CSCanada
Management Science and Engineering
Vol. 12, No. 1, 2018, pp. 1-11
DOI:10.3968/10066

ISSN 1913-0341 [Print]
ISSN 1913-035X [Online]
www.cscanada.net
www.cscanada.org

Measurement of Enterprise Dynamic Capabilities Based on Intuitionistic Fuzzy Sets: Research in Financial Industry

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Supported by Guangdong Provincial Key Platform and a Major Reseaerch Project: Dynamic measurement in E-Commerce Enterprises in Guangdong Province, 2015.12-2018.12.

Received 15 January 2018; accepted 6 February 2018
Published online 16 March 2018

Abstract

This paper proposes a method of intuitionistic fuzzy sets (IFS) to measure enterprise dynamic capabilities (EDC). It first identifies the key indicators of EDC measurement in financial industry through expert scoring; then it transforms the assessment of language phrase weights and values into the form of intuitionistic fuzzy numbers based on IFS theory; thirdly, it calculates the group comprehensive evaluation and final advantage degree, in order to obtain the dynamic ability score ranking. With an example, the last part is to verify the feasibility and effectiveness of the IFS to apply in measuring dynamic capabilities in 5 enterprises of the financial industry.

Key words: Enterprise dynamic capabilities; Intuitionistic fuzzy sets; Intuitionistic fuzzy number; Hesitation degree

Dai, Y. L. (2018). Measurement of Enterprise Dynamic Capabilities Based on Intuitionistic Fuzzy Sets: Research in Financial Industry . *Management Science and Engineering*, *12*(1), 1-11. Available from: URL: http://www.cscanada.net/index.php/mse/article/view/10066
DOI: http://dx.doi.org/10.3968/10066

INTRODUCTION

How to constantly keep the advantage over rivals for an enterprise is a core issue in the strategic management field. This topic has been developed in a pathway from Porter's five forces model combining industrial economics and management science (Porter, 1980), to resource-based conception of enterprise as a collection of a variety of resources (Wernerfelt, 1984), and now, EDC with varying environments as a background is proposed (Teece, Pisano, & Shuen, 1997). School of thought of Teece et al. (1997) considers those dynamic capabilities an ability of an organization to adapt to rapidly changed the environment by integration, construction and transformation. This theory contains three parts. The first is organizational and managerial processes, which are about method and convention to deal with business and their current model for practice. The second part is the position, which includes technology, intelligence patterns, the number of customers, relationship of suppliers and upstream vendor etc. The third part is paths, containing strategic decision benefiting a company and its development in the future.

Since dynamic capabilities had been presented, many scholars have been doing various research about conceptual features, capability classification, structural dimension of dynamic capabilities. From the concept aspect, the most topical definition is provided by Eisenhardt and Martin, are processes in a company utilizing resources to adapt to or even create a reformation of the market, especially, which are in terms of integration, reallocation, acquiring and releasing resources (Eisenhardt & Martin, 2000). Zollo and Winter (2002) think that dynamic capabilities are the stable mode of collective activities through learning, through these activities organizing system, companies can adjust operational convention to pursue improvement of efficiency. Helfat et al. (2003) shows that a dynamic capability is about an ability to organize purposively to create, extend and adjust resources. And those capabilities are for a primary decision maker to appropriately reallocate predictable enterprise resources and convention (Zahra, Sapienza, & Davisson, 2006).

From the view of capability classification, to answer the question about how to maintain the advantage in a dynamic environment for a company, Collis (1994) pointed that organizational capability should be divided into three classes. The first class is an ability for companies to implement basic functional activities, for instance, production planning and products for marketing. And the ability of development and creation which can be dynamically improved belongs to the second class. The last class is the capability to recognize the value of resources or develop new strategies such as corporate culture and organization management.

Based on the previous research, Winter (2003) proposed another classification from the aspect of coping with specific problems. The level-zero is the first type of capability to the survival of companies, for example, the capability of manufacture and sales for new products is the level-zero one for developing companies. The higher level compared with level-zero is level-one as dynamic capabilities that are also considered by level-two, level-three or more, with the ability to extend, change and create the zero-level ability needed by companies. Wang and Ahmed (2007) consider enterprise capability as a unity of abilities, which can help companies obtain the level-one capability based on the resources for target, the second level called "core capability" related to competitive edge, which needs combination with resources and capability, and the third level including adaptation and creation of resources, and organizational renewal and reorganization. The understanding of the dimension of dynamic capabilities structure has undergone a process of evolution from a single theoretical perspective to a multi-theoretical perspective.

The rise of the discussion of dynamic capabilities thrives from the theory of company evolution (Nelson & Winter, 1982). Alchian (1950) proposed that "managers cannot create perfect work practices and can just only constantly reconfigure or modify their own ability to develop capability" (pp.211-221). When the environment is dynamic or unpredictable, companies will deliberately change their work practices (March, 1991). In the perspective of the integration of evolution theory and organizational theory, Lansiti and Clark (1994) and Delmas (1999) argued that dynamic capabilities should include two dimensions: internal integration and external integration. Scholars, who later merged resource theory, argued that dynamic capabilities should consider three dimensions: integration of resource, reallocation, and acquisition and release of resources (Eisenhardt & Martin, 2000; Luo, 2000). From the point of view of integration, Wang and Ahmed (2007) think that dynamic capabilities can be summarized as three types: adaptability, absorption and innovation. In recent years, Chinese scholars have done some research on the structural dimensions and interrelations of dynamic capabilities from all angles with the practices of China. He et al. (2006) thinks that dynamic capabilities should be measured by six dimensions of customer value orienteering, technology and support, systemic policy support mechanism, organizational support system, renewal motivation, and strategy isolation mechanism. After conducted empirical research on more than 270 start-up companies, Jiang and Wang (2008) think they are capable of absorbing integration and innovation. Wang et al. (2010) take a point of view that dynamic capabilities should be divided into four parts, such as absorptive capacity, integration ability, learning ability and innovation ability of four parts. Based on the literature review, Bao and Long (2015) proposed that the measurement of dynamic capabilities can clearly define the ability of integration and reconstruction of resources.

In this discussion, the dynamic capability is an abstraction of abilities, implicit, inoperable and difficult to test (Eisenhardt & Martin, 2000). Therefore, quantitative research is crucial for validating scholars' opinions and arguments about dynamic capabilities and the universality of theories (Zahra, Sapienza, & Davisson, 2006). Edwards (2001) has proposed future research on dynamic measurement capability should adopt more sophisticated methods of measurement, for instance, different weight of each part of dimensions. In recent years, scholars have studied the dynamic capability of mostly in terms of its formation mechanism or theory of architecture. Although the empirical research on dynamic capabilities has been increasing year by year, the measurement methods are mainly case-studies and questionnaires (Bao & Long, 2015), and the research on the measurement of dynamic capabilities of enterprises lags behind. Therefore, on the basis of the theoretical framework, this paper focuses on how to decompose the dynamic capabilities of enterprises into measurable and specific contents, to make quantitative analysis and make the dynamic capabilities of enterprises more valuable.

This paper attempts to construct a new method to measure the dynamic capability. First of all, through analysis of literature, expert survey method can screen out the key indicators about the dynamic capability of companies. Moreover, based on the theory of IFS, the assessment of language phrase weights, values and language phrases are transformed into the form of intuitionistic fuzzy numbers. By calculating the comprehensive evaluation value of the program, the comprehensive evaluation value of the group and the final advantage degrees, dynamic capabilities of ranking of scores in five financial companies can be evaluated. In constructing the measurement method of dynamic capabilities, this article will take into consideration of model construction of measuring the indicator system of dynamic capabilities of enterprises, the determination of the weight of each indicator, the valuation of indicator values in uncertain environment, etc., in order to benefit to quantify the subsequent quantification

of dynamic capabilities and enterprises management practice.

1. EVALUATION INDICATOR SYSTEM OF EDC

1.1 Establishment of Evaluation Indicator System of EDC

In the measurement of dynamic capabilities measurement, there are different opinions. If the dynamic capabilities of a company are defined as some specific aspects such as resources or processes, then the interpretation of dynamic capability will be greatly confused (Thomas & Pollock, 1990). This paper follows Teece's original ideas and methods of definition when presenting dynamic capabilities, defining dynamic capabilities from abstract organizational and managerial processes. In this way, it helps define the concept of clear and definite dynamic capabilities and reflects the commonalities of dynamic capabilities (Feng & Wei, 2011). This paper summarizes different researchers on the structural dimensions of dynamic capabilities, with a focus on Teece et al.'s research in 1997 (Teece, Pisano, & Shuen, 1997) and He et al.'s research in 2014 (He, Li, & Fan, 2006) and Zollo et al.'s research (Zollo & Winter, 2002), meanwhile, borrows some measurement inspected by other scholars, which will measure the EDC from the three dimensions of resources integration ability, resource reconstruction ability and organizational learning ability.

1.1.1 Establishment of Measurement Indicator of Resource Integration Ability

This paper refers to the indicators of measurement from integration ability which is applied and tested by Teece et al. (1997), Zahra et al. (2006), Meng et al. (2007), Wang (2010) and Zhang (2013) to develop the seven dimensions of measurement, including the ability to reconfigure various essences inside companies, to acquire technology and resources through the Internet, to associate the company with upstream and downstream partners in production and operation, to cooperate with other companies in achieving the goal, to work with various departments accomplish the target, to recruit experienced employees from outside to obtain resources, to establish relationship with external parties to gain resources.

1.1.2 Establishment of Resources Reconstruction Capabilities Measurement Indicators

According to Teece et al. (1997), Rodriguez (2008), in order to improve the ability of enterprise resource reconstruction, it can be realized through the corporate culture, the incentive system, the staff's tending to take adventure, the pioneering spirit, and the rapid and efficient response to public policy changes. Accordingly, six measurement indicators of resources reconstruction capabilities are developed: The organizational structure allowing the departments to break the routine for flexibility, a rapid response mechanism, employees with spirit of adventure and pioneer, actively training for employees' innovative technical capabilities; prompt and efficient response to changing in public policies; an open and creative corporate culture being encouraged.

1.1.3 Establishment of Measurement Indicator of Organizational Learning Ability

On the basis of summarizing the results of previous studies, Marsick and Watkins (2003) divide learning into seven dimensions at three levels. The representative of the seven capabilities of learning constructs, including the target tasks consensus, commitment and authorization, trial and encouragement, knowledge transfer, teamwork, organizational flexibility, employee ability (Swee, 1998). Senge (1998) points out that building learning organizations through five practices: systematic thinking, self-transcendence, mental models, team learning, and common vision building. On the basis of knowledge from research, this paper develops eight dimensions to measure organizational learning ability from three aspects: individual, team and organization, which includes clear understanding of individual mission, reasonable commitments and authorizations conducted by managers, adequate incentives for innovative employees, creative ideas often proposed by employees, strong self-renewal and self-study of staff, internal learning and sharing mechanism for employees, common vision of a company, excellent atmosphere of team-work.

1.2 Establishment of Evaluation Indicator System

According to the previous literature research, 3 major classes and 24 respective detail indicators are obtained, by means of questionnaires for expert assessment to identify key indicators. The six experts are all from management consulting firms, of whom four have experience of over 10-year HR management in the financial industry and the other two have more than 5-year experience in management consultancy firms. These six experts started the business management consulting in the financial industry 3 years ago. Through thorough discussion and explanation of indicators from six experts, their understanding of the indicators is basically accurate and consistent. Therefore, this paper assumes that all experts have no misunderstandings about all the indicators and can give an objective and reasonable judgment on the importance of the indicators.

Taking the *i-th* indicator K_i evaluating the dynamic capabilities of firm *A* as an example, the average equation 1 used in the statistical analysis of the scores given by experts is as follows:

$$e_i^{(A)} = \sum_{t=1}^{t} u_r \, e_{ir}^{(A)}, i = 1,2,3,\cdots,g \qquad (1)$$

Where $e_{ir}^{(A)}$ represents the score given by the *r-th* expert in the expert committee for the importance of the *i-th*

indicator considered by firm A, u_r represents the weight of the rth expert in the expert committee, $e_i^{(A)}$ is the average of the importance of the *k-th* indicator, and *t* is the total number of experts.

Then, experts discussed the determination of the critical value of the threshold of the importance of dynamic alternative evaluation indicator. If the average value of the obtained indicator importance score is greater than or equal to the average value of the threshold, the corresponding alternative evaluation indicator of dynamic capability is the key indicator, which can be retained as a final evaluation indicator. Through experts' discussion, the indicator above 7.5 points is determined as the final evaluation indicator of the dynamic capabilities of enterprises which can be summarized as three aspects and ten indicators. The specific score results are seen in Table 1.

Table 1
Indicators of Evaluation for EDC

Classification of capability		Evaluation indicator	Score by experts
Resources integration	1	Capability of reallocation for essential resources	8
Resources integration	2	Acquisition of technology and resources from network	7.6
Resources integration	3	High correlation between upstream and downstream companies for production	5.2
Resources integration	4	Cooperation with other companies for target fulfilment	7
Resources integration	5	Achieving target by coordination between departments inside company	7.9
Resources integration	6	Acquiring resources through recruiting employees from outside	6.2
Resources integration	7	Acquiring resources in connection with the outside	6
Resource reallocation	8	Flexibility of rearranging organization	7.8
Resource reallocation	9	Rapid reaction mechanism	7
Resource reallocation	10	Creation and adventure of employees	5.9
Resource reallocation	11	Capability of training employees to create in technology	7.5
Resource reallocation	12	Quick and efficient reaction to variation of public policy	6.4
Resource reallocation	13	Enterprise culture to encourage spirit of creation	7.8
Resource reallocation	14	Acceptable new products or services developed often into market	8.2
Resource reallocation	15	Effort on products design for new function	6.4
Resource reallocation	16	Enhancement of activities by adopting new knowledge	5.3
Learning	17	Clear understanding of target for individual assignment	6.5
Learning	18	Reasonable admission and authorization of employees' behavior from manager	8.3
Learning	19	Policy of knowledge sharing for employees	6.8
Learning	20	Creative conceive proposed by employees	7.3
Learning	21	Strong desire for self-study and self-improvement	7.8
Learning	22	Study sharing mechanism for employees	8
Learning	23	Common vision of companies	6.4
Learning	24	Fine atmosphere of teamwork	7.3

They are all as following: Capability of reallocation for essential resources (K_1), acquisition of technology and resources from network (K_2), achieving target by coordination between departments inside company (K_5), Flexibility of rearranging organization (K_8), capability of training employees to create in technology (K_{11}), enterprise culture to encourage spirit of creation (K_{13}), acceptable new products or services developed often into market (K_{14}), reasonable Admission and Authorization of employees' behaviour from Manager (K_{18}), strong desire of self-study and self-improvement (K_{21}), study sharing mechanism for employees (K_{22}).

2. EDC EVALUATING MODEL BASED ON IFS

2.1 Conception and Definition of IFS

Each element in the classic set is explicit, this is to say, an element is confined to belong to a set or not, without exception. However, but in reality, some conceptions are not clear or exact in boundary, for example, "positive" and "reasonable commitment and authorization" in dynamic capabilities indicators, are vague description, which is not able to be exactly depicted with "belonging" or "not belonging", therefore, a descriptive degree is employed for this case. This indecisive uncertainty of boundary is called fuzziness.

Since the fuzzy set theory was proposed by Professor L. A. Zadeh of the University of California in 1965, this theory has been widely adopted in various branches in the modern world. Furthermore, Atanassov, a scholar from Bulgaria, developed Zadeh's Fuzzy Set concept, he expanded the terms of conventional Fuzzy Set with membership degree, to a combination of membership degree, non-membership degree and hesitancy, named intuitionistic fuzzy sets (IFS), which provides a more accurate method to illustrate the fuzziness. Atanassov (1986) (1995) explained the general definition of IFS, the details are shown as follows:

Definition 1.1 Assume a set $E=\{x_1,x_2,\cdots x_n\}$ as a non-null domain, an IFS A on E is defined with the form

$$A=\{\langle x,\mu_A(x),v_A(x)\rangle|x\in E\},$$

in which two functions $\mu_A(x):E\to[0,1]$ and $v_A(x):E\to[0,1]$ define the membership degree and the non-membership degree of for *A* in set *E* respectively, $0\le\mu_A(x)+v_A(x)\le 1$, also as expressed as $(\mu_A(x),v_A(x))$.

If for the intuitionistic fuzzy setsis

$$\alpha=\big(\mu_\alpha(x),v_\alpha(x)\big),\ \ \mu_\alpha(x),v_\alpha(x)$$

a constant function and taken as the intuitionistic fuzzy number, denoted as $\alpha=(\mu_\alpha,v_\alpha)$, in which,

$$\mu_\alpha\in[0,1],v_\alpha\in[0,1],\mu_\alpha+v_\alpha\le 1$$ Set $\ominus$

for all intuitionistic fuzzy numbers. Obviously, α^+=(1,0) is the largest of the intuitionistic fuzzy numbers, α^-=(1,0) is the smallest of intuitionistic fuzzy numbers.

If $\mu_A(x)=1-v_A(x)$, then the intuitionistic fuzzy set A is degraded to a general fuzzy set; if

$$\mu_A(x)=0,v_A(x)=1 \text{ or } \mu_A(x)=1,v_A(x)=0,$$

the information of *x* is accurate.

In Definition 1.2, let $\pi_A(x)=1-\mu_A(x)-v_A(x)$ be the intuition index (or Intuitionistic Indicator) of element *X* in *A*, which indicates the degree of uncertainty of the *X* belonging to the collection *A* or the degree of hesitation relative to the *A* (Hesitancy Degree).

An intuitionistic fuzzy set *A*, the subordinative degree $\mu_A(x)\in[0,1](\forall x\in E)$ and false membership of $v_A(x)\in[0,1](\forall x\in E)$ and intuitionistic index $\pi_A(x)\in[0,1](\forall x\in E)$ can indicate the degree of the three kinds of evidence that the object *x* belongs to the intuitionistic fuzzy set *A*, such as support, opposition, and abstention.

Definition 1.3 Let $\alpha_1=(\mu_{\alpha_1},v_{\alpha_1})$ and $\alpha_2=(\mu_{\alpha_2},v_{\alpha_2})$ intuitionistic fuzzy numbers, then

$$\alpha_1\le\alpha_2\Leftarrow\mu_{\alpha_1}\le\mu_{\alpha_2}\text{ and }v_{\alpha_1}\ge v_{\alpha_2}.$$

Let E a non-empty set,

$$A=\{\langle x,\mu_A(x),v_A(x)\rangle|x\in E\}$$
$$A_1=\{\langle x,\mu_{A_1}(x),v_{A_1}(x)\rangle|x\in E\}$$

and

$$A_2=\{\langle x,\mu_{A_2}(x),v_{A_2}(x)\rangle|x\in E\}$$

are intuitionistic fuzzy numbers, then:

$$\bar{A}=\{\langle x,v_A(x),\mu_A(x)\rangle|x\in E\}$$
$$A_1\cap A_2=\{\langle x,\min\{\mu_{A_1}(x),\mu_{A_2}(x)\},\max\{v_{A_1}(x),v_{A_2}(x)\}\rangle|x\in E\}$$
$$A_1\cup A_2=\{\langle x,\max\{\mu_{A_1}(x),\mu_{A_2}(x)\},\min\{v_{A_1}(x),v_{A_2}(x)\}\rangle|x\in E\}$$
$$A_1+A_2=\{\langle x,\mu_{A_1}(x)+\mu_{A_2}(x)-\mu_{A_1}(x)\mu_{A_2}(x),v_{A_1}(x)v_{A_2}(x)\rangle|x\in E\}$$
$$A_1\cdot A_2=\{\langle x,\mu_{A_1}(x)\mu_{A_2}(x),v_{A_1}(x)+v_{A_2}(x)-v_{A_1}(x)v_{A_2}(x)\rangle|x\in E\}$$

The above algorithms for IFS not only ensure that the place where the result is still an IFS, but also applies to the calculation of linguistic variables in an intuitionistic fuzzy environment.

Similarly, the following definitions of intuitionistic fuzzy numbers are defined.

Let $\alpha=(\mu_\alpha,v_\alpha)$, $\alpha_1=(\mu_{\alpha_1},v_{\alpha_1})$ and $\alpha_2=(\mu_{\alpha_2},v_{\alpha_2})$ be intuitionistic fuzzy numbers, then

$$\bar{\alpha}=(v_\alpha,\mu_\alpha)$$
$$\alpha_1\cap\alpha_2=\big(\min\{\mu_{\alpha_1},\mu_{\alpha_2}\},\max\{v_{\alpha_1},v_{\alpha_2}\}\big)$$
$$\alpha_1\cup\alpha_2=\big(\max\{\mu_{\alpha_1},\mu_{\alpha_2}\},\min\{v_{\alpha_1},v_{\alpha_2}\}\big)$$
$$\alpha_1\oplus\alpha_2=\big(\mu_{\alpha_1}+\mu_{\alpha_2}-\mu_{\alpha_1}\mu_{\alpha_2},v_{\alpha_1}v_{\alpha_2}\big)$$
$$\alpha_1\otimes\alpha_2=\big(\mu_{\alpha_1}\mu_{\alpha_2},v_{\alpha_1}+v_{\alpha_2}-v_{\alpha_1}v_{\alpha_2}\big)$$
$$\mu_{\alpha_1}\wedge\mu_{\alpha_2}=\min\big(\mu_{\alpha_1},\mu_{\alpha_2}\big),v_{\alpha_1}\wedge v_{\alpha_2}=\min\big(v_{\alpha_1},v_{\alpha_2}\big)$$
$$\mu_{\alpha_1}\vee\mu_{\alpha_2}=\max\big(\mu_{\alpha_1},\mu_{\alpha_2}\big),v_{\alpha_1}\wedge v_{\alpha_2}=\max\big(v_{\alpha_1},v_{\alpha_2}\big)$$

For any intuitionistic fuzzy number $\alpha=(\mu_\alpha,v_\alpha)$, it can be sorted by the clarity equation

$$S(\alpha):S(\alpha)=\mu(\alpha)-v(\alpha)\cdot\pi(\alpha)$$

2.2 Measurement of EDC by IFS

The dynamic capability is an abstract concept, which is imperceptible and difficult to be measured. The indicators of that are not explicitly defined by the boundary, to an extent, they are vague and imprecise estimations. According to features of the dynamic capabilities and the definition of IFS, the structure of EDC is shown below.

2.2.1 Description of the Decision

Looking into the measurement of dynamic capabilities, the final result can be absorbed from the combination of the weights of language phrases and the evaluation from

experts. There are commentaries for some symbols as follows:

m – the companies to be evaluated

S – the set of m, $S= \{S_1, S_2, \ldots, S_m\}$, $m2$

n – the number of indicators for measurement

K – the set of indicators for measurement, $K=\{K_1, K_2, \cdots, K_n,\}$ n

E – the set of experts

W_j^q – the weight of indicator K_j

2.2.2 Conversion of Weights of Dynamic Capabilities and Group Aggregation

According to the IFS principle, the weights of language phrases can be converted into the form of IFS by using the conversion table shown in Table 2 (Fu & Zhao, 2014; Wang, 2009).

Table 2
Conversion Between Weights of Language Phrases and IFS & Evaluation of Nine-Grade Language Phrases and IFS-Formed Indicator

Weights of language phrases	Weights of IFS
Necessary (N)	[0.9,0.1-π]
Significant (S)	[0.7,0.3-π]
Moderate (M)	[0.5,0.5-π]
Circumstantial (C)	[0.3,0.7-π]
Additional (A)	[0.1,0.9-π]
Uncertain (U)	[0,0]
Evaluation of nine-grade language phrases	**IFS-formed indicator**
Excellent (E)	[0.9,0.1-π]
Very High (VH)	[0.8,0.2-π]
High (H)	[0.7,0.3-π]
Above Average (AA)	[0.6,0.4-π]
Average (A)	[0.5,0.5-π]
Below Average (BA)	[0.4,0.6-π]
Low (L)	[0.3,0.7-π]
Very Low (VL)	[0.2,0.8-π]
Bad (B)	[0.1,0.9-π]
Uncertain (U)	[0,0]

Through weight aggregation equation, the IFS weights can be aggregated into group weights of IFS. And then, let $\widetilde{w}_j^G = [u_w^G, v_w^G]$: Converted IFS values $\widetilde{w}_j^1, \widetilde{w}_j^2, \cdots, \widetilde{w}_j^q$ can be transferred into group weights $\widetilde{w}_j^G = [u_w^G, v_w^G]$ of IFS-formed indicator by using equation as:

$$\widetilde{w}_j^G = \widetilde{w}_j^1 \cap \widetilde{w}_j^2 \cap \cdots \cap \widetilde{w}_j^q = [u_{w_j}^1, v_{w_j}^1] \cap [u_{w_j}^2, v_{w_j}^2] \cap \cdots \cap [u_{w_j}^q, v_{w_j}^q]$$
$$= [\min\left\{u_{w_j}^1, u_{w_j}^2, \cdots, u_{w_j}^q\right\}, \max\left\{v_{w_j}^1, v_{w_j}^2, \cdots v_{w_j}^q\right\}] \quad (2)$$

The symbol "$\cap$" means set intersection among IFS values. Therefore, the group weights of IFS-formed indicator can be expressed as

$$\widetilde{w}_G = [\widetilde{w}_1^G, \widetilde{w}_2^G, \cdots, \widetilde{w}_n^G]$$

2.2.3 Conversion of Evaluation of Dynamic Capabilities

Values of dynamic capabilities for each company provided by experts are converted to IFS-formed evaluation value, which is referred to Table 2.

2.2.4 Max-Min-Max Operator

After got the expert evaluation value $\tilde{x}_{ij}^k$ and $\widetilde{w}_j^G$, it is aggregated and the concrete equation is as follows:

$$\tilde{z}_i^k = \left[u_{z_i}^k, v_{z_i}^k\right] = T\left(\tilde{x}_{ij}^k, \widetilde{w}_j^G\right)$$

Among them,

$$u_{z_i}^k = \vee\left[u_{x_y}^k \wedge u_{w_j}^G\right] = \max[\min\left[u_{x_y}^k, u_{w_j}^G\right]]$$
$$v_{z_i}^k = \wedge\left[v_{x_y}^k \vee v_{w_j}^G\right] = \min[\max\left[v_{x_y}^k, v_{w_j}^G\right]] \quad (3)$$

2.2.5 Group Aggregation of the Comprehensive Evaluation of Dynamic Capability

Aggregating the comprehensive evaluation value of the dynamic capability of each company noted as $\tilde{Z}_i^1, \tilde{Z}_i^2, \cdots, \tilde{Z}_i^q$ into a group comprehensive evaluation value

$$\tilde{Z}_i^G = \left[u_{z_i}^G, v_{z_i}^G\right], i = 1,2,\cdots,m$$

with the following equation:

$$\tilde{Z}_i^G = \frac{1}{q}\otimes\left(\tilde{Z}_i^1 \oplus \cdots \oplus \tilde{Z}_i^q\right)$$
$$= \frac{1}{q}\otimes([\mu_T^1(S_i) + \mu_T^2(S_i) - \mu_T^1(S_i)\mu_T^2(S_i), v_T^1(S_i)v_T^2(S_i)] \oplus \tilde{Z}_i^3 \oplus \cdots \oplus \tilde{Z}_i^q) \quad (4)$$

3. CASE STUDY

In this case, there are five financial companies as objects of study, which were funded within 4 years. These six selected experts have experiences providing consulting services for these five companies so that they are all well-informed with these companies.

3.1 Acquisition of Weights for Dynamic Capacity

Since ten key indicators are confirmed in the previous chapter, afterwards, the weights of these ten key indicators should be identified. Let the set of experts as E= {E_1, E_2, E_3, E_4, E_5, E_6} , weights of indicators of language phrases can be acquired as shown in Table 3.

Table 3
Weights of Indicators of Language Phrases

Indicators	Experts					
	E_1	E_2	E_3	E_4	E_5	E_6
Capability of reallocation for essential resources (K_1)	E(0.0)	H(0.0)	H(0.2)	A(0.2)	H(0.0)	H(0.0)
Acquisition of technology and resources from network (K_2)	H(0.0)	H(0.2)	H(0.2)	H(0.2)	H(0.1)	H(0.2)
Achieving target by coordination between departments inside company (K_5)	VH(0.1)	H(0.2)	A(0.1)	H(0.1)	A(0.1)	A(0.1)
Flexibility of rearranging organization (K_8)	VH(0.0)	H(0.1)	H(0.3)	H(0.2)	A(0.1)	H(0.2)
Capability of training employees to create in technology (K_{11})	H(0.1)	H(0.0)	H(0.2)	H(0.1)	H(0.0)	H(0.1)
Enterprise culture to encourage spirit of creation (K_{13})	H(0.2)	U(0.3)	H(0.1)	H(0.2)	BA(0.2)	A(0.1)
Acceptable new products or services developed often into market (K_{14})	E(0.0)	H(0.0)	H(0.0)	H(0.2)	H(0.2)	H(0.2)
Reasonable Admission and Authorization of employees' behavior from Manager (K_{18})	H(0.2)	A(0.2)	H(0.0)	A(0.2)	H(0.0)	H(0.2)
Strong desire of self-study and self-improvement (K_{21})	H(0.2)	A(0.2)	H(0.2)	H(0.2)	H(0.0)	H(0.1)
Study sharing mechanism for employees (K_{22})	A(0.1)	H(0.0)	E(0.0)	H(0.2)	A(0.2)	H(0.2)

From conversion of indicator K_j given by expert E_k through method revealed in Table 4, IFS-formed weights of group indicator are calculated by Equation 2 and shown in Table 4 after the weights W_{kj} of indicator K_j.

Table 4
Weights of Group Indicator

Indicator	Weights of group indicator
Capability of reallocation for essential resources (K_1)	[0.5,0.3]
Acquisition of technology and resources from network (K_2)	[0.7,0.3]
Achieving target by coordination between departments inside company (K_5)	[0.3,0.7]
Flexibility of rearranging organization (K_8)	[0.5,0.4]
Capability of training employees to create in technology (K_{11})	[0.7,0.3]
Enterprise culture to encourage spirit of creation (K_{13})	[0.3,0.4]
Acceptable new products or services developed often into market (K_{14})	[0.7,0.3]
Reasonable Admission and Authorization of employees' behavior from Manager (K_{18})	[0.5,0.3]
Strong desire of self-study and self-improvement (K_{21})	[0.5,0.3]
Study sharing mechanism for employees (K_{22})	[0.5,0.4]

3.2 Evaluation Matrix

Firstly, results of evaluation for respective dynamic capabilities of five e-commercial companies should be given by five experts for, meanwhile, each result should be confined within basic language phrases set and be followed with a degree of hesitancy (π) provided by experts. the basic language phrases set is {Excellent (E), Very High (VH), High (H), Above Average (AA), Average (A), Below Average (BA), Low (L), Very Low (VL), Bad (B), Uncertain (U)}. Looking into surveys from experts, the results of evaluation K_j (K = 1, 2, 5, 8, 11, 13, 14, 18, 21, 22) given by six experts E_q (q = 1, 2, 3, 4, 5, 6) for solution S_i (i = 1, 2 ,3 ,4 ,5) are displayed in Table 5.

Continued

Table 5
Results of Evaluation From the Six Experts

		K_1	K_2	K_5	K_8	K_{11}	K_{13}	K_{14}	K_{18}	K_{21}	K_{22}
E_1	S_1	AA(0.0)	AA(0.2)	A(0.1)	BA(0.0)	A(0.1)	AA(0.0)	H(0.2)	BA(0.0)	H(0.2)	H(0.1)
E_1	S_2	A(0.2)	AA(0.0)	H(0.1)	AA(0.1)	AA(0.0)	AA(0.1)	AA(0.1)	H(0.2)	AA(0.0)	AA(0.0)
E_1	S_3	H(0.0)	A(0.1)	A(0.1)	H(0.1)	H(0.2)	H(0.0)	AA(0.0)	H(0.2)	H(0.1)	H(0.0)
E_1	S_4	VH(0.0)	H(0.0)	H(0.1)	H(0.0)	H(0.2)	H(0.0)	AA(0.0)	VH(0.2)	AA(0.1)	AA(0.0)
E_1	S_5	A(0.0)	BA(0.2)	AA(0.1)	AA(0.0)	AA(0.2)	AA(0.2)	AA(0.1)	BA(0.0)	BA(0.2)	A(0.1)
E_2	S_1	A(0.0)	A(0.2)	H(0.1)	AA(0.1)	AA(0.0)	AA(0.1)	AA(0.1)	A(0.2)	A(0.1)	BA(0.1)
E_2	S_2	A(0.1)	AA(0.2)	A(0.1)	AA(0.1)	AA(0.1)	AA(0.0)	A(0.2)	A(0.1)	AA(0.2)	AA(0.1)
E_2	S_3	A(0.2)	A(0.2)	A(0.1)	AA(0.2)	A(0.0)	A(0.0)	AA(0.0)	A(0.0)	H(0.0)	AA(0.1)
E_2	S_4	H(0.2)	AA(0.1)	AA(0.1)	VH(0.2)	VH(0.2)	E(0.0)	E(0.1)	VH(0.2)	H(0.1)	H(0.1)
E_2	S_5	BA(0.0)	AA(0.1)	A(0.0)	AA(0.1)	BA(0.0)	AA(0.2)	AA(0.0)	AA(0.2)	BA(0.1)	BA(0.0)
E_3	S_1	A(0.1)	H(0.0)	H(0.1)	H(0.2)	BA(0.2)	H(0.0)	H(0.2)	A(0.2)	AA(0.1)	H(0.2)
E_3	S_2	H(0.2)	VH(0.1)	AA(0.2)	AA(0.2)	A(0.2)	A(0.0)	VH(0.0)	H(0.2)	A(0.0)	A(0.2)
E_3	S_3	AA(0.1)	AA(0.1)	H(0.0)	AA(0.2)	AA(0.0)	AA(0.0)	AA(0.0)	AA(0.2)	A(0.0)	H(0.0)
E_3	S_4	AA(0.1)	E(0.1)	AA(0.0)	H(0.0)	H(0.0)	H(0.0)	VH(0.1)	VH(0.2)	H(0.1)	AA(0.0)
E_3	S_5	A(0.1)	A(0.0)	AA(0.1)	BA(0.0)	AA(0.0)	A(0.1)	BA(0.1)	BA(0.0)	AA(0.0)	AA(0.1)
E_4	S_1	H(0.0)	A(0.0)	H(0.2)	BA(0.2)	BA(0.0)	A(0.0)	A(0.2)	H(0.1)	H(0.1)	BA(0.2)
E_4	S_2	H(0.2)	VH(0.0)	VH(0.2)	AA(0.2)	AA(0.1)	H(0.0)	VH(0.2)	AA(0.1)	H(0.2)	H(0.2)
E_4	S_3	A(0.0)	AA(0.2)	A(0.0)	H(0.2)	A(0.2)	AA(0.2)	A(0.1)	AA(0.1)	AA(0.1)	A(0.0)
E_4	S_4	AA(0.1)	AA(0.2)	H(0.1)	VH(0.0)	VH(0.0)	VH(0.0)	AA(0.2)	AA(0.0)	VH(0.2)	AA(0.0)
E_4	S_5	AA(0.2)	AA(0.1)	BA(0.1)	BA(0.1)	BA(0.2)	AA(0.2)	AA(0.2)	BA(0.2)	AA(0.1)	A(0.0)
E_5	S_1	H(0.2)	H(0.2)	H(0.1)	BA(0.2)	BA(0.0)	H(0.0)	H(0.2)	H(0.0)	H(0.1)	BA(0.1)
E_5	S_2	AA(0.2)	A(0.2)	AA(0.1)	A(0.2)	AA(0.2)	AA(0.2)	AA(0.1)	AA(0.0)	AA(0.0)	AA(0.0)
E_5	S_3	AA(0.0)	AA(0.2)	A(0.0)	A(0.0)	A(0.2)	AA(0.1)	H(0.0)	AA(0.0)	H(0.1)	A(0.0)
E_5	S_4	VH(0.2)	E(0.0)	AA(0.0)	VH(0.2)	H(0.2)	AA(0.0)	H(0.1)	VH(0.1)	AA(0.1)	H(0.0)
E_5	S_5	A(0.2)	BA(0.0)	BA(0.0)	AA(0.2)	BA(0.0)	BA(0.0)	BA(0.1)	BA(0.1)	AA(0.1)	AA(0.2)
E_6	S_1	H(0.1)	BA(0.1)	BA(0.1)	H(0.1)	A(0.2)	H(0.0)	H(0.2)	H(0.0)	H(0.2)	H(0.1)
E_6	S_2	A(0.2)	A(0.1)	AA(0.1)	AA(0.0)	H(0.1)	H(0.1)	A(0.2)	H(0.2)	A(0.1)	AA(0.2)
E_6	S_3	AA(0.2)	AA(0.2)	A(0.2)	AA(0.0)	AA(0.1)	AA(0.0)	AA(0.2)	AA(0.2)	AA(0.2)	AA(0.2)
E_6	S_4	E(0.1)	AA(0.1)	H(0.0)	AA(0.0)	AA(0.1)	VH(0.1)	VH(0.0)	AA(0.0)	AA(0.0)	H(0.2)
E_6	S_5	A(0.0)	AA(0.2)	A(0.2)	A(0.2)	AA(0.1)	AA(0.0)	AA(0.2)	AA(0.0)	BA(0.2)	AA(0.0)

The solutions S_i (i = 1,2,3,4,5) given by six experts E_q (q = 1,2,3,4,5,6) are given in the indicator K_j (j = 1,2,5,8,11,13,14,18,21,22) into six evaluation matrixes in the form of intuitionistic fuzzy number $\tilde{x}_{ij}^1(q = 1,2,3,4,5,6)$ are:

$$[\tilde{x}_{ij}^1] = \begin{array}{c} \\ S_1 \\ S_2 \\ S_3 \\ S_4 \\ S_5 \end{array} \begin{bmatrix} K_1 & K_2 & K_5 & K_8 & K_{11} & K_{13} & K_{14} & K_{18} & K_{21} & K_{22} \\ [0.6,0.4] & [0.6,0.2] & [0.5,0.4] & [0.4,0.6] & [0.5,0.4] & [0.6,0.4] & [0.7,0.1] & [0.4,0.6] & [0.7,0.1] & [0.7,0.2] \\ [0.5,0.3] & [0.6,0.4] & [0.7,0.2] & [0.6,0.3] & [0.6,0.4] & [0.6,0.3] & [0.6,0.3] & [0.7,0.1] & [0.6,0.4] & [0.6,0.4] \\ [0.7,0.3] & [0.5,0.4] & [0.5,0.4] & [0.7,0.2] & [0.7,0.1] & [0.7,0.3] & [0.6,0.4] & [0.7,0.1] & [0.7,0.2] & [0.7,0.3] \\ [0.8,0.2] & [0.7,0.3] & [0.7,0.2] & [0.7,0.3] & [0.7,0.1] & [0.7,0.3] & [0.6,0.4] & [0.8,0.0] & [0.6,0.3] & [0.6,0.4] \\ [0.5,0.5] & [0.4,0.4] & [0.6,0.3] & [0.6,0.4] & [0.6,0.2] & [0.6,0.2] & [0.6,0.3] & [0.4,0.6] & [0.4,0.4] & [0.5,0.4] \end{bmatrix}$$

$$[\tilde{x}_{ij}^2] = \begin{array}{c} \\ S_1 \\ S_2 \\ S_3 \\ S_4 \\ S_5 \end{array} \begin{bmatrix} K_1 & K_2 & K_5 & K_8 & K_{11} & K_{13} & K_{14} & K_{18} & K_{21} & K_{22} \\ [0.5,0.5] & [0.5,0.3] & [0.7,0.2] & [0.6,0.3] & [0.6,0.4] & [0.6,0.3] & [0.6,0.3] & [0.5,0.3] & [0.5,0.4] & [0.4,0.5] \\ [0.5,0.4] & [0.6,0.2] & [0.5,0.4] & [0.6,0.3] & [0.6,0.3] & [0.6,0.4] & [0.5,0.3] & [0.5,0.4] & [0.6,0.2] & [0.6,0.3] \\ [0.5,0.3] & [0.5,0.3] & [0.5,0.4] & [0.6,0.2] & [0.5,0.5] & [0.5,0.5] & [0.6,0.4] & [0.5,0.5] & [0.7,0.3] & [0.6,0.3] \\ [0.7,0.1] & [0.6,0.3] & [0.6,0.3] & [0.8,0.0] & [0.8,0.0] & [0.9,0.1] & [0.9,0.0] & [0.8,0.0] & [0.7,0.2] & [0.7,0.2] \\ [0.4,0.6] & [0.6,0.3] & [0.5,0.5] & [0.6,0.3] & [0.4,0.6] & [0.6,0.2] & [0.6,0.4] & [0.6,0.2] & [0.4,0.5] & [0.4,0.6] \end{bmatrix}$$

To be continued

Continued

$$[\tilde{x}_{ij}^{3}]=\begin{array}{c}\\ S_1\\ S_2\\ S_3\\ S_4\\ S_5\end{array}\begin{array}{c}\begin{array}{cccccccccc}K_1 & K_2 & K_5 & K_8 & K_{11} & K_{13} & K_{14} & K_{18} & K_{21} & K_{22}\end{array}\\ \begin{bmatrix}[0.5,0.4] & [0.7,0.3] & [0.7,0.2] & [0.7,0.1] & [0.4,0.4] & [0.7,0.3] & [0.7,0.1] & [0.5,0.3] & [0.6,0.3] & [0.7,0.1]\\ [0.7,0.1] & [0.8,0.1] & [0.6,0.4] & [0.6,0.2] & [0.5,0.3] & [0.5,0.5] & [0.8,0.2] & [0.7,0.1] & [0.5,0.5] & [0.5,0.2]\\ [0.6,0.3] & [0.6,0.3] & [0.7,0.3] & [0.6,0.2] & [0.6,0.4] & [0.6,0.4] & [0.6,0.4] & [0.6,0.2] & [0.5,0.5] & [0.7,0.3]\\ [0.6,0.3] & [0.9,0.0] & [0.6,0.4] & [0.7,0.3] & [0.7,0.3] & [0.7,0.3] & [0.8,0.1] & [0.8,0.0] & [0.7,0.2] & [0.6,0.4]\\ [0.5,0.4] & [0.5,0.5] & [0.6,0.3] & [0.4,0.6] & [0.6,0.4] & [0.5,0.4] & [0.4,0.5] & [0.4,0.6] & [0.6,0.4] & [0.6,0.3]\end{bmatrix}\end{array}$$

$$[\tilde{x}_{ij}^{4}]=\begin{array}{c}\\ S_1\\ S_2\\ S_3\\ S_4\\ S_5\end{array}\begin{array}{c}\begin{array}{cccccccccc}K_1 & K_2 & K_5 & K_8 & K_{11} & K_{13} & K_{14} & K_{18} & K_{21} & K_{22}\end{array}\\ \begin{bmatrix}[0.7,0.3] & [0.5,0.5] & [0.7,0.1] & [0.4,0.4] & [0.4,0.6] & [0.5,0.5] & [0.5,0.3] & [0.7,0.2] & [0.7,0.2] & [0.4,0.4]\\ [0.7,0.1] & [0.8,0.2] & [0.8,0.0] & [0.6,0.2] & [0.6,0.3] & [0.7,0.3] & [0.8,0.0] & [0.6,0.3] & [0.7,0.1] & [0.7,0.1]\\ [0.5,0.5] & [0.6,0.2] & [0.5,0.5] & [0.7,0.1] & [0.5,0.3] & [0.6,0.2] & [0.5,0.4] & [0.6,0.3] & [0.6,0.3] & [0.5,0.5]\\ [0.6,0.3] & [0.6,0.2] & [0.7,0.2] & [0.8,0.2] & [0.8,0.2] & [0.8,0.2] & [0.6,0.2] & [0.6,0.4] & [0.8,0.0] & [0.6,0.4]\\ [0.6,0.2] & [0.6,0.3] & [0.4,0.5] & [0.4,0.5] & [0.4,0.4] & [0.6,0.2] & [0.6,0.2] & [0.4,0.4] & [0.6,0.3] & [0.5,0.5]\end{bmatrix}\end{array}$$

$$[\tilde{x}_{ij}^{5}]=\begin{array}{c}\\ S_1\\ S_2\\ S_3\\ S_4\\ S_5\end{array}\begin{array}{c}\begin{array}{cccccccccc}K_1 & K_2 & K_5 & K_8 & K_{11} & K_{13} & K_{14} & K_{18} & K_{21} & K_{22}\end{array}\\ \begin{bmatrix}[0.7,0.1] & [0.7,0.1] & [0.7,0.2] & [0.4,0.4] & [0.4,0.6] & [0.7,0.3] & [0.7,0.1] & [0.7,0.3] & [0.7,0.2] & [0.4,0.5]\\ [0.6,0.2] & [0.5,0.3] & [0.6,0.3] & [0.5,0.3] & [0.6,0.2] & [0.6,0.2] & [0.6,0.3] & [0.6,0.4] & [0.6,0.4] & [0.6,0.4]\\ [0.6,0.4] & [0.6,0.2] & [0.5,0.5] & [0.5,0.5] & [0.5,0.3] & [0.6,0.3] & [0.7,0.3] & [0.6,0.4] & [0.7,0.2] & [0.5,0.5]\\ [0.8,0.0] & [0.9,0.1] & [0.6,0.4] & [0.8,0.0] & [0.7,0.1] & [0.6,0.4] & [0.7,0.2] & [0.8,0.1] & [0.6,0.3] & [0.7,0.3]\\ [0.5,0.3] & [0.4,0.6] & [0.4,0.6] & [0.6,0.2] & [0.4,0.6] & [0.4,0.6] & [0.4,0.5] & [0.4,0.5] & [0.6,0.3] & [0.6,0.2]\end{bmatrix}\end{array}$$

$$[\tilde{x}_{ij}^{6}]=\begin{array}{c}\\ S_1\\ S_2\\ S_3\\ S_4\\ S_5\end{array}\begin{array}{c}\begin{array}{cccccccccc}K_1 & K_2 & K_5 & K_8 & K_{11} & K_{13} & K_{14} & K_{18} & K_{21} & K_{22}\end{array}\\ \begin{bmatrix}[0.7,0.2] & [0.4,0.5] & [0.4,0.5] & [0.7,0.2] & [0.5,0.3] & [0.7,0.3] & [0.7,0.1] & [0.7,0.3] & [0.7,0.1] & [0.7,0.2]\\ [0.5,0.3] & [0.5,0.4] & [0.6,0.3] & [0.6,0.4] & [0.7,0.2] & [0.7,0.2] & [0.5,0.3] & [0.7,0.1] & [0.5,0.4] & [0.6,0.2]\\ [0.6,0.2] & [0.6,0.2] & [0.5,0.3] & [0.6,0.4] & [0.6,0.3] & [0.6,0.4] & [0.6,0.2] & [0.6,0.2] & [0.6,0.2] & [0.6,0.2]\\ [0.9,0.0] & [0.6,0.3] & [0.7,0.3] & [0.6,0.4] & [0.6,0.3] & [0.8,0.1] & [0.8,0.2] & [0.6,0.4] & [0.6,0.4] & [0.7,0.1]\\ [0.5,0.5] & [0.6,0.2] & [0.5,0.3] & [0.5,0.3] & [0.6,0.3] & [0.6,0.4] & [0.6,0.2] & [0.6,0.4] & [0.4,0.4] & [0.6,0.4]\end{bmatrix}\end{array}$$

3.3 Max-Min-Max Operator: Matrix Evaluation and Group Indicator Weight Aggregation

After evaluation ($\tilde{x}_{ij}^{k}$ and $\tilde{w}_j^{G}$) of dynamic capabilities from experts, Table 6 is a decision matrix aggregated by equation 3.

Table 6
Decision Matrix

	S_1	S_2	S_3	S_4	S_5
E_1	[0.7,0.4]	[0.6,0.4]	[0.7,0.4]	[0.7,0.4]	[0.6,0.4]
E_2	[0.6,0.4]	[0.6,0.4]	[0.6,0.4]	[0.7,0.3]	[0.6,0.5]
E_3	[0.7,0.3]	[0.7,0.4]	[0.6,0.4]	[0.7,0.4]	[0.6,0.4]
E_4	[0.5,0.4]	[0.7,0.3]	[0.6,0.5]	[0.7,0.4]	[0.6,0.5]
E_5	[0.7,0.4]	[0.6,0.4]	[0.7,0.5]	[0.7,0.4]	[0.5,0.6]
E_6	[0.7,0.5]	[0.7,0.4]	[0.6,0.4]	[0.7,0.4]	[0.6,0.4]
	0.99838, 0.00384	0.998272, 0.003072	0.997696, 0.0064	0.999271, 0.003072	0.99488, 0.0096

3.4 Comprehensive Scores of Enterprises Dynamic Capabilities

Through Equation 4, the group comprehensive evaluation is aggregated from the evaluation from each company by experts. The calculation process is as follows:

$$\begin{aligned}S_1 &= \frac{1}{q}\otimes\left(\tilde{Z}_i^1\oplus\cdots\oplus\tilde{Z}_i^6\right)\\ &=\frac{1}{6}\otimes\left([\mu_T^1(S_1)+\mu_T^2(S_2)-\mu_T^1(S_1)\mu_T^2(S_2),v_T^1(S_1)v_T^2(S_2)]\oplus\tilde{Z}_i^3\oplus\tilde{Z}_i^4\oplus\tilde{Z}_i^5\oplus\tilde{Z}_i^6\right)\\ &=\frac{1}{6}\otimes([(0.7+0.6-0.7\times0.6,0.4\times0.4)]\oplus[0.7,0.3]\oplus[0.5,0.4]\oplus[0.7,0.4]\oplus[0.7,0.5])\\ &=[0.99838,0.00384]\end{aligned}$$

$$S_2 = \frac{1}{q}\otimes\left(\tilde{Z}_i^1 \oplus \cdots \oplus \tilde{Z}_i^6\right)$$

$$= \frac{1}{6}\otimes([\mu_T^1(S_1) + \mu_T^2(S_2) - \mu_T^1(S_1)\mu_T^2(S_2), v_T^1(S_1)v_T^2(S_2)]\oplus\tilde{Z}_i^3\oplus\tilde{Z}_i^4\oplus\tilde{Z}_i^5\oplus\tilde{Z}_i^6)$$

$$= \frac{1}{6}\otimes([(0.6 + 0.6 - 0.6\times 0.6, 0.4\times 0.4)]\oplus[0.7, 0.4]\oplus[0.7, 0.3]\oplus[0.6, 0.4]\oplus[0.7, 0.4])$$

$$= [0.998272, 0.003072]$$

$$S_3 = \frac{1}{q}\otimes\left(\tilde{Z}_i^1 \oplus \cdots \oplus \tilde{Z}_i^6\right)$$

$$= \frac{1}{6}\otimes([\mu_T^1(S_1) + \mu_T^2(S_2) - \mu_T^1(S_1)\mu_T^2(S_2), v_T^1(S_1)v_T^2(S_2)]\oplus\tilde{Z}_i^3\oplus\tilde{Z}_i^4\oplus\tilde{Z}_i^5\oplus\tilde{Z}_i^6)$$

$$= \frac{1}{6}\otimes([(0.7 + 0.6 - 0.7\times 0.6, 0.4\times 0.4)]\oplus[0.6, 0.4]\oplus[0.6, 0.5]\oplus[0.7, 0.5]\oplus[0.6, 0.4])$$

$$= [0.997696, 0.0064]$$

$$S_4 = \frac{1}{q}\otimes\left(\tilde{Z}_i^1 \oplus \cdots \oplus \tilde{Z}_i^6\right)$$

$$= \frac{1}{6}\otimes([\mu_T^1(S_1) + \mu_T^2(S_2) - \mu_T^1(S_1)\mu_T^2(S_2), v_T^1(S_1)v_T^2(S_2)]\oplus\tilde{Z}_i^3\oplus\tilde{Z}_i^4\oplus\tilde{Z}_i^5\oplus\tilde{Z}_i^6)$$

$$= \frac{1}{6}\otimes([(0.7 + 0.7 - 0.7\times 0.7, 0.4\times 0.3)]\oplus[0.7, 0.4]\oplus[0.7, 0.4]\oplus[0.7, 0.4]\oplus[0.7, 0.4])$$

$$= [0.999271, 0.003072]$$

$$S_5 = \frac{1}{q}\otimes\left(\tilde{Z}_i^1 \oplus \cdots \oplus \tilde{Z}_i^6\right)$$

$$= \frac{1}{6}\otimes([\mu_T^1(S_1) + \mu_T^2(S_2) - \mu_T^1(S_1)\mu_T^2(S_2), v_T^1(S_1)v_T^2(S_2)]\oplus\tilde{Z}_i^3\oplus\tilde{Z}_i^4\oplus\tilde{Z}_i^5\oplus\tilde{Z}_i^6)$$

$$= \frac{1}{6}\otimes([(0.6 + 0.6 - 0.6\times 0.6, 0.4\times 0.5)]\oplus[0.6, 0.4]\oplus[0.6, 0.5]\oplus[0.5, 0.6]\oplus[0.6, 0.4])$$

$$= [0.99488, 0.0096]$$

Looking into to result of calculation, $S_4 > S_1 > S_2 > S_3 > S_5$, the dynamic capabilities of forth company is at the first place in the rank, whereas, the fifth company is ranked at last.

CONCLUSION

This paper firstly reveals a combination of IFS method and EDC, which proposes a measurement to measure dynamic capabilities of companies in financial industry. This measurement not only deals with the evaluation of dynamic capabilities in case of incomplete information and uncertainty of experts, also identify the weights of an indicator. Rank is produced by aggregation from experts' evaluation of dynamic capabilities by their preferences. Furthermore, this method can be applied to estimate the current level and rank of companies' dynamic capabilities for investor and managers to make decisions of investment or management, which is a practical approach.

REFERENCES

Alchian, A. (1950). Uncertainty, evolution and economic theory. *Journal of Political Economy, 58*(3), 211-221.

Atanassov, K. (1986). Intuitionistic fuzzy sets. *Fuzzy Sets and Systems*, (20), 87-96.

Atanassov, K. (1995). Remarks on the intuitionistic fuzzy sets III. *Fuzzy Sets and Systems*, (75), 401-402.

Bao, G., & Long, S. (2015). Research of enterprise dynamic capabilities: Updated Review and Outlook. *Foreign Economics & Management*, (07), 74-87.

Collis, D. J. (1994). Research note: How valuable are organizational capabilities? *Strategic Management Journal, 15*(S1), 143-152.

Delmas, M. A. (1999). Exposing strategic assets to create new competencies: The case of technological acquisition in the waste management industry in Europe and North America. *Industrial and Corporate Change,* (8), 635-650.

Edwards, J. (2001). Multidimensional constructs in organizational behavior research: An integrative analytical framework. *Organizational Research Methods,* (4), 144-192.

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: What are they. *Strategic Management Journal, 21*(4), 1105-1121.

Feng, J., & Wei, J. (2011). Review and outlook of dimension division and measurement research of foreign dynamic capabilities. *Foreign Economics & Managemen, 7*, 26-33.

Fu, C., & Zhao, J. (2014). Multi-attribute decision method based on intuitionistic fuzzy set. *Systems Engineering,* (4), 131-136.

He, X., Li, X., & Fan, H. (2006). Measurement and effectiveness of dynamic capabilities: practical research based on chinese experience. *Management World,* (03), 94-103.

Helfat, C. E., Peteraf, M. A., & Smith, M. E. (2003). The dynamic resource-based view: Capability lifecycles. *Strategic Management Journal, 24*(10), 997-1010.

Jiang, Q., & Wang, C. (2008). Practical research of enterprise dynamic capabilities measurement: Example of 270 companies from an incubator. *Studies in Science of Science, 26*(3), 604-611.

Lansiti, M., & Clark, K. (1994). Integration and dynamic capabilities: Evidence from product development in automobiles and mainframe computers. *Industrial and Corporate Change, 3*(3), 557-606.

Luo, Y. (2000). Dynamic capabilities in international expansion. *Journal of World Business, 35*(4), 355-378.

March, J. G. (1991). Exploration and exploitation in organizational learning. *Organization Science*(2), 71-78.

Marsick, V. J., & Watkins, K. E. (2003). Demonstrating the value of an organization's learning culture: The dimensions of the learning organization questionnaire. *Advances in Developing Human Resources, 5*(2), 132-151.

Meng, X., Wang, C., & Yang, J. (2007). Research reviews of theoretical model of enterprise dynamic capabilities. *Foreign Economics & Management, 10*, 9-16.

Nelson, R. R., & Winter, S. G. (1982). *An evolutionary theory of economic change.* Cambridge, MA: Belknap Press.

Porter, M. E. (1980). *Competitive strategy: Techniques for analyzing industries and competitors*. New York: Free Press.

Rodriguez, P. I. (2008). Building dynamic capabilities in product development: The role of knowledge management. *The Role of Knowledge Management IE Business School Working Paper*, WP08-14.

Senge, P. M. (1998). The leader's new work: Building learning organizations. *Sloan Management Review, 32*, 439.

Swee, C. (1998). Toward a learning organization: The strategic building blocks. *Sam Advanced Management Journal, 63*(2), 15.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal, 18*(7), 509-533.

Thomas, H., & Pollock, T. G. (1990). From I-O economics S-C-P paradigm through strategic groups to competence-based competition: Reflections on the puzzle of competitive strategy. *British Journal of Management, 10*(2), 127-140.

Wang, C. L., & Ahmed, P. K. (2007). Dynamic capabilities: A review and research agenda. *International Journal of Management Review, 9*(1), 31-51.

Wang, J., Wang, Y., & Han, J. (2010). Research of conception development and dimension measurement about enterprise dynamic capabilities. *Journal of Beijing Normal University (Social Science Edition),* (06), 123-133.

Wang, P. (2009). QoS-aware Web services selection with intuitionistic fuzzy set under consumer's vague perception. *Expert Systems With Applications, 36*, 4460-4466.

Wernerfelt, B. A. (1984). Resource-based view of the firm. *Strategic Management Journal, 5*(2), 171-180.

Winter, S. G. (2003). Understanding dynamic capabilities. *Strategic Management Journal, 24*(10), 991-995.

Zahra, S. A., Sapienza, H. J., & Davisson, J. P. (2006). Entrepreneurship and dynamic capabilities: A review, model and research agenda. *Journal of Management Studies, 43*(4), 917-955.

Zhang, D. (2013). Research of dynamic evolution of enterprise core competitiveness theory. *Economic Research Guide, 3*, 20-23.

Zollo, M., & Winter, S. G. (2002). Deliberate learning and the evolution of dynamic capabilities. *Organization Science, 13*(3), 339-351.