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Assessment the results of QSPM in opportunities strength for electronically waste of environmental management by SWOT method in Pira Iranian drilling company

Ali Kazemi, Leila Ebrahimi Ghavam Abadi*[2]

Department of Environmental Management, Khouzestan Science and Research Branch, Islamic Azad University (IAU), Khouzestan, Iran

[1]Department of Environmental Management, Collage of Agriculture, Islamic Azad University, Ahvaz Branch, Ahvaz, Iran

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Abstract

Electronic and electrical equipment production growth and development along with their short life has led to production of enormous amount of electronic and electrical waste. The aim of the current research is to evaluate the results of QSPM matrix using SWOT analysis in aggressive strategy to environmentally manage electronic waste of Pira Iranian Drilling Company. Statistical population to answer the questionnaire included all employees (90 people) in staff department. Sample size was determined 73 people through Cochran formula while the random sampling was conducted. The results revealed that the company with the score of 2.35 has weak internal position regarding electronic and electric waste management whereas its score of 2.55 indicates its strong external position. Ultimately, primary strategies were prioritized in 3 categories the most important of which were determined as interacting with relevant organizations in order to repair and donate defective electronic and electrical equipment as well as separating them prior to the final disposal with the score of 8.8 plus using instructions in order to optimize not only collecting but also conserving electronic waste with the score of 8.11.

***Corresponding Author:** Leila Ebrahimi Ghavam Abadi ✉ leilaebrahimy@yahoo.com

Introduction

According to the report issued by the UN, a range of 20 to 50 million e-wastes have been disposed of per annum most of which are produced in the U.S. (Aali Deh Chenari *et al.* 1391). E-wastes are growing three times as fast as other kinds of waste. Meanwhile the life span of electronic products has decreased (Neyland, 2008). Electronic waste (e-waste) is considered the fastest waste production source in the European Union. On the one hand, Electronic equipment short life (Ching-Hwa *et al.* 2004) and people's diversism using new electronic devices on the other hand have turned e-waste into a global issue.

E-waste contains more than 60 types of chemical, metallic and metalloid compounds some of which are hazardous, some valuable and some others are both. Due to these hazardous elements, e-waste recycling results in both legal and environmental issues (Omrani and Alavi, 1373).

Iran, as a developing country, is suffering from this problem. Based on the statistics reported by the papers in Iran, approximately 4 million computers, 18 million television sets as well as thousands of electronic appliances have ever been disposed of Counting other electronic devices, there will be a great mass of e-waste for which no managerial or recycling plan has ever been proposed. It should be noted that such a problem is increasingly getting exacerbated (Farvandi *et al.* 1388).

The aim of the current study is to evaluate the results of QSPM matrix using SWOT analysis in aggressive strategy to environmentally manage e-waste of Pira Iranian Drilling Company.

Based on the definition provided by Organization for Economic Cooperation and Development (OECD), any device operating with electricity whose useful life has come to an end is considered as e-waste (Khetriwal *et al.* 2009). Razavi Dinani *et al.* (1391) suggested that the first and by far the most effective strategy to reduce this kind of waste is inform university students of environmental threats of such waste.

Based on Aali Deh Chenari *et al.* (1391), for the e-waste problem to be dissolved, the public should be informed to contribute to separation and collection of e-waste. Furthermore, not only does e-waste recycling need to be fully supervised but also the manufacturers should be motivated to use safe and recyclable components in electronic equipment.

Abedin Zadeh *et al.* (1391) stated that the total weighted score in Internal Factor Evaluation (IFE) matrix (strength and weakness) was calculated as 2.35 which indicates that weaknesses are more that strengths, i.e. e-waste management of Rasht suffers from weak internal position. External Factor Evaluation (EFE) matrix (opportunity and threat) with the total weighed score of 2.83 indicates that, in the present situation, e-waste management of Rasht can demonstrate high performance by enhancing the opportunities against the threats.

Astani and Lorestani (1389) noted that e-waste management of Hamedan has weak internal and external positions.

Khorzani (1386) suggested that it is suitable if focus strategy has a tendency toward growth strategy. Thus, it is suggested to both maintain current economic conditions regarding self-regulation and profitability levels and make efforts to fulfill the goals through changes in methods, culturalization, technological updates as well as software and hardware mobilization.

Based on the findings of Ylä-Mella *et al.* (2014), the waste of electronic and electrical equipment (WEEE) instruction has been executed successfully in Finland and it is turning into a law. Besides, the infrastructures for recycling e-waste have been established and e-waste collection has improved noticeably.

According to Torretta *et al* (2013), e-waste collection in Italy increased along with the rise of solid waste collection efficiency. Pilot studies in order to increase public awareness have turned out to be effective in Romania.

Kiddee *et al.* (2013) pointed that machinery development using ecological design, proper collection of e-waste, e-waste recycling and recovery through safe methods, appropriate ways to disposal, prevention of exporting used electronic equipment to developing countries and increasing public awareness of this type of waste impacts are the keys to successful e-waste management.

The study carried out by Yang *et al* (2008) revealed that as the amount of household e-waste rises, recycling capacity needs to increase, too. Proper management of WEEE will also lead to an increase in secondary sources.

Yuan (2013) believed that the city authorities are required to use the strong points including suitable geographical location and high level of the government awareness of construction waste management planning. Waste separation at source and waste remediation prior to disposal seems economically attractive strategies (Posada, 2010).

Data analysis was conducted via SPSS and Microsoft Excel was used to draw the charts. SWOT analysis and QSPM matrix were applied to evaluate strengths, weaknesses, opportunities and threats regarding e-waste management in Pira Iranian Drilling Company and to determine aggressive strategy score of e-waste management, respectively.

The strengths and weaknesses of Pira Haffari Company were used as internal factors whereas its opportunities and threats were regarded external factors.

The findings of Srivastava *et al.* (2005) proposed action plans regarding the society and government contribution to effectively managing household solid waste. The aim of this paper is assessment the results of QSPM in opportunities strength for electronically waste of environmental management by SWOT method in Pira Iranian Drilling Company.

Materials and methods

Population

Basic information was collected using library method and field study. Questionnaire was used along with interview for data collection. The population to answer the questionnaire consisted of entire employees of the staff department of Pira Haffari Company (90 people).

Sample size was determined 73 people through Cochran formula while the random sampling was conducted. The questionnaire contained 20 items excluding demographic ones (age, gender, education, job experience) which formed the first section of the questionnaire.

The items related to e-waste and its management in Pira Iranian Drilling Company constituted the second section of the questionnaire.

The latter included 16 three-alternative items (yes, no, not sure) whose aim was to evaluate both awareness of the staff of Pira Iranian Drilling Company regarding e-waste and their evaluation of e-waste management. 4 open-ended questions were included at the third section. Yes was considered positive in the awareness section while no and not sure were regarded as negative.

Questionnaire reliability was determined 75% using Cronbach's alpha. Face validity and content validity of the questionnaire were assessed using the ideas of some environmental experts and university professors.

Data analysis

Data analysis was conducted via SPSS and Microsoft Excel was used to draw the charts. SWOT analysis

and QSPM matrix were applied to evaluate strengths, weaknesses, opportunities and threats regarding e-waste management in Pira Iranian Drilling Company and to determine aggressive strategy score of e-waste management, respectively. In SWOT analysis, effective factors on the company were divided into internal and external ones.

The strengths and weaknesses of Pira Haffari Company were used as internal factors whereas its opportunities and threats were regarded external factors.

Results and discussions

Table 1 includes the information regarding the age, gender, education and job experience of the sample.

Table 1. Demographic information of the sample.

Category	Subcategory	Frequency	Percent	Sum	Percent
Gender	Male	5	7		
	Female	68	93	73	100
Age	Younger than 25	0	0		
	25-35	33	45	73	100
	35-45	33	45		
	Older than 45	7	10		
Education	Lower than high school diploma	0	0		
	High school diploma	5	7		
	Associate of Art	12	16	73	100
	Bachelor's Degree and higher	56	77		
Job experience	Less than 5 years	12	16		
	5-10 years	26	36		
	10-15 years	7	10	73	100
	More than 15 years	28	38		

According to table 1, the majority of the participants were male aged between 25 and 45 having Bachelor's Degree or higher with job experience of more than 15 years.

The results of SWOT analysis

Tables 2 and 3 contain IFE as well as EFE matrixes of e-waste management in Pira Iranian Drilling Company.

Table 2. IFE matrix of e-waste management in Pira Iranian Drilling Company.

No.	Strength	Weight	Rating	Weighted score
S_1	Easy access and transport of e-waste to the temporary accumulation locations	0.05	4	0.2
S_2	Accumulation of e-waste in a suitable location	0.05	4	0.2
S_3	Existence of an employee responsible for collecting, transporting and accumulating e-waste of the company	0.04	3	0.12
S_4	Existence of an accumulation location inside the company	0.04	4	0.16
S_5	Existence of a job opportunity for an e-waste expert in the company	0.04	3	0.12
S_6	HSE unit existence in the company	0.04	4	0.16

No.	Strength	Weight	Rating	Weighted score
S_7	Holding environmental course in the company	0.03	4	0.12
S_8	High level of staff awareness of e-waste and their hazardous materials	0.03	4	0.12
S_9	Acceptance of having scientific relation with scientific societies	0.03	4	0.12
S_{10}	Existence of the staff with high education	0.03	4	0.12
	Weakness			
W_1	Non-existence of e-waste management in the company	0.08	1	0.08
W_2	Not recycling and reusing e-waste in the company	0.06	1	0.06
W_3	No separation of e-waste from other kind of waste in the company	0.06	1	0.06
W_4	No regular e-waste collection	0.05	2	0.1
W_5	No rule and regulation regarding e-waste management in the company	0.05	1	0.05
W_6	No training courses regarding e-waste management	0.05	2	0.1
W_7	No written instruction regarding WEEE	0.05	1	0.05
W_8	No e-waste recycling plant in Ahvaz	0.05	2	0.1
W_9	Long distance between the locations of temporary accumulation and final disposal	0.05	2	0.1
W_{10}	Lack of trained human power to manage e-waste in the company	0.04	2	0.08
W_{11}	No information bank and statistics of the combination and production of e-waste	0.03	1	0.03
W_{12}	No mobilization of technology, facilities and capabilities regarding e-waste management	0.03	2	0.06
W_{13}	No research and development unit regarding e-waste management	0.02	2	0.04
Total		**1**	**-**	**2.35**

The weighted score of the internal factors evaluation (strength and weakness) was determined 2.35 which is lower than 2.5 indicating that Pira Iranian Drilling Company has weak internal position regarding e-waste management.

Table 3. EFE matrix of e-waste management in Pira Iranian Drilling Company.

No.	Opportunities	weight	Rating	Weighted score
O_1	E-waste separation, reuse, sales, donation and separation of their hazardous components prior to final disposal	0.07	4	0.28
O_2	Holding training courses, meetings and conferences regarding WEEE	0.04	4	0.16
O_3	Organizations acceptance of WEEE recycling and reuse	0.04	3	0.12
O_4	Job opportunity creation for younger environmental experts	0.04	3	0.12
O_5	Existence of investors to establish WEEE recycling plants	0.04	3	0.12

No.	Opportunities	weight	Rating	Weighted score
O_6	Existence national and international of standards, rules and regulations regarding WEEE	0.04	4	0.16
O_7	Interaction with relevant organizations regarding WEEE	0.04	4	0.16
O_8	Existence of the industries and markets regarding recyclable materials throughout the city and area	0.03	4	0.12
O_9	Media advertisement for public awareness of WEEE	0.03	3	0.09
O_{10}	People's religious beliefs regarding optimal use	0.03	3	0.09
O_{11}	People's desire for a healthy environment	0.03	3	0.09
O_{12}	Capability of the private sector regarding e-waste management	0.03	4	0.12
O_{13}	Existence of universities and colleges of environment in the city	0.03	3	0.09
O_{14}	Existence of the organization of waste management in the city	0.03	3	0.09
O_{15}	Existence of environmental NGOs in the city	0.02	3	0.06
O_{16}	Possibility of taking advantage of other countries' experiences	0.02	3	0.06
	Threats			
T_1	Break-out of professional diseases due to contact with hazardous material contained in e-waste	0.06	1	0.06
T_2	Environmental pollution increase	0.06	1	0.06
T_3	Natural resources destruction	0.04	1	0.04
T_4	Growing increase of electronic equipment which leads to an increase in WEEE	0.04	1	0.04
T_5	High variety of hazardous components and material used in electronic equipment and the difficulty determining entire undesirable impacts of their waste disposal on the environment and human	0.03	1	0.03
T_6	Existence of electronic parts and waste black markets	0.03	2	0.06
T_7	Unofficial recycling by peddlers	0.03	2	0.06
T_8	High-quality electronic equipment purchase limitation due to sanctions	0.03	2	0.06
T_9	Costly process of setting up the culture of proper e-waste production and separation	0.03	2	0.06
T_{10}	Poor weather conditions of Ahvaz (high temperature and humidity)	0.03	2	0.06
T_{11}	Landscape destruction	0.03	1	0.03
T_{12}	Lack of the budget to improve knowledge of the public and company staff regarding WEEE	0.03	2	0.06
Total		**1**	**-**	**2.55**

The weighted score of the external factors evaluation (opportunities and threats) was determined 2.55 which is higher than 2.5 indicating that Pira Iranian Drilling Company has more opportunities regarding e-waste management compared with its threats.

The results of QSPM matrix application

QSPM matrix was provided after aggressive strategies determination and was received attractiveness score whose results are shown in table 4.

Table 4. QSPM matrix related to SO strategy of e-waste management in Pira Iranian Drilling Company.

Strategic factor	Weighted Score	SO_1		SO_2		SO_3		SO_4		SO_5		SO_6	
		AS	TAS	AS	TAS	AS	TAS	AS	TAS	AS	TAS	AS	TAS
Strength													
S_1	0.2	4	0.8	1	0.2	1	0.2	1	0.2	2	0.4	1	0.2
S_2	0.2	4	0.8	1	0.2	1	0.2	2	0.4	2	0.4	1	0.2
S_3	0.12	3	0.36	2	0.24	1	0.12	1	0.12	3	0.36	1	0.12
S_4	0.16	4	0.64	1	0.16	1	0.16	2	0.32	2	0.32	1	0.16
S_5	0.12	2	0.24	2	0.24	1	0.12	1	0.12	2	0.24	1	0.12
S_6	0.16	2	0.32	4	0.64	3	0.48	3	0.48	4	0.64	4	0.64
S_7	0.12	2	0.24	4	0.48	4	0.48	2	0.24	4	0.48	4	0.48
S_8	0.12	1	0.12	4	0.48	2	0.24	1	0.12	2	0.24	2	0.24
S_9	0.12	2	0.24	3	0.36	4	0.48	4	0.48	4	0.48	4	0.48
S_{10}	0.12	1	0.12	3	0.36	3	0.36	2	0.24	2	0.24	2	0.24
Opportunities													
O_1	0.28	3	0.84	2	0.56	1	0.28	4	1.12	1	0.28	1	0.28
O_2	0.16	2	0.32	4	0.64	4	0.64	2	0.32	2	0.32	2	0.32
O_3	0.12	2	0.24	1	0.12	3	0.36	4	0.48	2	0.24	2	0.24
O_4	0.12	1	0.12	3	0.36	1	0.12	1	0.12	1	0.12	1	0.12
O_5	0.12	2	0.24	2	0.24	2	0.24	2	0.24	2	0.24	2	0.24
O_6	0.16	4	0.64	3	0.48	3	0.48	2	0.32	4	0.64	4	0.64
O_7	0.16	3	0.48	3	0.48	3	0.48	3	0.48	3	0.48	3	0.48
O_8	0.12	2	0.24	1	0.12	1	0.12	4	0.48	2	0.24	2	0.24
O_9	0.09	1	0.09	2	0.18	4	0.36	2	0.18	2	0.18	3	0.27
O_{10}	0.09	1	0.09	1	0.09	2	0.18	1	0.09	1	0.09	1	0.09
O_{11}	0.09	1	0.09	1	0.09	2	0.18	1	0.09	2	0.18	2	0.18
O_{12}	0.12	2	0.24	1	0.12	2	0.24	2	0.24	2	0.24	2	0.24
O_{13}	0.09	2	0.18	1	0.09	3	0.27	2	0.18	3	0.27	2	0.18
O_{14}	0.09	2	0.18	1	0.09	3	0.27	3	0.27	3	0.27	3	0.27
O_{15}	0.06	2	0.12	1	0.06	3	0.18	3	0.18	2	0.12	2	0.12
O_{16}	0.06	2	0.12	2	0.12	2	0.12	2	0.12	3	0.18	3	0.18
TAS total			8.11		7.2		7.36		7.63		7.89		6.97

Table 4. Continuation QSPM matrix related to SO strategy of e-waste management in Pira Haffari Company.

Strategic factor	Weighted Score	SO_7		SO_8		SO_9		SO_{10}		SO_{11}		SO_{12}	
		AS	TAS	AS	TAS	AS	TAS	AS	TAS	AS	TAS	AS	TAS
Strength													
S_1	0.2	2	0.4	1	0.2	1	0.2	1	0.2	1	0.2	1	0.2
S_2	0.2	2	0.4	1	0.2	1	0.2	1	0.2	1	0.2	1	0.2
S_3	0.12	1	0.12	1	0.12	1	0.12	1	0.12	1	0.12	1	0.12
S_4	0.16	2	0.32	1	0.16	1	0.16	1	0.16	1	0.16	1	0.16
S_5	0.12	2	0.24	4	0.48	1	0.12	1	0.12	1	0.12	2	0.24
S_6	0.16	3	0.48	3	0.48	3	0.48	3	0.48	3	0.48	2	0.32
S_7	0.12	2	0.24	1	0.12	4	0.36	3	0.48	3	0.36	2	0.24

Strategic factor	Weighted Score	SO_7		SO_8		SO_9		SO_{10}		SO_{11}		SO_{12}	
		AS	TAS	AS	TAS	AS	TAS	AS	TAS	AS	TAS	AS	TAS
S_8	0.12	2	0.24	2	0.24	3	0.24	2	0.36	3	0.36	2	0.24
S_9	0.12	3	0.36	4	0.48	4	0.48	4	0.48	4	0.48	3	0.36
S_{10}	0.12	1	0.12	1	0.12	2	0.24	2	0.24	3	0.36	1	0.12
Opportunities													
O_1	0.28	4	1.12	1	0.28	1	0.28	1	0.28	2	0.56	2	0.56
O_2	0.16	2	0.32	2	0.32	4	0.48	3	0.64	3	0.48	1	0.16
O_3	0.12	4	0.48	3	0.36	2	0.24	2	0.24	3	0.36	3	.036
O_4	0.12	2	0.24	4	0.48	2	0.12	1	0.24	1	0.12	1	0.12
O_5	0.12	4	0.48	2	0.24	2	0.12	1	0.24	1	0.12	4	0.48
O_6	0.16	3	0.48	2	0.32	2	0.32	2	0.32	3	0.48	2	0.32
O_7	0.16	3	0.48	3	0.48	3	0.32	2	0.48	2	0.32	3	0.48
O_8	0.12	4	0.48	3	0.36	3	0.24	2	0.36	1	0.12	4	0.48
O_9	0.09	3	0.27	2	0.18	1	0.36	4	0.09	1	0.12	4	0.48
O_{10}	0.09	2	0.18	1	0.09	1	0.36	4	0.09	1	0.09	1	0.09
O_{11}	0.09	2	0.18	1	0.09	2	0.27	3	0.18	1	0.09	1	0.09
O_{12}	0.12	4	0.48	2	0.24	3	0.24	2	0.36	1	0.12	4	0.48
O_{13}	0.09	2	0.18	4	0.36	4	0.27	3	0.36	2	0.18	2	0.18
O_{14}	0.09	3	0.27	2	0.18	3	0.18	2	0.27	2	0.18	3	0.27
O_{15}	0.06	2	0.12	3	0.18	3	0.18	3	0.18	2	0.12	2	0.12
O_{16}	0.06	2	0.12	2	0.12	2	0.12	2	0.12	4	0.24	3	0.18
TAS total		8.8		6.88		7.29		6.7		6.6		6.75	

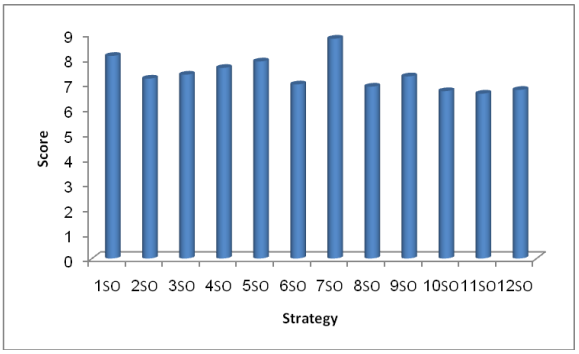

Fig. 1. The score of aggressive strategies (SO) of e-waste management in Pira Haffari Company.

Based on the scores, the most important aggressive strategies (SO) are as following:

1. SO_7: Interaction with relevant organizations in order to repair and donate defective electronic equipment as well as separate their hazardous components prior to final disposal (score of 8.8)

2. SO_1: Following the instructions to optimize the collection and accumulation of e-waste (score of 8.11)

3. SO_5: Execution of the instructions, rules and regulations regarding e-waste in Pira Iranian Drilling Company (score of 7.89)

4. SO_4: Interaction with the industries and markets to sell or recycle e-waste (score of 7.63)

5. SO_3: Scientific relation with environmental societies to hold and participate in national and international e-waste management seminars and conferences (score of 7.36).

Conclusion

The scores of aggressive strategies of e-waste management in Pira Iranian Drilling Company were categorized based on the following priorities: Aggressive strategies of the first priority, SO_7:

Interaction with relevant organizations in order to repair and donate defective electronic equipment as well as separate their hazardous components prior to final disposal. SO_1: Following the instructions to optimize the collection and accumulation of e-waste. These strategies put emphasis on the interaction and cooperation with relevant organizations as well as following national and international rules and instructions to plan the e-waste management model in Pira Iranian Drilling Company. Aggressive strategies of the second priority, SO_5: Execution of the instructions, rules and regulations regarding e-waste in Pira Iranian Drilling Company. SO_4: Interaction with the industries and markets to sell or recycle e-waste. SO_9: Interaction with universities to run e-waste management training courses in the company. SO_2: HSE unit exploitation to promote the staff's awareness regarding e-waste. These strategies place great emphasis on the interaction and cooperation with scientific societies in order to promote the staff's awareness as well as to recycle and reuse the e-waste produced by the company. Aggressive strategies of the second priority, SO_6: Interaction with environmental societies to execute e-waste national and international standards. SO_8: Taking advantage of university elites and environmental universities along with increasing job opportunities resulted from private sector investment. SO_{12}: Recycling industry development throughout the city and creating competitive atmosphere amongst the present recycling industries to enhance the quality of the separated materials. SO_{10}: Using media advertisement as well as laying emphasis on people's religious faith in order to increase the awareness regarding e-waste management. SO_{11}: Exploitation of other countries' experiences about e-waste management. These strategies highlight the recycling and relevant issues along with cooperation and interaction with other countries to use their experiences.

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