EVALUATING OF THE CHOSEN ELECTRONIC SHOP WEBSITES IN IRAN THROUGH THE COMBINED AHP/DEA MODEL

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ABSTRACT

The development of electronic commerce has caused the advent of electronic shop websites all over the world. With a good electronic commerce management and preparing significant technical and legal infrastructure, the number of Dot.Com companies like E-shop website has increased in Iran progressively. In this paper, we try to evaluate 23 chosen e-shop websites in Iran using the combined AHP/DEA model. The results have shown that in the research period, Finaleshop and Ahangsara are in top rank in 2008 because of their good performance in the digital world.

Keywords: Electronic shop, Combined AHP/DEA model

1. Introduction

One of the most interesting aspects of electronic commerce is electronic shop. Over Time cities have changed to electronic cities and customers don't go to physical shops, but satisfy their needs through electronic shops (E-shop).

Iran has embraced Electronic commerce world using network, information- and communication technologies as a lot of people are interested in the virtual world. However beside these attractions of electronic commerce, the need to know about the points of strength and weakness of competitors is required. In other words, electronic shops to perform well in a competitive market must control competitors' activities and analyze them. This allows them to find their position in the market, the share of market, share of mind and share of heart.

This issues which are vital components for E-shop life and growth, have shown the importance of using scientific methods to investigate E-shops position. Scientific methods are classified in two groups, quantity methods like DEA (Data Envelopment Analysis) and quality methods like AHP (Analysis Hierarchy Process). Each of these methods has some problems. For example quantity methods are perfectly mathematical and human factors don't enter in these models. On the other hand, quality methods are related to experts' decision, and it is likely that opinions differ.

To avoid the problems of each of these two methods, we can use a combined AHP/DEA model. In this type of approach, we can gain quantity and quality methods advantages and we can solve the respective problems of these methods.

2. Empirical Studies

Many researchers have used combined AHP/DEA model in their studies. Also many papers have been prepared with a focus on electronic shops. In this chapter, we will discuss these studies separately and briefly:

2.1 Empirical studies in combined AHP/DEA model

Cai and Wu in their study in 2001 about Financial Evaluation, in a first step through AHP method, analyzed and adjusted financial evaluation systems and in a second step through DEA method presented a model, the results of which are showing efficient units.

Stern and et.al in 2000 have used a quantity- quality approach. In this research, the combined model is presented in 2 steps to rank decision making organizational units. In a first step, the DEA model is used for each pair of units and their efficiency is compared. In a second step a pairwise comparison matrix is constructed to rank units in accordance with AHP analysis.

Mohammadi and Hoseinizade in 2007 have ranked Insurance agencies in Iran through the combined AHP/DEA model. In this article, first one DEA model was calculated for each pair of agencies, then a pairwise comparison matrix was constructed and at last with using AHP model, ranking was completed.

In a study by the name of "Evaluating Science and Industrial University faculties of Iran from 1998-1999 using AHP/DEA method" that was done by Fattahi at 2000, the two-step mathematical model was used.

Nakhaee (2003) in his research with the name of "Identification and ranking of Key capacities of organization through the AHP/DEA model", after identification of operational criteria, used DEA method to measure faculties efficiency in two educational and research dimensions. In this paper for each faculty, management and scale efficiency were analyzed and at last faculties ranking was done by AHP model.

2.2 Empirical studies in E-shop

Fathi and Azizi (2006) in their research about measuring electronic maturity level in electronic shops in Iran have presented an important model for Iranian conditions and applicably measure and evaluate maturity levels of electronic shops and websites in Iran in the summer of 2006.

Bayat and et.al in 2007 through a fuzzy approach have presented a technique to measure customer satisfaction in electronic shops. In this essay, more than using attributes of fuzzy sets, a method to measure customer satisfaction, identification and rank of key factors for E-shops customer satisfaction is presented.

Sepehri and Asadi (2006) identified key factors of customer confidence in B2C websites and then estimated the importance of each factor. One of the results of this paper is that if customer recognition of the companies and their goods is increased, customer confidence in electronic shops will also increase.

Seock and et.al in 2006 in their study have investigated websites evaluating factors in 414 students between 22-18 years old. Results showed that websites evaluating factors are related to customers' relationship channels and their requirements.

In a study about the issues of electronic shops validity in Austria that was done by Garnik (2006), the factors that influenced customers' confidence in electronic shops were analyzed. The results have shown that electronic shops validity is sensitively related to efficient functions, availability and security.

3. Data Envelopment Analysis (DEA)

In this part, we briefly discuss the DEA method. DEA method is a linear mathematical programming technique based on an approach that constructs an efficient frontier envelopment with the data, and calculates each data point's efficiency relative to this frontier. DEA assumes that the variables of the data

can be logically divided into inputs and outputs. Each data point corresponds to a decision making unit (DMU) or a producer in practice. The decision of a unit is to convert inputs into outputs as efficiently as possible. For example if the goal is efficiency analysis of n unit, that all of them has m input and s output, efficiency of k^{th} unit ($k = 1,2,...,n$) is calculated as below:

$$Max \quad h_k = \frac{\sum_{r=1}^{s} u_r y_{rk}}{\sum_{i=1}^{m} v_i x_{ik}} \tag{1}$$

$$St: \quad \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \le 1 \qquad (j = 1,2,...,n)$$

$$u_r \ge 0 \qquad (r = 1,2,...,s)$$

$$v_i \ge 0 \qquad (i = 1,2,...,m)$$

Where x_{ij} is i^{th} input for j^{th} unit, y_{rj} is r^{th} output for j^{th} unit, u_r is weight of r^{th} output and v_i is weight of i^{th} input.

DEA has been successively applied to a variety of fields such as studying the efficiency of commercial banks, to anticipate the consequences of school reforms and to investigate online customer shopping efficiency. But this model has a problem with DEA model is it mathematical approach which makes it difficult to use.

4. Analytic Hierarchy Process (AHP)

Analytic hierarchy process (AHP) is becoming quite popular in research due to the fact that its utility outweighs other research methods. The development of AHP could be traced back to the early 1970s in response to the scarce resources allocation and planning needs for the military. AHP is a hierarchical representation of a system. A hierarchy is an abstraction of the structure of the system, consisting of several levels representing the decomposition of the overall objective to a set of clusters, sub- clusters, and so on down to the final level. We can show AHP method through four steps that can be summarized in two phases. The first phase is a designing phase and the second an evaluating phase (Figure.1).

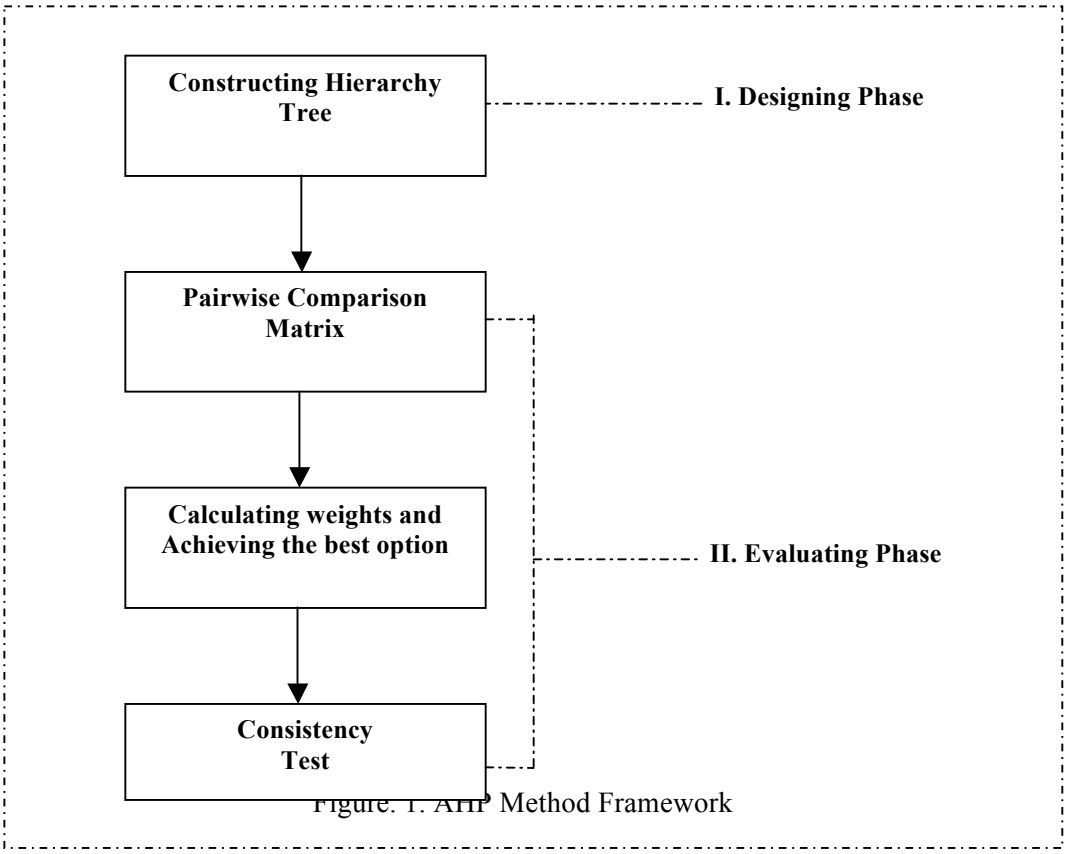

Figure. 1. AHP Method Framework

5. AHP/DEA Approach:

AHP/DEA approach is a kind of two- step approaches to gain Decision Making Units (DMU).

In this method, first a DEA model is chosen for each pairwise unit without including other units.

After that through the achieved results from DEA model, a pairwise comparison matrix is constructed and with AHP model, the full ranking is completed. The steps of this approach are done as follows:

Step 1: Pairwise Comparison Matrix through DEA model:

Suppose that there is n unit. Each unit has m input and s output. x_{ij} is i^{th} input in j^{th} unit and y_{rj} is r^{th} output in j^{th} unit. For each A and B pair, one DEA model is constructed as below:

$$E_{AA} = \max_{u_r, v_i} \sum_{r=1}^{s} u_r y_{rA} \tag{2}$$

$$st: \quad \sum_{i=1}^{m} v_i x_{iA} = 1$$

$$\sum_{r=1}^{s} u_r y_{rA} \le 1$$

$$\sum_{r=1}^{s} u_r y_{rB} - \sum_{r=1}^{m} v_i x_{iB} \le 0$$

$$u_r, v_i \ge 0 \qquad (r = 1,2,...,s), (i = 1,2,...,m)$$

E_{AA} is the amount of optimized efficiency of unit A. If unit A is efficient, then $s_2 = 0$ and $s_3 \geq 0$ and if unit A is not efficient then $s_2 \succ 0$ and $s_3 = 0$. Other variables are zero. To achieve the best crossover evaluation for unit B, following models are designed:

$$E_{BA} = \max Z_{BA} = \sum_{r=1}^{s} u_r y_{rB} \tag{3}$$

$$st: \quad \sum_{i=1}^{m} v_i x_{iB} = 1$$

$$\sum_{r=1}^{s} u_r y_{rB} \leq 1$$

$$\sum_{r=1}^{s} u_r y_{rA} - E_{AA} \sum_{i=1}^{m} v_i x_{iA} = 0$$

$$u_r, v_i \geq 0 \qquad (r = 1,2,...,s), (i = 1,2,...,m)$$

E_{BA} is optimized crossover evaluating of unit B. In accordance with the to two above models, BB and AB must be solved to calculate E_{BB} and E_{AB}. So four DEA models are solved and amounts of E_{AA}, E_{BA}, E_{BB} and E_{AB} are calculated. With the results of this models and using the below relation for each i and j units, pairwise comparison matrix that each a_{jk} element of it is calculating as following equation, as shown.

$$a_{ij} = 1 \qquad if \quad i = j, \qquad a_{jk} = \frac{E_{jj} + E_{jk}}{E_{kk} + E_{kj}} \tag{4}$$

Step 2: Ranking through AHP model:

In according to pairwise comparison matrix, in a second step, an analytical hierarchy process is constructed to calculate maximum Eigen value ($\lambda_{\max}$) and Eigen vector ($\vec{w}$). j^{th} element in $\vec{w}$ vector shows the relative importance of j^{th} unit. The units that have maximum of $\vec{w}$ take the first place in the ranking.

This implied method has some advantages. Firstly inconsistencies in AHP method are removed, anymore the problem of proportional of number of units and Inputs and outputs removes too.

6. Research Methodology

In this paper, twenty three electronic shops (E-shop) are evaluated. We tried to choose equal (Homo) shops in reference to their activity scope. We selected E-shops in the field of books and music trade. After the selection of the e-shops, each of their inputs and outputs are investigated. Choice of Inputs and outputs is according to E-shop's control on theses variables. About Input variables, Number of fix employers (X_1), Number of business model (X_2), Number of goods and services on website (X_3) and daily sales (X_4) are recorded and on the output variables issue, total viewers (Y_1), monthly viewing from Iran (Y_2) and monthly Income (Y_3) are selected.

We must note that all statistics of variables were obtained in October 2008 by means of interviewing and some related software like Webgozar, Persianstat, Alexa and Compete. Some E-shop holders didn't agree

to name their e-shop in paper, so we used a coding system ($Eshop_1, Eshop_2, ..., Eshop_{23}$) to hide chosen e-shops names but in appendix1, e-shops names are shown.

Inputs and outputs data for 23 chosen e-shops are presented in table.1:

Table. 1. The Chosen Electronic shop's inputs and outputs in 2008

Y_3	Y_2	Y_1	X_4	X_3	X_2	X_1	E-shop	No.
123134	1110847	1134648	20	25	6	2	$Eshop_1$	1
434088	2297950	3610960	55	45	6	3	$Eshop_2$	2
124467	1369591	1192713	75	35	5	3	$Eshop_3$	3
106198	821883	1069775	16	40	6	2	$Eshop_4$	4
374822	1252633	2520405	15	50	6	3	$Eshop_5$	5
25919	313923	279150	13	10	6	2	$Eshop_6$	6
70130	250805	864576	12	12	6	2	$Eshop_7$	7
1050857	1333039	6663392	70	30	6	2	$Eshop_8$	8
171452	594710	1755802	24	15	6	3	$Eshop_9$	9
89070	111858	1046073	18	30	6	2	$Eshop_{10}$	10
101727	207829	860925	22	25	6	1	$Eshop_{11}$	11
59388	15156	541330	25	35	5	2	$Eshop_{12}$	12
1484073	133150	1353881	18	35	6	3	$Eshop_{13}$	13
86015	279683	521383	21	20	6	3	$Eshop_{14}$	14
86570	388876	900198	19	15	6	2	$Eshop_{15}$	15
23768	9820	200645	17	20	5	3	$Eshop_{16}$	16
36961	304648	429047	15	10	5	1	$Eshop_{17}$	17
127832	894152	1289024	21	20	6	2	$Eshop_{18}$	18
79265	839950	717479	15	15	6	1	$Eshop_{19}$	19
71445	104423	983953	19	20	5	3	$Eshop_{20}$	20
48986	-	476976	16	20	5	2	$Eshop_{21}$	21
188163	420319	1823887	20	25	6	2	$Eshop_{22}$	22
21347	3401	162266	15	15	4	2	$Eshop_{23}$	23

7. Using AHP/DEA model in E-shops ranking:

In this part, we discuss using AHP/DEA model in the chosen e-shops ranking. For example we investigate how to model inputs and outputs in accordance with $Eshop_1$ and $Eshop_2$ through AHP/DEA approach

Step 1: Constructing Pairwise Comparison Matrix using DEA model:

Each element in pairwise comparison matrix is calculated from four DEA model. For example the four models for $Eshop_1$ and $Eshop_2$ are as follows:

$$
\begin{aligned}
&E_{11}: \\
&\max \quad 1134648u_1 + 1110847u_2 + 123134u_3 \\
&st: \\
&\quad 2v_1 + 6v_2 + 25v_3 + 20v_4 = 1 \\
&\quad 1134648u_1 + 1110847u_2 + 123134u_3 \le 1 \\
&\quad 3610960u_1 + 2297950u_2 + 434088u_3 - 3v_1 - 2v_2 - 45v_3 - 55v_4 \le 0 \\
&\quad u_1, u_2, u_3, u_4, v_1, v_2, v_3, v_4 \ge 0
\end{aligned}
\tag{5}
$$

The optimized result for above model is $E_{11} = 1$.

$$
\begin{aligned}
&E_{22}: \\
&\max \quad 3610960u_1 + 2297950u_2 + 434088u_3 \\
&st: \\
&\quad 3v_1 + 6v_2 + 45v_3 + 55v_4 = 1 \\
&\quad 3610960u_1 + 22979508u_2 + 434088u_3 \le 1 \\
&\quad 1134648u_1 + 1110847u_2 + 123134u_3 - 2v_1 - 6v_2 - 25v_3 - 20v_4 \le 0 \\
&\quad u_1, u_2, u_3, u_4, v_1, v_2, v_3, v_4 \ge 0
\end{aligned}
\tag{6}
$$

The optimized result for above model is $E_{22} = 1$.

$$
\begin{aligned}
&E_{12}: \\
&\max \quad 1134648u_1 + 1110847u_2 + 123134u_3 \\
&st: \\
&\quad 2v_1 + 6v_2 + 25v_3 + 20v_4 = 1 \\
&\quad 1134648u_1 + 1110847u_2 + 123134u_3 \le 1 \\
&\quad 3610960u_1 + 2297950u_2 + 434088u_3 - 3v_1 - 6v_2 - 45v_3 - 55v_4 \le 0 \\
&\quad u_1, u_2, u_3, u_4, v_1, v_2, v_3, v_4 \ge 0
\end{aligned}
$$

(7)

$$E_{21}:$$
$$\max \quad 3610960u_1 + 2297950u_2 + 434088u_3$$

(8)

$$st:$$
$$3v_1 + 6v_2 + 45v_3 + 55v_4 = 1$$
$$3610960u_1 + 2297950u_2 + 434088u_3 \le 1$$
$$1134648u_1 + 1110847u_2 + 123134u_3 - 2v_1 - 6v_2 - 26v_3 - 20v_4 \le 0$$
$$u_1, u_2, u_3, u_4, v_1, v_2, v_3, v_4 \ge 0$$

And the optimized result for two above model is $E_{12} = E_{21} = 1$.

The relevant element in a pairwise comparison matrix will be calculated as below. This element refers to the first row and the second column in the matrix.

$$a_{12} = \frac{E_{11} + E_{12}}{E_{21} + E_{22}} = \frac{1+1}{1+1} = 1 \tag{9}$$

By calculating a_{12}, we can calculate a_{21} too. Because in this matrix, elements are symmetrical in relation to the main diagonal. So:

$$a_{21} = \frac{1}{a_{12}} \tag{10}$$

Continuously, we can calculate a_{ij} element for all of the e-shops to compare pairs of them. Results of these calculations for 23 e-shops are constructing a pairwise comparison matrix through 1012 linear programming models and calculations of 529 a_{ij} elements. Table.2 shows the constructed pairwise comparison matrix:

Table .2. The Pairwise Comparison matrix for the chosen e-shops in Iran (2008)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
A	1	1	1	1	1	1.172	1	1	1	1	1.166	1.73	1	1.067	1	4.149	1.028	1	1	1	1.904	1	3.472
B	1	1	1.132	1	1	1.239	1	1	1	1.129	1.398	3.039	1	1.384	1.494	0.25	1.253	1	1	1.576	0.908	1	0.456
C	1	0.883	1	1	1	1	1	1	1	1	1	1	1	1	1	1.499	1	1	1	1	1	1	1
D	1	1	1	1	1	1	1	1	1	1	1	1.196	1	1	1	2.237	1	1	1	1	1.04	1	1.302
E	1	1	1	1	1	1	1	1	1	1.447	1	3.105	1	1.271	1	5.025	1	1	1	1.025	2.114	1	4.672
F	0.853	0.807	1	1	1	1	1	1	0.987	1	1	1	1	1	1	1	1	0.851	0.583	1	1	1	1
G	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1.422	1	1	1	1	1.088	1	1.373
H	1	1	1	1	1	1	1	1	1	1.369	1	4.405	1	1.522	1.263	8.13	1	1	1	1.838	3.194	1	8.849
I	1	1	1	1	1	1.013	1	1	1	1.259	1	1	1	1.332	0.01	5.128	1	1	1	1.414	1.4	1	5.025
J	1	0.885	1	1	0.691	1	1	0.61	0.794	1	1	1.234	1	1	1	1.428	1	0.946	1	1	1.096	0.637	1.352
K	0.857	0.715	1	1	1	1	1	1	1	1	1	1.326	1	1	1	3.311	1	1	1	1	1.314	1	2.865
L	0.578	0.329	1	0.836	0.322	1	1	0.227	1	0.81	0.754	1	0.799	1	1	1	1	1	0.952	1	1	0.378	1.177
M	1	1	1	1	1	1	1	1	1	1	1	1.25	1	1	1	1.588	1	1	1	1	1.237	1	1.563
N	0.937	0.722	1	1	0.786	1	1	0.657	0.75	1	1	1	1	1	0.996	2.105	1	0.836	1	1	1	0.915	2.145
O	1	0.747	1	1	1	1	1	1	0.99	1	1	1	1	1.004	1	3.039	1	1.074	1	1	1.191	1	2.71
P	0.241	0.125	0.667	0.447	0.199	1	0.703	0.123	0.195	0.7	0.302	1	0.629	0.475	0.329	1	0.821	0.229	0.679	0.685	1	0.157	1
Q	0.972	0.798	1	1	1	1	1	1	1	1	1	1	1	1	1	1.218	1	0.681	0.948	1	1	1	1.162
R	1	1	1	1	1	1.175	1	1	1	1.057	1	1	1	1.196	0.931	4.366	11.468	1	1	1.092	1.992	1	4
S	1	1	1	1	1	1.715	1	1	1	1	1	1.05	1	1	1	1.472	1.054	1	1	1	1.112	1	1.425
T	1	0.788	1	1	0.975	1	1	0.544	0.707	1	1	1	1	1	1	1.459	1	0.915	1	1	1	0.674	1.381
U	0.525	0.454	1	0.961	0.473	1	0.919	0.313	0.714	0.912	0.761	1	0.808	1	0.839	1	1	0.505	0.899	1	1	0.326	1
V	1	1	1	1	1	1	1	1	1	1.596	1	2.645	1	1.092	1	6.369	1	1	1	1.483	3.067	1	5.291
W	0.288	0.228	1	0.768	4.672	1	0.728	0.113	0.199	0.739	0.349	0.849	0.639	0.466	0.369	1	0.86	0.25	0.701	0.724	1	0.189	1

Step 2: Ranking through AHP model

In this step, we used a pairwise comparison matrix (Table .2) that was calculated in step one to rank units through AHP method. It is important to note that, because of using DEA method, the matrixes are consistently compatible.

Table .3. The Chosen E-shops ranking in Iran (2008)

E-shop	Weight	Rank
$Eshop_8$	0.0683	1
$Eshop_{22}$	0.0583	2
$Eshop_5$	0.0551	3
$Eshop_{18}$	00509	4
$Eshop_9$	0.0505	5
$Eshop_1$	0.0502	6
$Eshop_3$	0.0484	7
$Eshop_{11}$	0.0456	8
$Eshop_{15}$	0.0452	9
$Eshop_{19}$	0.0437	10
$Eshop_{13}$	0.0432	11
$Eshop_{22}$	0.0431	12
$Eshop_7$	0.0423	13
$Eshop_3$	0.0415	14
$Eshop_{14}$	0.0405	15
$Eshop_6$	0.0395	16
$Eshop_{17}$ $Eshop_{10}$	0.0391 0.0391	17
$Eshop_{20}$	0.0389	18
$Eshop_{12}$	0.0326	19
$Eshop_{23}$	0.0324	20
$Eshop_{21}$	0.0312	21
$Eshop_{16}$	0.0204	22
-	-	23

8. The results and recommendations

Both of the quality and quantity models have some problems. In this paper, in order to avoid these problems, we use the AHP/DEA approach. In this way, at first we used DEA method to construct a pairweise comparison matrix and then to rank, we used AHP method. Our tested- units were 23 chosen electronic shop in Iran. The results of this paper showed that $Eshop_8$ has maximum weight and vice versa $Eshop_{16}$ has minimum weight. $Eshop_8$ and $Eshop_{22}$ with using different business models and electronic payment can support customers from all parts of Iran and other countries too. But other e-shops have no good business model or customer relationship management in their businesses.

The results of this study show that E-business knowledge (i.e E-Business Model, CRM, E-business Strategy) can play an important role as a tool to increase the ranking of E-shops in Iran. In order to do that, according to the study of the literature on this issue by the author, there are some recommendations:

- Free training of E-shop holders by government to achieve efficient E-shops in Iran

- E-shop holders must hire ICT expert to increase their purchase and customers loyalty

- The Ministry of business in Iran should create a controlling body of E-shops in Iran to manage and control their quality and activities

- Governments, by establishing enough information and necessary services, can communicate with their citizens and substantial education on using the technology of ICT creates an electronic shopping culture in a given society.

Appendix .1:

No.	Electronic shop	Code
1	www.beethovenmc.com	$Eshop_1$
2	www.musicshop.com	$Eshop_2$
3	www.adinebook.com	$Eshop_3$
4	www.cdhonar.com	$Eshop_4$
5	www.iranbin.com	$Eshop_5$
6	www.kharidecd.com	$Eshop_6$
7	www.bekhan.com	$Eshop_7$
8	www.finaleshop.ir	$Eshop_8$
9	www.bookcity.co.ir	$Eshop_9$
10	www.agahbookshop.ir	$Eshop_{10}$
11	www.aftabshop.com	$Eshop_{11}$
12	www.qpeshop.com	$Eshop_{12}$
13	www.birdco.ir	$Eshop_{13}$
14	www.iranjoin.com	$Eshop_{14}$
15	www.bezhco.com	$Eshop_{15}$
16	www.persianbook.net	$Eshop_{16}$
17	www.30dbuy.com	$Eshop_{17}$
18	www.iran-books.com	$Eshop_{18}$
19	www.eshop.daneshpajoohan.org	$Eshop_{19}$
20	www.shop.porforosh.com	$Eshop_{20}$
21	www.irancdcenter.com	$Eshop_{21}$
22	www.ahangsara.com	$Eshop_{22}$
23	www.sharghi.net	$Eshop_{23}$

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