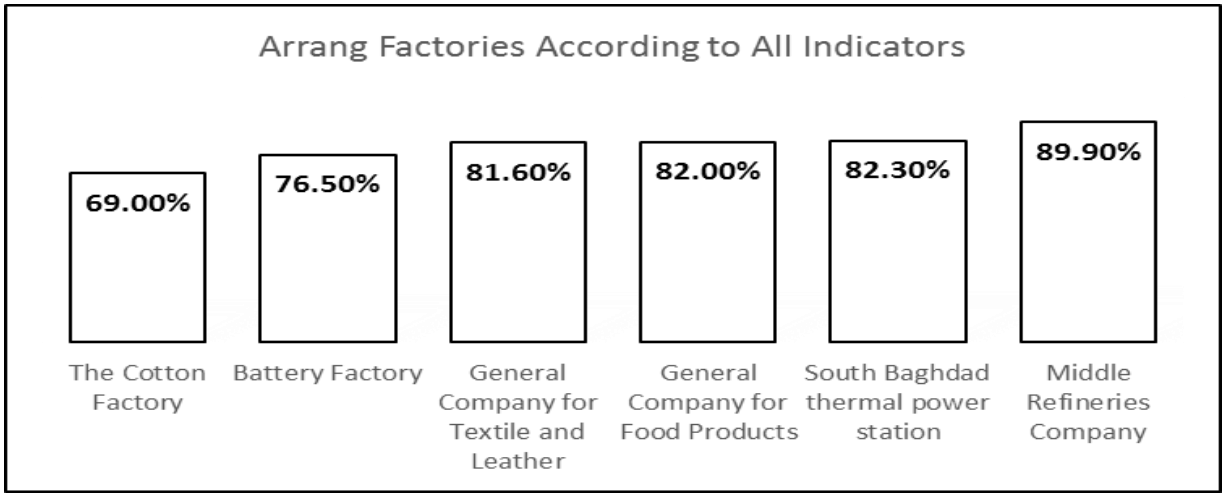

Figure 4(e). Arrange Factories According to Indicator Four

5. Conclusions

Based on the results from numerical analysis, the following points are drawn:

1. The best application rate of the first indicator, performance, and infrastructure Indicator in The South Baghdad thermal power station and Middle Refineries Company (85.7%), and General Company for Textile and Leather (80%). The unacceptable application rate is at General Company for Food Products (77.1%), Battery Factory (75.7%) and The Cotton Factory (%74).
2. The best application rate of the second indicator, Training indicator in The Middle Refineries Company (83.3%), South Baghdad thermal power station and Battery Factory (80%). The unacceptable application rate in The General Company for Food Products and General Company for Textile and Leather (76.7%), and The Cotton Factory.(%66)
3. The best application rate of the third indicator, industrial and occupational safety indicator in The Middle Refineries Company (100%), South Baghdad thermal power station (87.3), General Company for Textile and Leather, Battery Factory and General Company for Food Products (80%). The unacceptable application rate in The Cotton Factory.(%73.3)
4. The best application rate of the fourth indicator, environmental control indicator in the General Company for Textile and Leather (90%), Middle Refineries Company, South Baghdad thermal power station, and General Company for Food Products (80%). The unacceptable application rate is Battery Factory and The Cotton Factory (60%).

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7. APPENDIX (A)

Table (7). Frequency details of questioner lists answer with five likert scale for all indicators

NO.	Indicator	Rate of frequency				
		strongly applied %	Applied %	Undecided %	Not applicable %	strongly not applied %
1	Indicators of performance and infrastructure					
1.1	Saving the buildings and places of service work		6 from 6			
			100			
1.2	Saving the instruments and laboratories	3 from 6	3 from 6			
		50	50			
1.3	The activity of water net in the activity		6 from 6			
			100			
1.4	The activity of wastewater net in the activity	1 from 6	5 from 6			
		16.7	83.3			

1.5	The quantity of production achieved		3 from 6 50	3 from 6 50		
1.6	The quality of production achieved	1 from 6 16.7	5 from 6 83.3			
2	Training indicators					
2.1	the organization limits that its need of training	2 from 6 33.3	3 from 6 50	1 from 6 16.7		
2.2	the individuals aptitude which works by influent works on the production from locality the training ,education, skills and experiences	1 from 6 16.7	3 from 6 50	2 from 6 33.3		
2.3	the training meet the requirements of training	1 from 6 16.7	4 from 6 66.7	1 from 6 16.7		
2.4	the organization works by evaluation its procedures to meet the requirements	1 from 6 16.7	4 from 6 66.7	1 from 6 16.7		
2.5	the organization works by procedures to sure of realizing of workers for importance of the activities that they makes in it and contribution them in inquiry of the aims		5 from 6 83.3	1 from 6 16.7		
2.6	the organization puts a procedures to awareness its members on their roles and their responsibilities in order to inquiry of the aims		5 from 6 83.3	1 from 6 16.7		
3	Industrial and occupational safety indicators					
3.1	the organization saves a special procedures for health safety for the workers during their daily work	1 from 6 16.7	4 from 6 66.7	1 from 6 16.7		
3.2	the organization saves a special procedures for industrial and occupational safety for the workers during their daily work	1 from 6 16.7	5 from 6 83.3			
3.3	the organization works by saving a anticipation procedure to sudden accidents	2 from 6 33.3 	4 from 6 66.7 83.3	 16.7		

4	Environmental control indicators					
4.1	The organization works by control on the quantity of effluent		5 from 6 83.3	1 from 6 16.7		
4.2	the organization works by control on the quantity of emission	1 from 6 16.7	3 from 6 50	2 from 6 33.3		
4.3	the organization works by controls on the environment pollution that result from effluent		4 from 6 66.7	2 from 6 33.3		
4.4	the organization works by controls on the environment pollution that result from emission	1 from 6 16.7	3 from 6 50	1 from 6 16.7	1 from 6 16.7	