Research Article

Research on Entrepreneur Environment Management Evaluation Method Derived from Advantage Structure

Zhang Li-Li, Hou Xi-Lin and Wang Li
School of Business Administration, University of Science and
Technology Liaoning, Anshan 114051, China

Abstract: In this study, we put forward multilayer behavior evaluation indicator system and dynamic multistage evaluation method based on individual advantage. From the perspective of best to each evaluated entrepreneur to determine each object's evaluation indicator weight vector that reflects advantages and disadvantages, one stage comprehensive evaluation method is put forward. Each stage weight is driven from individual comprehensive value with the thought of best to each entrepreneur, so to rank all the objects on multistage. It is helpful to encourage entrepreneur bearing environment society responsibility and sustainable development. Through calculation example, feasibility and effectiveness of the method is proved.

Keywords: Advantage structure, comprehensive evaluation, entrepreneur environment management behavior indicator, environmental economy, multistage evaluation

INTRODUCTION

Environmental protection becomes more and more important for enterprises to enhance competitiveness and social reputation (Nishitani *et al.*, 2012). Entrepreneurs' environment management activities face lots of challenges (Kalim, 2010; Wang and Chin, 2009; Franklin and Hao, 2008), they are very important for environmental protection results (Dietrich and Lubomir, 2010), it is helpful to make entrepreneurs carry on good effort. Different entrepreneurs face different inner and outside situations, it is essential to evaluate according to individual advantages, it is helpful for entrepreneurs to improve their environmental management behavior sustainable. Entrepreneur environmental management is a process with different stages, dynamically multistage evaluation method according to advantages is of important theoretical meaning and significant practical value.

Evaluation methods have achieved lots of progress. Most of the existing methods evaluate according to the same evaluation indicators and weights, such as linear weighted method, goal programming method, analytic hierarchy process, economic analysis method, principal component analysis, factor analysis, grad scale-up method, fuzzy comprehensive evaluation, etc. However, evaluated objects want to evaluate based on weight apt to individual advantages, Data Envelopment Analysis (DEA) (Jia and Liu, 2012) reflects the thought of individual advantages, but it can not ranking all the evaluated objects. Jing you evaluation methods system

have achieved success in some level. Since these methods satisfy the needs of the reality that different objects have different advantages and disadvantages. If evaluating according to same standard, it may cause unfair and discouragement, different people have different opinions about important, they usually think self advantage is more contributable. In order to meet this kind of actual needs, the indicator weights have to be determined for each object. This study researches on evaluation methods according to individual advantage structure of each evaluated entrepreneur. The evaluation methods contain three parts, the first one is entrepreneur environment management behavior individual advantage structure identification method based on goal programming model and optimization algorithm; the second one is single stage evaluation method based on individual advantage weights layer by layer; the third one is multistage evaluation according to each stage advantage weight.

ENTREPRENEUR ENVIRONMENTAL MANAGEMENT BEHAVIOR EVALUATION INDICATOR SYSTEM

Comprehensively considering the domestic and foreign environment responsibility evaluation system, evaluation indicator system is constructed (Table 1).

Individual advantage structure identification model: Taking Zhao *et al.* (2009, 2010) research achievements as reference, according to the uniform evaluation

Corresponding Author: Hou Xi-Lin, School of Business Administration, University of Science and Technology Liaoning, Anshan 114051, China, Tel.: 18841274352

Table 1: Entrepreneur environment management behavior evaluation indicator system

Category	Contents			
Policy management	Board taking full responsibility	Clear commitment or state	Passed environmental certification	Environmental protection budget
Information publication	Environmental harm litigation	Comprehensive environment report	Energy conservation and emission reduction data	Degree of convenient inquires
Communal participation	Personnel full participation	Donations for the environmental protection	Cooperation with NGO	Interaction with the community
Recycling economy	Product recycling system	Solid dangerous goods disposal	Investment guarantee in science and technology	Corresponding measures to make up
Worldwide technical standardization	Perform the same policy	Basic environmental data	Income and investment data	Environmental litigation proportion
Incidence relation	Internal personnel relationship	Supply and marketing relationship	Customer relationship	Relationship with people being hurt
Development history	Reward or punishment	Environmental protection goal	Course of global development	Environment contribution

indicator system and evaluated object's indicator value vector, indicator weight vector from the perspective of best to evaluated object is what we called individual advantage structure.

Taking three layer evaluation indicator system as example, individual advantage structure can be identified as the following models. The top index is expressed as z, intermediate index is y_1, y_2, y_3... y_m, intermediate index of i is expressed as y_i, which is consisted by p_i basic index, expressing as x_{i1}, x_{i2} ... x_{ipi}.

At period t_k, there are evaluated entrepreneurs, the basic indicator value (which is obtained by average of all the scores of evaluator giving) of each entrepreneur is expressed by A_k:

$$A_{t_k} = \begin{bmatrix} x_{11}(t_k) & x_{12}(t_k) & \cdots & x_{mp_m}(t_k) \\ x_{21}(t_k) & x_{22}(t_k) & \cdots & x_{mp_m}(t_k) \\ \vdots & \vdots & & \vdots \\ x_{n1}(t_k) & x_{n2}(t_k) & \cdots & x_{mp_m}(t_k) \end{bmatrix} \quad (1)$$

$$t_k = 1, 2, \cdots, P_k$$

According to the established evaluation index system and evaluation method (goal programming model) at period t_k, evaluation indicator weights are determined from the perspective of most favorable to evaluation entrepreneur respectively according to indicator value vector. Since there are n evaluated entrepreneurs, there are n weight vectors; each evaluated entrepreneur has different individual advantage structure. Advantage structure identification models from layer to layer are the following:

- Top level to basic level advantage structure identification model:

$$\min d_i(\vec{x}_i, \vec{x}^*) = \sum_{k=1}^{m} \sum_{j=1}^{p_k} w_{ikj}^2 (x_{kj}^* - x_{ikj})^2$$

$$s.t: \quad \sum_{k=1}^{m} \sum_{j=1}^{p_k} w_{ikj} = 1 \quad (2)$$

$$w_{ikj} \geq 0, \quad k = 1, 2, \cdots m; j = 1, 2, \cdots, p_k$$

Therein,
$d_i(\vec{x}_i - \vec{x}^*)$ = The distance between evaluated the entrepreneur i to ideal entrepreneur,

the shorter the distance, the more like to ideal status, the better

x_{kj}^* = The ideal value basic indicator j of middle level k

x_{ikj} = Entrepreneur i's basic level the j indicator of middle level k

w_{ikj}^* = Decision variable which makes the distance smallest, it is also the basic indicator x_{ikj} weight from the top level

- Middle level k indicator to its basic level indicator advantage structure identification model:

$$\min_{\lambda} d_{ik}^2 (\vec{x}_i, \vec{x}^*) = \sum_{j=1}^{p_k} \lambda_{ikj}^2 (x_{ikj}^* - x_{ikj})^2$$

$$s.t: \quad \sum_{j=1}^{p_k} \lambda_{ikj} = 1 \quad (3)$$

$$\lambda_{ikj} \geq 0 \quad j = 1, 2, \cdots p_k$$

Therein,
$d_{ik}(\vec{x}_i - \vec{x}^*)$ = The distance between the evaluated entrepreneur i to ideal entrepreneur about middle level indicator k

x_{kj}^* = The ideal value of j the basic indicator of middle level k

x_{ikj} = Entrepreneur i 's j th basic indicator of middle level k

λ_{ikj}^* = Decision variable which makes the distance smallest, it is also the basic indicator x_{ikj} advantage weight from direct middle indicator

- Top level indicator z to middle level indicator y_i advantage structure identification model:

$$\min_{\mu} d_i^2 (\vec{y}_i, \vec{y}^*) = \sum_{k=1}^{m} \mu_{ik}^2 (y_{ik} - y_{ik}^*)^2$$

$$s.t: \sum_{k=1}^{m} \mu_{ik} = 1 \quad (4)$$

$$\mu_{ik} \geq 0, k = 1, 2, ..., m$$

$$y_{ik}^2 = \sum_{j=1}^{p_k} (\lambda_{ikj}^*)^2 (x_{ikj}^* - x_{ikj})^2$$

Therein,

y_{ik}^* = The ideal value of indicator k. when $x_{ikj}^* = x_{ikj}$, $y_{ik}^* = 0$

The solution set of function (1) is:

- If there is at least one evaluation value equal to ideal value, then the sum of the indicators which reach the ideal value is 1, other index weights are all 0

- If there is no evaluation value reaching ideal value, then, the weight can be obtained by:

$$w_{ij}^* = \frac{\dfrac{1}{(x_{ikj}^* - x_{ikj})^2}}{\displaystyle\sum_{i=1}^{m}\sum_{j=1}^{p_k}\dfrac{1}{(x_{ikj}^* - x_{ikj})^2}} \quad i = 1, 2, .., m, \ j = 1, 2, ..., p_k. \quad (5)$$

By inference, solutions of other identification models can be obtained.

Evaluation model of entrepreneur environmental management behavior based on individual advantage structure: According to each evaluated entrepreneur's advantage structure (indicator weight vector), we can get n evaluation results on each evaluated entrepreneur. Through averaging all the individual advantage structure (indicator weight), we can get evaluation indicator weight layer by layer, the evaluation model of entrepreneur i is of each layer is as following. In a note, top indicator comprehensive value calculation according to model (6) and (8) are the same:

- Top level indicator comprehensive value according to basic indicator is:

$$y_i = d_i\left(\vec{x}_i - \vec{x}^*\right) = \sqrt{\sum_{k=1}^{m}\sum_{j=1}^{p_k} \overline{w}_{jk}^{*2}\left(x_{kj}^* - x_{ikj}\right)^2} \quad (6)$$

- Middle level comprehensive value according to basic indicator is:

$$d_{ik}\left(\vec{x}_i, \vec{x}^*\right) = \sqrt{\sum_{j=1}^{p_k} \overline{\lambda}_{kj}^{*2}\left(x_{ikj}^* - x_{ikj}\right)^2} \quad (7)$$

- Top level comprehensive value from middle level indicator:

$$d_i\left(\vec{y}_i, \vec{y}^*\right) = \sqrt{\sum_{k=1}^{m} \overline{\mu}_k^{*2}(y_{ik} - y_{ik}^*)^2} \quad (8)$$

Multi-period entrepreneur environment management behavior evaluation model: According to function (6)-(8), each period entrepreneur's comprehensive value is obtained. Each period value parameter can be obtained according to model (9):

$$\min_{wt_k} d_{t_k}^2\left(\vec{z}_{t_k}, \vec{z}^*\right) = \sum_{t_k=1}^{P_k} \theta_{t_k}^2\left(z_{t_k} - z_{t_k}^*\right)^2$$

$$s.t: \sum_{t_k=1}^{P_k} \theta_{t_k} = 1 \quad\quad (9)$$

$$\theta_{t_k} \geq 0, t_k = 1, 2, ..., P_k$$

We can get final evaluation result of each entrepreneur according to model (10):

$$Z = \sqrt{\sum_{t_k=1}^{P_k} \overline{\theta}_{t_k}^{*2}(z_{t_k} - z_{t_k}^*)^2} \quad (10)$$

According to the logic of reasoning layer by layer, the top layer final evaluation result can be obtained of each entrepreneur.

CALCULATION EXAMPLE AND DISCUSSION

Calculation example: There are 5 entrepreneurs needing evaluation and ranking on six periods. Confined to the length of the thesis, all the initial data can be seen in attached schedule. Table 2 displays policy management initial data of evaluated objects as example. According to model (3), five evaluated entrepreneurs policy management indicator individual advantage structures are shown in Table 3, according to model (7), middle level indicator comprehensive value is shown in Table 4, According to model (4), five evaluated entrepreneurs top to middle level individual advantage structures are shown in Table 5, according to model (8), top level indicator comprehensive value is calculated, the results are shown in Table 6.

Similarly, six periods top level comprehensive value of each evaluated entrepreneur can be calculated. According to model (9) and (10) and obtained each period comprehensive value, we can get the final result of each entrepreneur, entrepreneur 1 multi-period value is 0.201, entrepreneur 2's value is 0.197, entrepreneur 3's value is 0.213, entrepreneur 4's value is 0.253, entrepreneur 5's value is 0.187. And the ranking result is: entrepreneur $5 \succ$ entrepreneur $2 \succ$ entrepreneur 1 $\succ$ entrepreneur $3 \succ$ entrepreneur 4.

Discussion: The bigger value parameter means the better performed evaluated entrepreneur. According to Table 3, entrepreneur 1 has advantage on "environmental protection budget" "clear commitment or state" and "passed environmental certification", but has disadvantages on other indicators. By inference,

Table 2: Original data of taking policy management as example

	Environment management and policy management			
	Board taking full responsibility	Clear commitment or state	Passed environmental certification	Environmental protection budget
Entrepreneur 1	2	3	1	4
Entrepreneur 2	3	4	4	3
Entrepreneur 3	4	1	5	2
Entrepreneur 4	5	3	3	4
Entrepreneur 5	3	5	2	3

Table 3: Middle level to basic level indicator advantage structure at period t_k

	Environment management and policy management			
	Board taking full responsibility	Clear commitment or state	Passed environmental certification	Environmental protection budget
Entrepreneur 1	0	0	0	1
Entrepreneur 2	0.0588235294117647	0.418300653594771	0.418300653594771	0.104575163398693
Entrepreneur 3	0	0	1	0
Entrepreneur 4	0.5	0	0	0.5
Entrepreneur 5	0	1	0	0

Table 4: Middle level indicator comprehensive value at period t_k

	Policy management				
Entrepreneur 1	0	0.50	1	0	0.50
Entrepreneur 2	0.471359209	0.161690417	0.431620052	0.295783229	0.320461455
Entrepreneur 3	1	0.25	0	0.5	0.75
Entrepreneur 4	0.5	0.416666667	0.527046277	0	0.416666667
Entrepreneur 5	0.5	0.25	1	0.5	0
Comprehensive value	0.49271842	0.315671417	0.591733266	0.259156646	0.397425624
Ranking	4	2	5	1	3

Table 5: Top level to middle level indicator advantage structure at period t_k

	Environment management						
	Policy management	Information publication	Communal participation	Recycling economy	Worldwide technical standardization	Incidence relation	Development history
Entrepreneur 1	0.2500	0.2500	0	0.2500	0.2500	0	0
Entrepreneur 2	0	0	0	0.3333	0	0.3333	0.3333
Entrepreneur 3	0.3333	0.3333	0	0	0.3333	0	0
Entrepreneur 4	0.2000	0.2000	0	0.2000	0.2000	0	0.2000
Entrepreneur 5	0.1667	0.1667	0.1667	0	0.1667	0.1667	0.1667

Table 6: Top level comprehensive value at period t_k

	Entrepreneur 1	Entrepreneur 2	Entrepreneur 3	Entrepreneur 4	Entrepreneur 5
Entrepreneur 1 angle	0	0.225346955	0.320047739	0.365623516	0.195433990
Entrepreneur 2 angle	0.370370370	0	0.213565974	0.351364184	0.384900179
Entrepreneur 3 angle	0.381881308	0.353553391	0	0.166666667	0.448763734
Entrepreneur 4 angle	0.271313677	0.158113883	0.242670330	0	0.323608131
Entrepreneur 5 angle	0.144597201	0.140098896	0.235875541	0.254081902	0
Comprehensive value	0.233632511	0.175422625	0.202431917	0.227547254	0.270541207
Ranking	4	1	2	3	5

other three entrepreneurs' advantages and disadvantages can be identified.

According to Table 4, about middle level indicator "policy management", from the perspective of entrepreneur 1, according to entrepreneur 1's advantage structure, the distance value is 0, according to entrepreneur 2's advantage structure; t entrepreneur1's distance value is 0.47. Entrepreneur 1 value is 0.49, ranking fourth. Entrepreneur 2 value is 0.32, ranking second. Entrepreneur 3 value is 0.59, ranking fifth. Entrepreneur 4 value is 0.26, ranking first. Entrepreneur 5 value is 0.40, ranking third.

According to Table 5, entrepreneur 1 has advantage on "policy management", "information publication", "recycling economy" and "worldwide technical standardization", has disadvantages on other indicators. Entrepreneur 2 has advantage on "recycling economy", "incidence relation" and "development history", has disadvantages on other indicators. And the like, advantages and disadvantages of entrepreneur 3, entrepreneur 4 and entrepreneur 5 are identified.

According to Table 6, entrepreneur 1's top comprehensive value is 0.23, ranking fourth. Entrepreneur 2's top value is 0.17, ranking first. Entrepreneur 3's top value is 0.20, ranking second. Entrepreneur 4's top value is 0.23, ranking third. Entrepreneur 5's top value is 0.27, ranking fifth.

CONCLUSION

Summarizing the enterprise development progress, it is not difficult to find that enterprise develop and make progress as entrepreneurs actively exploring and acting in match with external environmental development needs according to the inner quality of the enterprise. However, the situation of the environment and the enterprise condition inevitably bring about different behaviors of entrepreneurs. And different environmental management behavior brings different benefits for the society. Thus, in order to encourage entrepreneurs to protect the environment according to one's own advantages and disadvantages, it is important to evaluate according to environmental management advantages. This study builds up an evaluation model based on each evaluation objects' individual advantage characteristics. Obviously, each entrepreneur hopes to be evaluated by maximization environmental protection or work efforts and obtaining achievements by standing out their individual advantage characteristics. Therefore, there is a reality demand for evaluation method based on entrepreneur's advantage environmental protection characteristic. Furthermore, there are different economy situations among different development stages, so, considering of dynamic multi-stage evaluation is necessary.

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