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Research on Evaluation System of Internet Venture Capital Project based on Matter - Element Method

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Abstract

Drawing on experience of evaluation procedures on decision-making in the field of venture capital project, this paper establishes an evaluation procedures of telecommunications business innovation hatching project, combined with matter-element extension and other related theories. Firstly, by reviewing the evaluation index system related to innovation project and venture capital institutions, we construct the evaluation index system of Internet venture investment projects from four aspects, which are entrepreneurial team, technical/product, market and finance. Then, combining the characteristics of Internet business venture investment projects, with the project's classical field, segment field and matter element we establish the matter-element extension model of Internet venture investment project. An example is given to verify its feasibility and reasonability and the results provide a new way to assess the Internet venture capital project.

Keywords: *Internet; Venture capital; Matter-element extension model; Project evaluation*

1. Introduction

The rapid development of the Information and Communication Technology (ICT) makes venture capital projects in the field of Internet into a new round of Venture Capital hotspots. According to the 2014 first quarter data of China's VC market Investment Report, in 131 venture capitals, the Internet sector investments accounted for 66 which has become the focus of investor attention in the industry. In order to improve the success rate of project incubation, we first need to select innovative projects with development potential in Innovation Incubator management work. So how to use a scientific and rational appraisal system on venture investment project to get a systematic analysis and evaluation, and select the success one has important implications for entrepreneurial investors.

Research on evaluation of innovation project focus on project evaluation procedures, project evaluation system and project evaluation methods, as follows:

1. Researchon the project assessment procedure: Based on an assessment practice of 90 investment projects, Tyebjeeand Bruno(1984) summarized a five-stage decision-making process of venture capital project evaluation: get project stage, project selection stage, the project evaluation stage, the stage of investment agreements and the management after investment stage. Roberts (1991) conducted a thorough investigation on companies which has more than ten years history of high-tech venture capital, and summed up the decision-making procedures consists of three stages:make a rough screening for business plan book,understand venture team and more information about the project, make an in-depth, detailed analysis and evaluation on the project.

2. Research on project evaluation index system: According to the factor analysis of the

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90 projects scoring results by the venture capitalists, Tyebjee and Bruno (1984) extracted the most crucial factor affecting the results of the project evaluation:market appeal, product differentiation, management ability, resistance to environmental threats. Vance H.Fried and Robert.Hirsch (1994) selected 18 venture investment projects from different fields and at different development stages of United States as a case study, and they obtained a generic evaluation system of venture capital project including the management capabilities, product strategy thought and expected benefits. Steven N.Kaplan and Per Stromberg (2000) started directlyto analyze the decision-making raw materials from the Venture Investment Project. They conduct in-depth study for contracts and investment analysis report of 20 venture investment companies, and then summarized the evaluation criteria that Ventures commonly used when evaluating the project include the following four aspects: attractiveness of investment opportunities, the management team, investment terms, and investment environment.ZouXiaohua, TianLixin (2016) for the current CCS project investment risk, established a risk assessment model based on improved comprehensive cloud investment. They taking into consideration the economic, technical and social risks of CCS projects, construct the risk index system of CCS projects, anduse the improved comprehensive normal cloud to realize the evaluation of the risk level.

3. Research on project evaluation methods:The commonly used method of project evaluation is Delphi, which can achieve the effect of collective decision-making through by-round feedback survey for expert advice to get the final convergence of expert's opinions. The relevant scholars began to apply Analytical Hierarchy Process(AHP) to evaluation in venture capital projects.Meanwhile, theorists of project evaluation conduct fuzzy mathematics theory into AHP and construct the fuzzy comprehensive evaluation method. On the basis of a qualitative analysis of the evaluation criteria, Tyebjee and Bruno (1984) built the first American venture capital project evaluation model by factor analysis and linear regression of the results of the 90 venture capital projects by experts. In addition, in the research on project valuation methods, typical findings include three categories: The first category is the traditional project valuation methods; the second is Real option method which applied the B-S option pricing model to the project evaluation; the third category is the option game analysis. XuGuang, *etc*. (2015) through the analysis of the connotation and characteristics of the concept of technology innovation project, according to the "risk-return" analysis, established the evaluation index of technology innovation project. And on this basis, combined with the network level analysis method, the evaluation indicators of technological innovation projects are analyzed, and the weight of each index is obtained, and the evaluation system of technological innovation project is constructed.

Synthesis of existing research, we find that the researches on evaluation index system and evaluation model of Internet venture capital project are still relatively scarce. This article firstly draws on the advanced experience in the field of venture capital project evaluation, and based on the characteristics of the Internet business innovation incubator project evaluation; construct the corresponding evaluation index system.And then, giving full consideration to the characteristics of the Internet business innovation incubator project, we build an integrated assessment model which provides a practical assessment toolfor the Internet business innovation incubator project.

2. Internet Venture Project Primaries Assessment

In the initial stage receiving and screening of the Internet venture capital projects, incubators usually has no contact with the project team, and the information that can be learned about the project are only project plans.Thus the project plan becomes the foundation and the object of the project primary evaluation. Primary assessment stage of the project is mainly based on the set of evaluation criteria and screening model to reject inappropriate project plan, and thus carry out initial screening to the project which apply

for the hatching.

2.1. Project Primaries Assessment Procedures

Reference herein to "six stage" investment assessment decision-making process, we divided the project evaluation primary stage into two parts: the rapid screening stage of the project planand comprehensive screening stage of project plans stage. In the rapid screening stage of the project plan, we first need to formulate basic screening criteria based on develop strategies of incubators, determine the basic prerequisite for incubating projects, andeliminate the projects that does not satisfy the prerequisites. After the rapid screening of the project plan is the comprehensive screening stage of project plan. In this stage,we need to conduct a more detailed review to all aspectsof the contents of the project plan to determine whether the project be able to enter the next stage of a comprehensive assessment. The aspects including the feasibility of product, market outlook, entrepreneurial team, risk tolerance and so on

2.2. The Project Evaluation Criteria Primaries

This article will choose the prerequisitesthat the project apply for incubator should meet as rapid screening criteria for the project. Making the Internet business innovation incubator base as a case, according to the principles of the Internet business innovation and management of the business incubator, the project must meet the following conditions:

1.Direction of projects should focus on mobile Internet, cloud computing, networking and other areas that can form a complementary to the main Internet business;

2.Products different from that Internet companies have independently researched and managed;

3.Project technical sources is clear and no intellectual property disputes;

4.It should has a clear product form and a clear product positioning, and in the basic information section the core of demand for products, the core functionality and target audience can be clearly summed up ;

5.It should have a clear business model or revenue model, business model and profit point of the product in the basic information section can be succinctly outlined.

In comprehensive screening stage, incubators will analyze the project plans in detail. Assessments in comprehensive screening stage include the following aspects: project document, entrepreneurial team, products, markets, financial planning, and risk analysis.

2.3. Project Primaries Evaluation Model

On the basis of the constructed fuzzy screening system by Yager (1993), this paper design a fuzzy screening model for comprehensive screening of project plans. In the text of Yager, based on Lukasiewicz implication and Godel implication, Yager built fuzzy screening model of the project document respectively. Therefore, according to the characteristics of primaries evaluation of Internet venture capital project, we established a fuzzy screening model for comprehensive screening of project plans,reference to Yager'sfuzzy screening system.

The first thing is to determinethe scoring criteria ofthe various indicators.Each index score usethe 0-5 grade ratings standard, and the score results equal sum of the assessment factors score. Make P represent index score, and $P=\{0,1,2,3,4,5\}=\{P_0,P_1,P_2,P_3,P_4,P_5\}$.

Secondly, determine the importance of each indicator. Since the primary assessment of the project is only a rough rapid assessment,we do not establish the right weights to indicators, only assess the importance of each indicator. The degree of importance are also divided into 5levels,where

$S = \{very\ important(S_5),\ the\ more\ important(S_4),\ medium(S_3),\ relatively\ unimportant(S_2),\ very\ not\ important(S_1)\} = \{5,4,3,2,1\}$

Finally, get the composite score. P_j represents value to the j-th indicator, S_j represents the importance score of the j-th index, the composite score of the project value Z calculated by the following formula:

$$Z = min\{S_j \to P_j\}$$

Formula (3-1)

Where $\to$ representsGodel implication operator, namely

$$S_j \to P_j = \begin{cases} P_j, if\ S_j > P_j \\ 5, if\ S_j \le P_j \end{cases}$$

Formula (3-2)

Compare Z with established screening threshold Z^*, when $Z \ge Z^*$, the project will enter through a comprehensive screening to comprehensive assessment stage, otherwise the project will be eliminated.

3. Construction of the Internet Venture Capital Project Evaluation Index System

In order to select the right comprehensive evaluation indicators of Internet business investment projects, the articledraws on the latest research results of evaluation index system of domestic and foreign venture capital project and the evaluation index system China's best venture capital institutions in 2014 Forbes published employed. Using the Delphi method for the selected index number to get amendments and then we finalize the comprehensive assessment index system of entrepreneurial team, product / technology, marketing, and finance four aspects:

(1) Entrepreneurial team U_1 :Excellent managers and team member's structure arethe core factor in establishing the success business team. Therefore, the assessmentof entrepreneurial team should include both managers' quality U_{11} and team members' quality U_{12}.

(2) Product / Technology U_2 : The technology is the basis for product innovation, and the product is the carrier of technology, so this article integrated product and technology into an evaluation index categories. The product / technology assessment of Internet venture capital projects include the following three aspects: First one is the feasibility assessment U_{21}, namely to assess the feasibility of the development of pioneering products; Second one is innovative assessment U_{22}, which refers to the innovation degree of product and technology innovation comprehensive evaluation; Third one is value assessment U_{23}, namely whether the project can provide value for users and match market and then commercialized.

(3) Market U_3: General evaluation of market factors start from the market capacity of products, its growth potential and other aspects, and then the business model will be evaluated from marketing channel, profit model, *etc*..Finally their competitiveness will be evaluated from the number of alternatives and the degree of substitutability, its competitive advantages and value chain aspects. On this basis, this paper combine with the characteristics of the Internet market to divide it into the market size prospects U_{31}, business model U_{32}, market competitiveness U_{33},including three secondary indicators and eight level indicators.

(4) Financial U_4: Taking into account the initial stages of product development, which lacks more stable historical data and the relevant parameters have not been determined, the mainstream financial evaluation methods are difficult to be used to evaluate finance of Internet business investment projects. Therefore, this article mainly from the rationality of financing needs U_{41}, rationality of financial planning U_{42}, control mechanisms of financial risks U_{43} conducts the project feasibility analysis and financial risk, and we do not set up three indicators.

In summary, the evaluation index of Internet business investment projects this paper constructs are as follows:

Table 1. Indicators Table of Internet Business Investment Projects

First indicators	**Secondary**	**Third indicators**
Entrepreneurial team (U_1)	Team manager (U_{11})	Entrepreneurial enthusiasm (U_{111})
		Insight into the development of the industry capacity (U_{112})
		Execution (U_{113})
		Personal qualities (U_{114})
	Team members (U_{12})	Capability and expertise relevant experience (U_{121})
		Teamwork (U_{122})
Reliability product / technology (U_2)	Feasibility (U_{21})	Supporting technology (U_{211})
		Product design reliability (U_{212})
	Innovation (U_{22})	Technology Innovation (U_{221})
		Innovation of the product (U_{222})
	Value (U_{23})	User value of the product (U_{231})
		Commercially degree (U_{232})
Market (U_3)	The size of the market prospects (U_{31})	Target market capacity (U_{311})
		Target market

		growth (U_{312})
		Continuingmarket demand (U_{313})
	Reasonable business models (U_{32})	Market positioning (U_{321})
		Rationality and innovative profit model (U_{322})
		Collaborative and telecommunications companies (U_{323})
	Market competitiveness (U_{33})	The number of alternative products and alternative capacity (U_{331})
		This product differentiation competitive advantage (U_{332})
Finance (U_4)	Rationality of financing needs (U_{41})	—
	The reasonableness of the financial plan (U_{42})	—
	Financial risk control mechanism (U_{43})	—

4. Internet Venture Capital Project Evaluation Model Based on Matter-element Extension

4.1. Select Comprehensive Assessment Model

The Comprehensive evaluation of the Internet innovation project is based on the construction of evaluation index system, the project is evaluated objectively, and the weight of each evaluation index is determined, and then the whole evaluation is made. In view of the Internet innovation projects have many uncertain factors and most projects are in the initial stage of product development. Besides, most indices are difficult to collect more stable data. Therefore, the comprehensive and fuzziness of the index system lead to that making the comprehensive evaluation by quantitative method is impossible. In this article, we consider to introduce correlation function with characterization extension sets to try to construct a comprehensive evaluation model, which is based matter-element extension and establishthe correlation function on the basis of the controlled field, the classical field, and thedistance and place values. With this, we want to realize qualitative change to quantitative, effectively avoid the fuzziness of the evaluation index, and objectively reflect the level of the index.

Matter-element extension method is derived in the matter-element analysis theory, and the core of the theory is that based on matter-element model and use extension transformation to find solutions of incompatible problem. Standard form of

matter-element is: $R=[N,c,v]$,which N denotes the things, c denotes the features of that things, v denotes the value of characteristic. Assuming that all of the features of a certain thing N are n , the n features are represented as $(c_1,c_2,...,c_n)$, and the corresponding value are $(v_1,v_2,...,v_n)$, then the n-dimensional feature element matrix of the things can be expressed as:

$$R=\begin{bmatrix} N & c_1 & v_1 \\ & c_2 & v_2 \\ & \cdots & \cdots \\ & c_n & v_n \end{bmatrix}$$

4.2. Establishment of Comprehensive Evaluation Model Based on Matter - element Extension Method

Based on the comprehensive evaluation index system of Internet innovation project, the project comprehensive evaluation model based on matter-element extension method is constructed as follows according to the theory of matter-element extension model.

(1)Set evaluation level domain

According to the characteristics of the project to be evaluated, the evaluation level domain is $N=\{N_{01},N_{02},N_{03},...,N_{0t}\}$, in which the number of evaluation grade is t .

(2)Determine the classical domain matter element matrix and thesegment domain matter-element matrix.

Classical field matter-element matrix can be expressed as：

$$R_{0j}=\begin{bmatrix} N_{0j} & c_1 & V_{0j1} \\ & c_2 & V_{0j2} \\ & \cdots & \cdots \\ & c_n & V_{0jn} \end{bmatrix}=\begin{bmatrix} N_{oj} & c_1 & <a_{0j1},b_{0j1}> \\ & c_2 & <a_{0j2},b_{0j2}> \\ & \cdots & \cdots \\ & c_n & <a_{0jn},b_{0jn}> \end{bmatrix} \quad \text{Formula(4-1)}$$

N_{0j} expresses that the evaluation grade is at the level of $j\ (j=1,2,...,t)$, c_i $(i=1,2,...,t)$ express the characteristics of the evaluation level of N_{0j} , $V_{0ji}=<a_{0ji},b_{0ji}>$ expresses the value range of the characteristic c_i , when the leave of project evaluation level is j .

The matrix is expressed as:

$$R_p=\begin{bmatrix} N_p & c_1 & V_{p1} \\ & c_2 & V_{p2} \\ & \cdots & \cdots \\ & c_n & V_{pn} \end{bmatrix}=\begin{bmatrix} N_p & c_1 & <a_{p1},b_{p1}> \\ & c_2 & <a_{p2},b_{p2}> \\ & \cdots & \cdots \\ & c_n & <a_{pn},b_{pn}> \end{bmatrix} \quad \text{Formula (4-2)}$$

Among them, N_P expresses all of the evaluation level, $V_{pi}=<a_{pi},b_{pi}>$ expresses the allowable range of values, and $V_{0pi}\subset V_{pi}$.

(3)Determine the matter-element to be evaluated.

Therefore, first of all, the evaluation value of each bottom index is obtained through expert evaluation, and then the evaluation results of the bottom index are expressed as the matter-element matrix:

$$R = \begin{bmatrix} r & c_1 & v_1 \\ & c_2 & v_2 \\ & \cdots & \cdots \\ & c_n & v_n \end{bmatrix} \quad \text{Formula (4-3)}$$

Where r represents the bottom index, $v_i\,(i=1,2,...,n)$ as the value of c_i, namely the evaluation value of the index.

(4) Calculate the correlation degree of the matter-element to be evaluated on each evaluation grade.

Set the v_i as the value of ci which is the i-th characteristic of the matter-element to be evaluated. The distance between the points v_i to the finite real interval $V_0 < a,b >$ is defined as:

$$P(v_i,\ V_0) = \left| v_i - \frac{1}{2}(a+b) \right| - \frac{1}{2}(b-a) \quad \text{Formula (4-4)}$$

According to the formula, the distance between the point v_i to the classical domain interval V_{0ji} and the segment interval V_{pi} can be expressed as:

$$\rho(v_i,\ V_{0ji}) = \left| v_i - \frac{1}{2}(a_{0ji} + b_{0ji}) \right| - \frac{1}{2}(b_{0ji} - a_{0ji}) \quad \text{Formula (4-5)}$$

$$\rho(v_i,\ V_{pi}) = \left| v_i - \frac{1}{2}(a_{pi} + b_{pi}) \right| - \frac{1}{2}(b_{pi} - a_{pi}) \quad \text{Formula (4-6)}$$

The correlation degree of c_i on evaluation grade j is defined as:

$$K_j(v_i) = \frac{\rho(v_i,\ V_{0ji})}{\rho(v_i,\ V_{pi}) - \rho(v_i,\ V_{0ji})} \quad \text{Formula (4-7)}$$

The correlation degree of the bottom indexU_{kil} on the evaluation grade j can be expressed as:

$$K_j(U_{kil}) = \frac{\rho(v_{kil},\ V_{0ji})}{\rho(v_{kil},\ V_{pi}) - \rho(v_{kil},\ V_{0ji})} \quad \text{Formula (4-8)}$$

(5) Todetermine theevaluation level of bottom index.

According to the size of the correlation degree to determine the evaluation level, the greater the degree of correlation with the evaluation grade, the more close to the evaluation level, namely if:

$$K_{j0}(U_{kil}) = \max_{j\in(1,2,...t)} K_j(U_{kil}) \quad \text{Formula (4-9)}$$

The evaluation of index U_{kil} is at the level of j_0.

(6)To determine the weight of the index.

In the determination of index weights,in order to avoid the fuzzy problem that individual judgment cannot fully take into account, when constructing the judgment matrix by the analytic hierarchy process (AHP). In this article, the triangular fuzzy is introduced into the structure of AHP judgment matrix to make the result is more reliable and accurate. Specific steps are as follows:

Fuzzy judgment matrix is constructed firstly:

$$R = (r_{ij})_{n\times n} \tag{9}$$

Among them, *n* is the number of indices of the indicator layer, and $r_{ij} = (l_{ij}, m_{ij}, u_{ij})$ is the triangular fuzzy number, which the lower and upper limit of triangular fuzzy number are l_{ij} and u_{ij}, and r_{ij} represents the linguistic variables.

Then carry on the consistency check:

$$M = (\mathrm{m}_{ij})_{n\times n} \tag{10}$$

Then calculate the comprehensive importance degree of index:

$$S_{\mathrm{i}} = \sum_{\mathrm{j}=1}^{\mathrm{n}} \mathrm{M}_{\mathrm{Ei}}^{\mathrm{j}} \otimes \left[\sum_{i=1}^{n} \sum_{j=1}^{\mathrm{n}} M_{Ei}^{j} \right]^{-1}, 1 \leqq i \leqq n, 1 \leqq j \leqq n \tag{11}$$

Among them, $\mathrm{M}_{\mathrm{Ei}}^{\mathrm{j}} = r_{ij}$ and S_i represents the important degree of the i-th index.

At last, the normalized weight value is calculated:

$$W = \left[d(C_1), d(C_2), \ldots, d(C_i), \ldots, d(C_n) \right]^T \tag{12}$$

Among them $d(C_i) = \dfrac{d'(C_i)}{d'(C_1), + d'(C_2) + \ldots + d'(C_i) + \ldots + d'(C_n)}$, $d'(C_i) = minP(S_i \geqq S_k)$, and $k \neq i$。

(7) To determine the comprehensive evaluation result of the project by means of extension evaluation transformation.

After determining the correlation degree of bottom index of each evaluation grade and the weight of each index, by the extension evaluation transformation, the correlation degree of each index can be calculated layer by layer, and finally the comprehensive evaluation results of the project can be obtained.

Weset the second indexis $U_{ki} = \left(U_{ki1} \quad U_{ki2} \quad \ldots \quad U_{kis} \right)$, and according to the correlation degree of bottom index of each evaluation grade, the correlation degree matrix of the index U_{ki} can be obtained:

$$A = \begin{bmatrix} K_1(U_{ki1}) & K_2(U_{ki1}) & \ldots & K_t(U_{ki1}) \\ K_1(U_{ki2}) & K_2(U_{ki2}) & \ldots & K_t(U_{ki2}) \\ \ldots & \ldots & \ldots & \ldots \\ K_1(U_{kis}) & K_2(U_{kis}) & \ldots & K_t(U_{kis}) \end{bmatrix} \qquad \text{Formula (4-15)}$$

And set the weight distribution of the third grade indices to $W_{ki} = \left(W_{ki1} \quad W_{ki2} \quad \ldots \quad W_{kis} \right)$ under the second index U_{ki}, socorrelation degree of the second index U_{ki} of each evaluation grade can be obtained.

$$K(U_{ki}) = W_{ki} \bullet A = (W_{ki1} \quad W_{ki2} \quad \ldots \quad W_{kis}) \bullet \begin{bmatrix} K_1(U_{ki1}) & K_2(U_{ki1}) & \ldots & K_t(U_{ki1}) \\ K_1(U_{ki2}) & K_2(U_{ki2}) & \ldots & K_t(U_{ki2}) \\ \ldots & \ldots & \ldots & \ldots \\ K_1(U_{kis}) & K_2(U_{kis}) & \ldots & K_t(U_{kis}) \end{bmatrix} \qquad \text{Formula (4-16)}$$

$$= \left(K_1(U_{ki}) \quad K_2(U_{ki}) \quad \ldots \quad K_t(U_{ki}) \right)$$

Then the correlation degree set of the second index U_{ki} on the evaluation set N is $K(U_{ki}) = \left(K_1(U_{ki}) \quad K_2(U_{ki}) \quad \ldots \quad K_t(U_{ki}) \right)$.

Determine the evaluation gradeof U_{ki} .If $K_{j0}(U_{ki}) = \max_{j\in(1,2,\ldots t)} K_j(U_{ki})$, theevaluation grade of index U_{ki} is j_0. Repeat the above steps, and the weighted correlation degree $k_j(U)$ of the project and evaluation grades of it can be obtained.

(8)To calculate the characteristic value of the class variables

The weighted correlation degree was normalized to get the comprehensive correlation degree:

$$\overline{K_j(U)} = \frac{K_j(U) - \min\limits_{j\in\{1,2,\ldots,\ t\}} K_j(U)}{\max\limits_{j\in\{1,2,\ldots,\ t\}} K_j(U) - \min\limits_{j\in\{1,2,\ldots,\ t\}} K_j(U)} \qquad \text{Formula (4-17)}$$

$$\text{Then} \quad j^* = \frac{\sum_{j=1}^{t} j \times \overline{K_j(U)}}{\sum_{j=1}^{t} \overline{K_j(U)}} \qquad \text{Formula (4-18)}$$

Among them U and j^* was called the characteristic value of class variables. The size of j^* reflects the degree to which the project to be evaluated is biased in favor of adjacent evaluation, so that it is more accurate to reflect the evaluation level of the project and the different status in the same evaluation level.

5. The Example Analysis of Valuation of Internet Venture Capital Project

Chocolate online custom project development of innovative products is a client application based on C2M mobile Internet, the target users are mainly couples, students and wedding， which is committed to enhance the degree of personalized products for the target users.As Venture investors, they need to make a comprehensive evaluation about four aspects including the project team strength, product technology, market prospects and finance and determine whether the project has a considerable potential for development in the future.

5.1. Primary Evaluation of the Internet venture capital Project

1. Rapid screening assessment

According to the previous analysis, mainly based on the basic information of the project document, we determine whether the project is in accordance with the requirements of the application for hatching in the rapid screening stage. Therefore, with 5 essential conditions as screening criterion, the basic information of the A project plan is quickly evaluated as following:

(1).The application direction of project A is mobile terminals and applications, which is in accord with innovation incubation project application areas that China Telecom has set;

(2).This product doesnot repeat with the self-developed products and operating products of the company;

(3).The technology source of this product is clear, and there are no intellectual property disputes;

(4).The basic information part can clearly describe the product concept, product function and the target user group. The product form is clear;

(5).In different channels, commercial mode and profit sources of products can be clearly summarized, and profit model is clear. Therefore, project A satisfies all the necessary conditions and can the pass through the rapid screening assessment stage to

enter the comprehensive screening assessment stage.

2.Comprehensive screening evaluation

In comprehensive screening stage, the project document of project A will have a detailed review of project, and we will use fuzzy screening model constructed previously to make the screening and evaluation of the project. The evaluation content includes: the quality of the project document, entrepreneurial team, products, market, financial planning, and risk.

According to the score standard established in the previous paper, the evaluation of the above 6 aspects of the project A is evaluated, and the important degree of each index is determine.The importance of index and scores of index are in the Table 2

Table 2. The Importance and scores of Index In Comprehensive Screening Stage

Index	The importance of index	The scores of index
Project document	$4(S_4)$	$5(P_5)$
Entrepreneurial team	$5(S_5)$	$5(P_4)$
Products	$5(S_5)$	$4(P_4)$
Market	$5(S_5)$	$4(P_4)$
Financial planning	$2(S_2)$	$2(P_2)$
Risk	$3(S_3)$	$4(P_4)$

According to the score of indices, using the fuzzy screening model constructed in the previous paper, the comprehensive score of the project A in the comprehensive screening stage was obtained.

$$Z = min\{S_j \to P_j\} = min\{5,5,4,4,5,5\} = 4$$

According to the long-term goal of innovation and incubation management and the characteristics of alternative projects, the project screening threshold Z^* will be identified as 4 points by incubation base, that is, the comprehensive score should greater than or equal to 4 points. So project A can pass the comprehensive screening stage, and will enter the comprehensive evaluation stage.

5.2. Comprehensive Evaluation of Innovative Projects Based on Matter-element Extension Model

1.Determine the evaluation level domain

This project has invited 15 experts to form the evaluation committee (including 5 technical experts, 6 product operation experts, 4 venture capitalists). On the basis of consulting the opinions of the review committee, evaluation set is determined as $N = \{very\ poor,\ poor,\ general,\ good,\ very\ good\ \} = \{N_{01}, N_{02}, N_{03}, N_{04}, N_{05}\}$, and use 0-10 system to represent the size of each evaluation level, where $N_{01} \in [0,4],\ N_{02} \in (4,6],\ N_{03} \in (6,8],\ N_{04} \in (8,9],\ N_{05} \in (9,10]$.

2.Determine the segment domain matter-element matrix and the classical domain matter element matrix.

The segment domain matter-element matrix is：

$$R_P = \begin{bmatrix} N_P & c_1 & <0,10> \\ & c_2 & <0,10> \\ & \cdots & \cdots \\ & c_{23} & <0,10> \end{bmatrix}$$

The classical domain matter-element matrix is:

$$R_{01} = \begin{bmatrix} N_{01} & c_1 & <0,4> \\ & c_2 & <0,4> \\ & \cdots & \cdots \\ & c_{23} & <0,4> \end{bmatrix}, \quad R_{02} = \begin{bmatrix} N_{02} & c_1 & <4,6> \\ & c_2 & <4,6> \\ & \cdots & \cdots \\ & c_{23} & <4,6> \end{bmatrix}, \quad R_{03} = \begin{bmatrix} N_{03} & c_1 & <6,8> \\ & c_2 & <6,8> \\ & \cdots & \cdots \\ & c_{23} & <6,8> \end{bmatrix},$$

$$R_{04} = \begin{bmatrix} N_{04} & c_1 & <8,9> \\ & c_2 & <8,9> \\ & \cdots & \cdots \\ & c_{23} & <8,9> \end{bmatrix}, \quad R_{05} = \begin{bmatrix} N_{05} & c_1 & <9,10> \\ & c_2 & <9,10> \\ & \cdots & \cdots \\ & c_{23} & <9,10> \end{bmatrix}$$

3. Calculate the matter to be evaluated

First determine score of each bottom index by using the following methods: the 15 experts of assessment committee give the scores of bottom index, and if the experts think that the index U_{kil} is very poor, the score of the index is $v_{kil} \in (0,4]$; if the experts think that the index is poor, the score of index is $v_{kil} \in (4,6]$; if you think the index is in general, the evaluation index of the $v_{kil} \in (6,8]$; if the experts think that the index is good, the score of index is $v_{kil} \in (8,9]$; if the experts think that the index is very good, score of the index is $v_{kil} \in (9,10]$. And because the review committee brings experts that mobile Internet technology experts, product specialists and venture capital operations experts who are from inside and outside of China Telecom together, with different professions, they will have cognitive bias about the same problem. Therefore, in order to reduce the impact of cognitive bias, in this article the expert evaluation results are classified, and are given different weights. Among them, technical experts has a higher weight of the three indices that the reliability of Technology (U_{111}), the reliability of the product design (U_{112}) and the innovative of technology application (U_{221})in the evaluation results ; and in product innovation (U_{222}), users of the product value(U_{231}), degree of commercialization of products (U_{232})and market indices, product operations experts has a higher weight in the evaluation results; Venture capital experts have a higher weight on the evaluation results of financial index; the evaluation of the entrepreneurial team belongs to the comprehensive evaluation, so the evaluation results of all the experts are given the same weight.

In these 15 assessors, there are 5 technical experts, 6 product operations experts, 4 entrepreneurs to participate in the assessment. Make the score value of technical experts expressed as v_{kij}^T, the product operation expert score value expressed as v_{kij}^P,and the score value of venture capitalists expressed as v_{kij}^I. After the evaluation results are classified, the value of the index U_{kil} is obtained:

$v_{kij} = 0.6 * \frac{\sum_{T=1}^{5} v_{kij}^{T}}{5} + 0.2 * \frac{\sum_{p=1}^{6} v_{kij}^{P}}{6} + 0.2 \frac{\sum_{I=1}^{4} v_{kij}^{I}}{4}$ (The evaluation result of technical experts has a higher weight)

$v_{kij} = 0.2 * \frac{\sum_{T=1}^{5} v_{kij}^{T}}{5} + 0.6 * \frac{\sum_{p=1}^{6} v_{kij}^{P}}{6} + 0.2 \frac{\sum_{I=1}^{4} v_{kij}^{I}}{4}$ (The evaluation result of product operations experts has a higher weight)

$v_{kij} = 0.2 * \frac{\sum_{T=1}^{5} v_{kij}^{T}}{5} + 0.2 * \frac{\sum_{p=1}^{6} v_{kij}^{P}}{6} + 0.6 \frac{\sum_{I=1}^{4} v_{kij}^{I}}{4}$ (The evaluation result of venture capital experts has a higher weight)

$v_{kij} = \frac{\sum_{T=1}^{5} v_{kij}^{T} + \sum_{p=1}^{6} v_{kij}^{P} + \sum_{I=1}^{4} v_{kij}^{I}}{15}$ (Give the same weight to all the experts' evaluation results.)

The evaluation value of each index of the bottom layer is determined by the above method, and the matter-element matrix is obtained as follows：

$$\mathbf{R} = \begin{bmatrix} \mathbf{N} & \mathbf{U}_{111} & 9.10 \\ & \mathbf{U}_{112} & 8.42 \\ & \mathbf{U}_{113} & 8.28 \\ & \mathbf{U}_{114} & 8.45 \\ & \mathbf{U}_{121} & 8.50 \\ & \mathbf{U}_{122} & 8.36 \\ & \mathbf{U}_{211} & 8.50 \\ & \mathbf{U}_{212} & 7.32 \\ & \mathbf{U}_{221} & 7.67 \\ & \mathbf{U}_{222} & 8.28 \\ & \mathbf{U}_{231} & 8.26 \\ & \mathbf{U}_{232} & 9.10 \\ & \mathbf{U}_{311} & 8.24 \\ & \mathbf{U}_{312} & 8.40 \\ & \mathbf{U}_{313} & 8.26 \\ & \mathbf{U}_{321} & 9.04 \\ & \mathbf{U}_{322} & 8.48 \\ & \mathbf{U}_{323} & 8.68 \\ & \mathbf{U}_{331} & 6.26 \\ & \mathbf{U}_{332} & 8.16 \\ & \mathbf{U}_{41} & 8.48 \\ & \mathbf{U}_{42} & 7.12 \\ & \mathbf{U}_{43} & 7.88 \end{bmatrix}$$

4. Calculate the correlation degree of the bottom indices.

Calculate the index correlation, and the correlation matrix is:

$$K=\left[K_j(V_K)\right]^{23*5}=\begin{bmatrix}-0.850 & -0.775 & -0.550 & 0.100 & 0.125\\ -0.737 & -0.605 & -0.210 & 0.362 & -0.269\\ -0.713 & -0.570 & -0.140 & 0.194 & -0.295\\ -0.742 & -0.613 & -0.225 & 0.409 & -0.262\\ -0.750 & -0.625 & -0.250 & 0.500 & -0.250\\ -0.727 & -0.590 & -0.180 & 0.281 & -0.281\\ -0.750 & -0.625 & -0.250 & 0.500 & -0.250\\ -0.553 & -0.330 & 0.340 & -0.202 & -0.385\\ -0.612 & -0.418 & 0.165 & -0.124 & -0.363\\ -0.713 & -0.570 & -0.140 & 0.194 & -0.295\\ -0.710 & -0.565 & -0.130 & 0.176 & -0.298\\ -0.850 & -0.775 & -0.550 & 0.100 & 0.125\\ -0.707 & -0.560 & -0.120 & 0.158 & -0.302\\ -0.733 & -0.600 & -0.200 & 0.333 & -0.273\\ -0.710 & -0.565 & -0.130 & 0.176 & -0.298\\ -0.840 & -0.760 & -0.520 & 0.040 & 0.043\\ -0.747 & -0.620 & -0.240 & 0.462 & -0.255\\ -0.780 & -0.670 & -0.340 & -0.320 & -0.195\\ -0.377 & -0.065 & 0.075 & -0.318 & -0.423\\ -0.693 & -0.540 & -0.080 & 0.095 & -0.313\\ -0.747 & -0.620 & -0.240 & 0.462 & -0.255\\ -0.520 & -0.280 & 0.440 & -0.234 & -0.395\\ -0.647 & -0.470 & 0.060 & -0.054 & -0.346\end{bmatrix}$$

Through the analysis of the correlation matrix, evaluation grades of bottom indices can be obtained. In the in 23 evaluation index what we give, the evaluation grade of four indices that enthusiasm for entrepreneurship, degree of commercialization, the cooperation with telecom companies and the rationality of market positioning is “very good(N_{05})”. There are 14 evaluation is "good (N_{04})", respectively: insight into the development of the industry, the executive ability, personal qualities, skills and experience, team cooperation spirit, the reliability of matching technology, the innovation degree of products, the user value of the product, the growth of target market, sustainability of market demand, rationality and innovation of profit model, the differentiated competitive advantage of this product, and the rationality of financing demand. The remaining 5 indices are "general(N_{03})", respectively: the reliability of product design, the innovation of technology application, quantities and substitute ability of substitute products, rationality of financial planning, and the control mechanism of financial risk. In summary, we can see that evaluation grade of bottom indices of the overall project is better, and we can predict the overall evaluation grade of the project better.

(5)Determine the index weight：

By using the fuzzy judgment matrix,the weight of each level index can be calculated in Table 3:

Table 3. Weight Table of Index System

Index	Weight	Index	Weight	Index	Weight
U_1	0.309	U_{11}	0.529	U_{111}	0.274
				U_{112}	0.262
				U_{113}	0.232
				U_{114}	0.232
		U_{12}	0.471	U_{121}	0.549
				U_{122}	0.451
U_2	0.319	U_{21}	0.325	U_{211}	0.511
				U_{212}	0.489
		U_{22}	0.342	U_{221}	0.424
				U_{222}	0.576
		U_{23}	0.333	U_{231}	0.552
				U_{232}	0.448
U_3	0.306	U_{31}	0.333	U_{311}	0.347
				U_{312}	0.334
				U_{313}	0.319
		U_{32}	0.339	U_{321}	0.346
				U_{322}	0.379
				U_{323}	0.275
		U_{33}	0.328	U_{331}	0.421
				U_{332}	0.579
U_4	0.066	U_{41}	0.331	—	—
		U_{42}	0.365	—	—
		U_{43}	0.304	—	—

From the weight distribution of each layer index in the table, the weight of the three indices including“Entrepreneurial team(U_1)", "product / Technology(U_2)", and "market(U_3)", are basically equivalent, and much larger than the "financial (U_4)". This shows that in the development process of the Internet venture project, the project team, the development of the product, the use of technology and the market situation at the time of the project development are needed to focus on the consideration and are the parts needed to manage. And in the entrepreneurial team, the weight of each downlink index is considerable, only the weight " expertise and experience (U_{121}) " is high, needed the project team strengthen attention in the formation of the team. Downlink indices weights of products and technical indices are quite heavy, and managers need to balance force. In

the downlink indices of the market indices, the weight of "the difference of competitive advantage of this product (U_{332}), " is slightly higher than other. Therefore, in the process of product development, we should pay attention to product differentiation, improve the competitive advantage, and then get the market.

(6)Extension comprehensive evaluation of project

According to the bottom indexes of each evaluation grade correlation and the index weigh,the correlation of second level index and a layer of indexand the evaluation grade are calculated through extension evaluation transformation. The grading matrices are:

$$K(U_{2i})=\begin{bmatrix} N_{04} & N_{04} & N_{04} & N_{04} & N_{04} & N_{04} & N_{04} & N_{03} & N_{04} & N_{03} & N_{03} \end{bmatrix}$$

$$K(U_{1i})=\begin{bmatrix} N_{04} & N_{04} & N_{04} & N_{03} \end{bmatrix}$$

Finally, we can obtain the comprehensive evaluation level $K(U)=\begin{bmatrix} N_{04} \end{bmatrix}$ of the project, the characteristic value is:

$$j^{*}=\frac{\sum_{j=1}^{5} j\times\overline{K_{\mathrm{j}}(U)}}{\sum_{j=1}^{5}\overline{K_{\mathrm{j}}(U)}}\approx 3.809$$

It can be concluded from the above results that the comprehensive evaluation level of project A is "good".The evaluation grades of single index are mostly in the "good" level and above, especially in the quality of management, the value of the products, business models and other which have higher weight coefficients, have an outstanding performance, and only a few indexes of the evaluation grade is in "general" level. Therefore, it can be considered that to the overall project the risk is in the controllable range, and has the good development potential, which can be considered by investors to be chosen and obtained the support fund. At the same time, the evaluation results also reflect the lack of project A in the product market competition and financial planning *etc*. The main reasons are that the lack of appropriate solutions of the products in information security risk, already with the scale of the B2C electricity suppliers can imitate the product business model to participate in the competition to bring potential competitive pressures, and financial budget allocation needs to be clear. Therefore, in the follow-up to the entrepreneurial stage, investors need to provide more targeted support and assistance to enhance the success rate of project A and growth rate. Therefore, in the follow-up to the entrepreneurial stage, investors need to provide more targeted assistance and support, in order to enhance the success rate and growth rate of project A.

6. Conclusion

This paper uses the matter-element extension method to construct the evaluation model of Internet venture capital projects, and the model was verified by examples to provide investors with a new way to assess the Internet venture investment projects. The results show that the matter-element method can better describe the evaluation of Internet venture capital projects. Besides, it is more objectively to reflect the true level of Internet venture capital projects, and reduce the error caused by qualitative assessment. However, considering that the Internet venture capital projects are in an immature stage of development, the financial index was given special consideration in the process of the index establishment, which means that the general financial evaluation indices is not used. But in practice, due to the evaluation content is different, as well as the difference of main body and involved background, the establishment of a comprehensive and systematic index system is still difficult. Therefore, there is yet to be further research and exploration.

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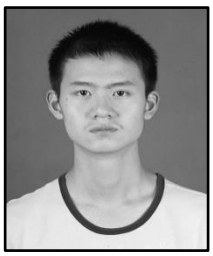

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