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ABSTRACT

This paper applies evolutionary view to investigate the enterprise tech-innovation process and study the uncertainty of the routine, net environment and the innovational technique. In the end the measurement of risk is described as the uncertainty characteristic then induced the coherent characteristic between the risk and the uncertainty, which can be applied in the theory on the innovation management.

Keywords: information flow; uncertainty; net-environment

1. INTRODUCTION

It is not an isolated event that enterprise's technology is achieved newly under the network environment. It exists as the result of the course. During the process of its organization realizing, uncertainty is the most essential characteristic of technological innovation. This text believe that its ultimate behavior can be reflected by the deviation of the achieved degree of the strategic destination at the given time point.

Among the scholars, there are lots of viewpoints that connect each other and set against to the uncertainty roots in the tech-innovation. Theory of Impacting perspective [Markus, L. & Robey, 1988; Thompson,1967] [1][2] believed that the quantity of technological information and the technological means constitute the uncertain source; And believed that , the exquisiteness not only influences the professional technological innovation course, but could promote the organization ability of the technological innovation during the course of enterprises tech-innovation with the formers' promotion. Theory of selective perspective and theory of conflict [Orlikowski and Yates, 1994] [3] believed that technology is the product of human's interaction , design and allocation. All the communication techniques which applied by the organization results from the complex social interaction, among which the main conflict s come from the individual and organizational framework [4].

In any case, this paper thinks the technological innovation as a coordination and uncertain course. We regard the incomplete knowledge and bounded rationality as the characteristic in the technological innovation course. Especially, because the object that tackles is incomplete restructure of the existing information, knowledge, technology, etc., during which the new knowledge must be created [5]. Many domestic and foreign scholars have strong interests in the risk measurement of the enterprise's innovation course. Among the numerous viewpoints, a agreement is achieved that risk founds on the goal-structure, which an aprioristic measurement index system is demanded while the index system couldn't be constructed by the economists and management experts at present [6][7][8].

2. THE ROOTS OF THE UNCERTAINTY IN THE ENTERPRISE TECH-INNOVATION PROCESS UNDER THE NET ENVIRONMENT

The concept of the uncertainty in the enterprise tech-innovation process refers to the total deviation of the current conditions with included in each of the decision points of the enterprise tech-innovation process and the choices with difference effected on enterprise by the very points. The result it directly caused is the total difference of the tech-innovation activity and the final decision's difference (relative).

Any course of the enterprise tech-innovation under the net-environment has involved three most essential objects: enterprise's structure, net-environment and innovation technology as for an object. The tech-innovation process is not only the development of the technology but also the changes of the social productivities' structure.

2.1 The structure of enterprise

The structure of enterprise is an economy system with a unique becoming history. While the enterprise engaged in tech-innovation activity, it must have the resources of two respects at least: 1, the information resources precipitated in past history; and 2, the convention that forms by searching in its history. The information resources of enterprises have the characteristics of two respects: 1, the size of its information amount; 2, the quality that information has (accuracy). According to information theory, the amount of information could be described according to its entropy, and according to Qiu Yuanhua's viewpoint: the quality that information has could be described by its complex entropy. In a word, the amount of information resource and its accuracies at

the time t could be described by a complex entropy $H(x_t)$ [9].

Definition: $H(x_t) = \sum_{k=1}^{n} |P(x_t) \ln P(x_t)|$

$$= \sum_{k}^{n} \left| P(x_t) \left[\ln P(x_t) + i \arg \ln P(x_t) \right] \right| , \quad (2\text{-}1)$$

In which: $x \in C$. So $H(x_t)$ indicates the above mentioned two respects of the information. It postulates the vector of information input in the course of the enterprise tech-innovation is $X_I^{n_1} = (x_{I1}, x_{I2} ... x_{In_1})$; The output of a given information vector transacted by the enterprise's convention is: $X_o^{n_2} = (x_{o1}, x_{o2} ... x_{on_2})$ .The transformation for a given input information vector in the course of the enterprise tech-innovation is $W_t = \bigcup_{k=1}^{n3} w_{tk}$,which means that at the time t, the transformation which is suitable to any input information is selected in the ensemble: $W_t = \bigcup_{k=1}^{n3} w_{tk}$ .The probability for a given w_{tk} to transform the information is P_{tk} .Under the above-mentioned condition , the equation: $X_{ot}^{n_2} = X_{It}^{n_1} W_{tk}$ exists, in which $k \in (1,2...n_3)$, i.e., when the input information vector is $x_{it}^{n_1}$,enterprise chooses w_{tk} in $W_t = \bigcup_{k=1}^{n_3} w_{tk}$ to transform, the information's output is $X_{ot}^{n_2}$;At the same time, from the viewpoint of enterprise's evolution, this kinds of enterprise could choose the uncertainty of w_{tk} in $W_t = \bigcup_{k=1}^{n_3} w_{tk}$ to make the enterprise tech-innovation process could be indicated by an iterated function system with probability, that is $IFSP_E : (R^{n_2}, w_{t1}, w_{t2} ... w_{tn_3}; P_{t1}, P_{t2} ... P_{tn_3})$, while.

$$\sum_{k=1}^{n_3} P_{tk} = 1 . \quad (2\text{-}2).$$

The above-mentioned $IFSP$ is not only a fractal ,but also because of its satisfactory characteristic of self-resemblance, it could explain the complexity in the evolution of the enterprise's becoming history very well [10]. Now discuss the becoming evolution of the convention in the course of enterprise tech-innovation.

The transform set is one cluster of enterprise's routine that has acted on outside and inside existing information resources $W_t = \bigcup_{k=1}^{n_3} w_{tk}$. It decides the information's characteristic and the evaluative course of itself at the next time point. This paper believes that the evolution of enterprise's routine is not depended on the result that enterprises calculate in advance, but limited by the result that chosen by society network. Therefore, once enterprises choose w_{tk} to transform, when w_{tk} is used on next step, it must has already absorbed the result this time. Embodying in mathematics, it is $w_{(t+t_0)k} = w_{tk} + \Delta w_{tk}$ (2-3)

In which t_0 is the cycle of choosing w_{tk}; Δw_{tk} is the emendation matrix ,which reflects the revision of routine because of choosing w_{tk} this time, namely the routine which the change causes is revised.

2.2 The network environment

The network environment represented by Internet dwindles the time lag greatly. Considering the network environment as a whole behavior characteristic for the system, the paper believes that the network environment could be regarded as an independent behavior subject because of the network imbedding formed in the course of the building of the innovation's object. Its behavior characteristic is similar with the enterprise's structure: namely it has certain information and convention. At the same time information is dealt with by the routine, the routine is evolving in this course. Besides of the fractal structure which is similar with the enterprise's structure, the pre-requisite factor of network environment is to choose function. This requires looking for a parameter of scaling the characteristic to confirm the choosing function.

Firstly, $IFSP$ structure is used to indicate the self-evolution course of the network, $IFSP_N : (R^{m_2}, w_{t1}, w_{t2} ... w_{tm_3}; P_{t1}, P_{t2} ... P_{tm_3})$,while,

$$\sum_{k=1}^{m_3} P_{tk} = 1 \quad (2\text{-}4).$$

On the other hand, in order to indicate the heredity and variation of the convention of the network, similarly with enterprise's structure $W_{(t+T_0)k} = w_{Ntk} + \Delta w_{Ntk}$, T_0 is the circulation cycle of w_{Ntk} chosen for the network; Δw_{Ntk} is the emendation matrix , which reflected the revision of convention because of choosing this time, namely the convention which the change causes is revised. Finally, to resolve the choosing function and scale the competition relation between convention and information, this paper sets about from the outside, confirms that $IFSP_N$ is chosen to be confirmed by the radius Z of the table in the technological convention that t may include constantly, $Z_{(t)} = \left| \ln C_{tn} - \ln Ct1 \right|$ (2-5),

Then $Z_{(t)}$ has determined field of the choices of the information resources and convention resource in the network. where C_{tn} is the cost of the technological information and convention S_{tn}, C_{t1} is the cost of technological information convention S_{t1}. Because the evolution of the network makes technological diffusion faster , enterprise's competition is aggravated in the network, then this paper supposes that: $Z'_{(t)} \le 0$. That means that with the evolution and development of the network, the difference on the cost of the information suitable for choosing and the routine will be smaller and smaller in the network. On the other hand, because of the variety of the network, the division among specialized departments of the technological innovation course will be more and more meticulous.

2.3 Tech-innovation as the object of development

Considering the object of enterprise's development and technological source , it is possible to have two kinds: 1).this tech-innovation is not existing in the environment of the network, namely the network environment does not have the same information as this, the existence of tech-innovation in the network environment gone on and existed by this enterprise, namely the original innovation in a normal sense ; 2).this tech-innovation exists in the environment of the network, and does not exist in this specific enterprise , namely the imitation innovation in a normal sense.

Setting up the permutation of all kinds of technology when moment t of the environment of the whole network as follows: $T_{Nt} = \{S_{t1,} S_{t2,} \ldots S_{tn}\}$ (2-6). This permutation Satisfies the above-mentioned assumption: namely by virtue of competition of the society, the possible technology choosing included in T_{Nt} is confirmed by the radius of the table $Z_{(t)} = \left|\ln C_{tn} - \ln C_{t1}\right|$, and $T_{Nt} = \{S_{ti} \in T_{Nt}\}$.

And two kinds of situations which are perhaps in of this tech-innovation of enterprise while discussing are expressed in order to make two types: 1), $S_{t+T_E} \in T_{Nt}$, namely this tech- innovation is imitation innovation. And 2), $S_{t+T_E} \notin T_{Nt}$; $S_{t+T_E} \in T_{N(t+T_N)}$, namely this tech- innovation innovates originally.

3. ENTERPRISE TECH-INNOVATION RISK MODEL

The uncertainty in the course of enterprise tech-innovation of course could be divided into two levels according to aspect: 1.the deviation of the goal object and the routine it selected to use in the structure of enterprise tech-innovation; 2. the risk that the uncertain factor in the course.

3.1 The risk resulting from the routine

According to the above mentioned: The route where enterprise evolves can be determined by $IFSP_E$, its routine is $\left[R^{n_2} : W_1, W_2 \ldots W_{n_2}\right]$, it is a IFS_E with a compression factor 0≤s <1, and in which the IFS_E the transformation is $w : \hbar(x) \longrightarrow \hbar(x)$ (3-1).

Define: $w(B) = \bigcup_{n=0}^{\infty} w_{k_t}(B) \quad \forall B \in \hbar(x)$, (3-2)

Where w_{k_t} is the compressive transform with a factor s in the space $(\hbar(x), \hbar(x))$ which satisfied the following:

$\hbar(w(B), w(C)) \le s\hbar(B, C)), \forall B, C \in \hbar(x)$. (3-3)

In which its only fixed point A satisfies $A = w(A) = \bigcup_{n=0}^{\infty} w_{k_t}(A)$, and $A = \lim w^n(B)$ $\forall B \in \hbar(x)$. It is a fractal. Now considering evolution of enterprise, definition of the corresponding displacement transformation S_t: $A \to A$ of $w(B) = \bigcup_{n=0}^{\infty} w_{k_t}(B)$ as $S(a) = w_{k_t}^{-1}(a), \alpha \in w(A)$ (3-4). Dynamical system $(A; S)$ is the displacement dynamical system going with IFS_E. It can be written as following: $S(a_n) = w_{nk_t}^{-1}(a_n), \alpha \in w_n(A)$ (3-5). Because of the sensitiveness of $S(a)$, the difference of the tracks of $w(B) = \bigcup_{n=0}^{N} w_{k^t}(B)$ will extend with the effect of dynamical system, i.e., $h_t(\omega(B), \omega(C))$ will change. In which h is the Hausdorff distance.

Therefore, it could be measured of the possibility of the difference between the direction which indicates the enterprise innovation and the direction of network evolution in the track space by $h_{(w_{(B)}, w_{(C)})_t}$ thus leads out conclusion 1): any uncertainty of enterprise tech-innovation is closely linked with the time t in the evolution track.

3.2 Risk caused by the uncertainty factor's

Constructed being aforesaid: $IFSP_E : (R^{n_2}, w_{t1}, w_{t2} \ldots w_{tn_3}; P_{t1}, P_{t2} \ldots P_{tn_3})$, according to the random density of model, ISFP can forms finite Marlkove chain. Its probability shows the probability factor in the random network chart, the

picture which outputs the result can be expressed with the matrix of making up.

We need to calculate the uncertainty in the course of the tech-innovation $H_{I\Delta t} = -\sum (W_{kt} \log_2 W_{kt}) P_{kt}$, (3-6) $H_{I\Delta t}$ shows the information flows impart entropy and the measurement of accuracy after the transformation, in which W_{kt} is the complex variable matrix.

In sum, the uncertainty of enterprise tech-innovation course can be shown by above-mentioned variables: $Q = (h_t, H_{I\Delta t})$. The first part h_t has expressed the uncertainty's measurement of the object chosen in the tech- innovation; The second part $H_{I\Delta t}$ is the uncertainty of the tech-innovation course while organizing.

4. THE MODEL DISCUSSING AND THE MEASUREMENT OF THE RISK

In the mathematics model of section 3, the economic meaning which represented by h_t is provided by w_{tk} in the model $W_t = \bigcup_{k=1}^{n_3} w_{tk}$. Now we assume that w_{tk} presents the concept of economic cost ,and h_t indicates the difference measurement of the cost of individual enterprise innovation and that of network innovation in the realistic economic life; If w_{tk} provides the matrix of information shift and processing, then h_t shows the difference of information output's availability in the social network.

The uncertainty at the second level could be confirmed by using two indexes of the complex variable. 1). Information transfer; 2).Accuracy of conducting of information. Thus forms a complex variable, P_{kt} is the probability that transformation matrix appears , if this information flow is expressed by one chart, its mathematics expression formula must be an adjoining matrix of an unconnected chart, which expressed once enterprise chooses some to deal with the way , it has no other things to substitute choosing in the future, namely the history determines their evolution possibilities, the border matrix of unconnected chart must could be simplified to a Jordan matrix , and restrained the appearance probability of Jordan matrix own probability so can simplify its calculation.

It must be pointed out that risk is aiming at a given goal collection. Therefore, the risk measurement could be come out throughout comparing the uncertainty's index and the given goal collection index.

Definition: The risk index of the innovation activity way j is: $R_j = 1 - \frac{\sum_{i=1}^{h-1} Q_{ij}}{Q_0(h-1)}$, (4-1)

In which: Q_0 is the given object restriction collection; h is the Q_0 's mark of the position according to Q_{ij}. The choice could be decided by the following expressions:

As for the given project j, the position form risk is $R_x^{(1)} = r_x^{(1)} r_x^{(2)}$, (4-2)

Risk of break even is: $R_x^{(2)} = P(w \subset t) = \int_{-\infty}^{t} f(w)d(w) = F(t)$, (4-3)

Risk of aggressive is: $R_x^{(3)} = P(w \subset T) = \int_{t}^{+\infty} f(\omega)d\omega = F(T)$, (4-4)

In which $r_x^{(1)} = -\int_{-\infty}^{+\infty} \ln f(\omega) dF(\omega)$, (4-5)

$$r_x^{(2)} = \begin{cases} 0 & T < \bar{x} - k\sigma_x \\ \dfrac{T + k\sigma - \bar{x}}{T - t + 2k\sigma} & T \geq \bar{x} - k\sigma_x \end{cases}, \quad (4\text{-}6)$$

$f(\omega)$ is the density distribute function for the restraining goal from collecting the element, σ is normalized deviation， $\bar{x}$ is the mean value. Its density distributing function is lead out with corresponding density evolution method by above-mentioned $IFSP$.

5. CONCLUSION

Throughout the research to the roots of the uncertainty and measurement of the risk in the enterprise tech-innovation process under the net environment, the paper's conclusions are as followed:

1).The uncertainty factor in the enterprise tech-innovation is decided by enterprise routine: the network and the innovation object ;

2).Because enterprise is a organic structure ,the using of fractal system to describe its evolution and the characteristic of self-similarity is felicitous ;the measurement of the tech-innovation risk is come out from the uncertainty of the enterprise tech-innovation and the given object restriction collection ;

3).Because the universal mathematics tools fail to appear, different mathematics tools are needed in the course of analyzing and researching enterprise tech-innovation process. A large amount of research on constructing and evolving the method and using with the density in $IFSP$ needed, it is a focal point of next research to find out its measurable triggers value.

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