CSCanada
International Business and Management
Vol. 6, No. 2, 2013, pp. 131-136
DOI:10.3968/j.ibm.1923842820130602.1140

ISSN 1923-841X [Print]
ISSN 1923-8428 [Online]
www.cscanada.net
www.cscanada.org

Enterprise Knowledge Creation Entropy Theoretical Analysis and Knowledge Entropy Model Study

WU Jie[a],*; MA Xuejun[a]; PENG Xingxing[a]

[a] School of Economy and Management, Jiangsu University of Science and Technology, Zhenjiang, Jiangsu, 212003, China.
*Corresponding author.

Supported by National Social Science Fund under No.11BGL039, National Natural Science Fund under No. 71271119, College Philosophy and Social Sciences Key Projects in Jiangsu Province under No. 2011ZDIXM036 and 2011 Doctoral Scientific Fund Project of the Ministry of Education under No. 20113223110007 and 2012 Humanities and Social Science Research Fund Project of the Ministry of Education under No. 12YJA630169.

Received 22 February 2013; accepted 13 April 2013

Abstract

Entering the 21st century, the knowledge economy as a new economic realizes the alternative of intellectual resources of material resources in the economic operational process, and it can greatly save energy and improve economic efficiency. Thus the value of existence of the enterprises in the context of knowledge economy is that the enterprises can conduct knowledge creation, transfer and use more efficient compared with the market. In essence, enterprises are the entity of knowledge production, the peculiarity of it owned to the difference between knowledge production ability and using ability. This paper used the similarity fundamental of the cross and comprehensive of natural science and social science, and imported the basic principles of entropy theory in thermodynamics to study the mechanism of knowledge creation, the key pathways and mechanisms, pointed out that the knowledge entropy can greatly save energy and improve economic efficiency. At the same time constructed a mathematical model of knowledge creation, and pointed out that any enterprises must continue to carry out knowledge creation and knowledge transfer to increase negative entropy to promote sustained and have a healthy development.

Key words: Entropy theory; Knowledge creation; Model

WU Jie, MA Xuejun, PENG Xingxing (2013). Enterprise Knowledge Creation Entropy Theoretical Analysis and Knowledge Entropy Model Study. *International Business and Management, 6*(2), 131-136. Available from: http://www.cscanada.net/index.php/ibm/article/view/j.ibm.1923842820130602.1140
DOI: http://dx.doi.org/10.3968/j.ibm.1923842820130602.1140

INTRODUCTION

Entering the 21st century, the knowledge economy as a new economic realizes the alternative of intellectual resources of material resources in the economic operational process, and it can greatly save energy and improve economic efficiency. Thus the value of existence of the enterprises in the context of knowledge economy is that the enterprises can conduct knowledge creation, transfer and use more efficient compared with the market. In essence, enterprises are the entity of knowledge production, the peculiarity of it owned to the difference between knowledge production ability and using ability.

1. ENTROPY THEORY

German physicist Crowe Sues in 1850 proposed the second law of thermodynamics thought: In an isolated system, hot always passes from the high temperature object to the low temperature object, finally achieves the balance. So he introduced he introduced a state function of entropy, since then, the concept of entropy as a metric conversion equivalence had been applied in many disciplines. Einstein overview of the status of the entropy theory in science: “entropy theory for the whole of science is the first rule.

1.1 Entropy Definitions

Crowe Sues defined entropy as:

$$ds = \frac{dQ}{T}$$

That the small increment of entropy is equal to the ratio of heat and temperature that absorbed from condition P_0 to condition P in the process of invertible element, described as "the law of entropy increase is: the process is always moving in the direction of increasing entropy in isolated system. Entropy is a measure of the degree of disorder of the system, and it is the measurements about the irreversibility of the system and uniformity.

1.2 Entropy Changes

To the isolated system, regardless of its initial state, since the entropy is always increasing, it will eventually develop into a homogeneous, single-balanced state, and any ordered structure will be destroyed, showing a deadly scene.. Only open system that has the material, energy and information exchange with the outside world is possible to be ordered.

To an open system far from equilibrium, for its constantly exchanges material energy with the outside world, its entropy change can be divided into two parts: one entropy change is caused by the process of irreversible of the system itself (d_is), this one is always positive, the other part is the system entropy change caused by the exchange of matter and energy with the outside world (d_es), this one can be positive or negative, the total entropy of the system as a whole is equal to the sum of: $ds=d_is+d_es$.

According to the second law of thermodynamics: In an isolated system, there is no source of entropy, that is $ds=0$, therefore, due to the non-equilibrium always spontaneously tends to be balance, with the continuous increase of entropy, the ordered state gradually becomes disordered state. However, in an open system, the entropy of the source may be greater than or less than zero, such as d_es is negative, and its absolute value is close to d_is, but the total entropy can be close to zero, so the system toward the new ordered by the disorder, and maintain a low entropy non-equilibrium stable and orderly structure. Thus, to an open system far from equilibrium, as it constantly exchanging matter and energy with the outside world, the non-equilibrium system can reduce the total entropy by negative entropy source, and reach a new stable and orderly structure, that is dissipative structure.

If a system is in a closed state, then, that all activities carried out will make it entropy increase, the result can only lead to blind development and anarchy, so companies must be open systems, and knowledge transfer and exchange with the outside world, increasing negative entropy, to ensure that companies from non-equilibrium to equilibrium.

2. INFORMATION ENTROPY

After the introduction of the concept of chance and random statistical methods in physics, it plays a stable function for people to handle the essence of entropy, and this understanding has also become the premise of the concept of information entropy in information theory. In physics, the connection of information and entropy begins from the unstable of the system state, the measurable relationship between the two had been mentioned in the Boltzmann's writings of 1872: "The entropy is a measure of the information lost in a system".

In 1948, Shannon emphasized the concept of "amount of information" on the basis of the summary of the previous results, he characterize the source of information through the statistical properties of the Markov process, and made a new definition of the concept of entropy from a new perspective, that is defines a discrete source of information "generated" amount of information, $H=-C\sum p_i \ln p_i$, so the information contacted with entropy. Shannon imported the concept of entropy into information theory, given the broad concept of entropy, and had opened up new fields of application of human knowledge.

Thus, the entropy theory stand out from the field of thermodynamics, infiltrating the various fields of human thought, culture and science and technology, and had got promotion, application and in-depth research in science technology , proved its great significance. However, the full significance of the concept of generalized entropy seemed have not been sufficiently studied, the application of entropy theory in the relatively new field has not been fully exploited, and need to be further explored.

3. KNOWLEDGE NEGATIVE ENTROPY EFFECT

Human evolution, social development, the creation of technical, the civilization of the system and the behavior of the optimization formed a strong negative entropy flow steady input into the social system. Innovative and high technology leaded with information technology that associated with knowledge is the input of negative entropy. It will enable the effective transformation of traditional industries. Thus, the knowledge-based economy as economic growth provides a "negative entropy mode", it is not means equivalent to one-way entropy increase mode in the industrial economic social. (XU, ZHANG, & ZHANG, 2009; YE, 2008; DONG, & GAO, 2012)

3.1 The Form Prerequisite of Knowledge Entropy

Knowledge entropy is a measure of transfer efficiency and resistance loss in the process of knowledge transfer of internal enterprise and external, and is also a measure of the effectiveness of knowledge management. The increase of knowledge entropy means "knowledge management performance is declining and is consuming constantly.

The Form Prerequisite of Knowledge Entropy including:

(1) The enterprises are open systems far from equilibrium.

(2) There is a nonlinear interaction between the various elements in internal of the enterprises.

(3) Internal of the enterprises continue to carry out the

exchange of knowledge with the environment, so that the total entropy is negative.

These conditions play a role in the enterprise from disorder to ordered. A microscopic random knowledge needs of disturbance in enterprise will be amplified by the relevant role, and develop into an overall macro huge fluctuations, this make enterprises enter the unstable state, then fell to a new stable and orderly state and form a vibrant ordered structure.

3.2 Enterprises' Knowledge Entropy Increase the Effect

When the coordination between the various elements inside of the system have a barrier, or the controllable input to the system reaches a certain level due to the environment, the system is difficult to go further control around the target, and it will exhibit a certain degree of disorder in the function, show the ordered weakening and disorder increased, this state of the system is the entropy increase effect. Similarly, knowledge entropy increase means that in the movement of enterprises, knowledge is always gradually reduced and consumed, under certain conditions, this is an irreversible process. This is also the diminishing law of knowledge innovation efficiency when the enterprises in closed equilibrium state. The reason why this rule exists, mainly due to the innovation efficiency of the process of knowledge flows constrained by certain variable elements, such as the expansion of the corporate structure, aging, the extension of the distribution channels, increased node, the obsolescence of the concept, the aging of knowledge, these elements gradually decreasing the efficiency of knowledge innovation in different levels, so emerge a stabilize this knowledge entropy increase trend. This trend makes knowledge systems evolved from order to disorder.

3.3 Through Knowledge Entropy Realized Enterprise Negative Entropy Value

The entropy increasing trend of enterprises own running, through open enterprise system that import negative entropy flow from the outside world to satisfaction the constantly produce of entropy will achieve a negative entropy to the whole enterprise system.

Knowledge entropy provides an important basis for the establishment of a scientific enterprise knowledge management architecture, knowledge creation, integration, transfer, application and so on, and this is through knowledge management framework of the knowledge supply chain, makes the element enterprises gathered together, "both independent and complementary, both competition and cooperation" is the common goal and shared interests of these enterprises. Under the entropy increasing trend, knowledge management framework of the knowledge supply chain can overcome the confusion caused by the lack of knowledge through completely open, self-learning, self-transformation, and continue the exchange of knowledge and information with the environment, and promote the efficiency of knowledge innovation through synergies and mutations that make knowledge supply chain achieve negative entropy.

4. KNOWLEDGE CREATION

Enterprise system is a cognitive system, their survival depends on the ability to acquire knowledge and knowledge innovation capacity that promote the development and evolution of the enterprises. The knowledge system of the enterprises is not the aggregate of personal knowledge in the enterprises. It is the balance of continued interaction of many of the enterprise "node", the knowledge exchange, shared standards and procedures mechanisms of cognitive processes.

Enterprise is a special type of cognitive system, capable of generating its own function, is an automatically generated cognitive system, it is a system based on the ability of produce its own knowledge and their interrelationship. Enterprises can play a role through knowledge creation. In such a cognitive system, the new knowledge can be generated by the existing knowledge. Books, manuals, guides, colleagues, business partners are conditions that able to disseminate knowledge or be able to create an environment conducive to the production of knowledge.(Carolina Lopez-Nicolas, Pedro Soto-Acosta, 2010; LI, HUANG, Ming-Tien Tsai, 2009; Daniela Carlucci, Giovanni Schiuma, 2009).

4.1 Knowledge Creation Mechanism

An existing enterprise as a cognitive system, the knowledge system such as routine programs and business strategy that has won the success before are strong inhibitor of knowledge change and innovation. Enterprises generally would not make changes to a running business strategy or an existing knowledge system that have been proved efficiency. The success of the existing knowledge system limits the possibility of change. So enterprises must destroy the existing operating status and knowledge systems to continue the creation of new knowledge (WU, LIU, SHI, 2006).

Enterprises should be run under the "information from noise" principle, based on the information most from the noise and improve on this basis. That is to say it develops from the chaos of the environment, because the occurrence of chaos and disorder is a condition that allows enterprises to broaden their knowledge of the ability. Creative enterprises respond to the confusion through self-enterprises: new ideas, new solutions, new products and new markets to replace the existing that damaged by these new things. In practice there is a creative disorder, this creative disorder can create order, therefore, the disorder and order is closely linked. For any creative process is not just the result of confusion, which itself is a chaotic, in

this sense, chaos and disorder changed the balance of the enterprises, and produce a new and very different balance from the conventional.

As with all other systems, enterprises are always trying to maintain a certain balance. Need to maintain a balance is the need of change, which originated of the existing confusions, these confusions from the system itself or the external of the system. An enterprise has extent of noise and disorder is one that capable to adapt to a greater confusion. It can import specific number of control chaos into their internal needs. So knowledge creation can be trained through a certain degree of noise and disorder.

4.2 Key of Knowledge Creations

Personal knowledge sector knowledge and corporate knowledge that composed an enterprise knowledge system all showing some kind of order, and so, this order is maintained by the enterprise absorbing negative entropy from the surrounding environment and overcome their own entropy increase trends, so knowledge creation closely linked to entropy theory.

Enterprise itself is not a closed system or isolated system, but there is a complex process of knowledge exchange with the outside in an open system. Knowledge creation is not only limited to "business survival" dynamic equilibrium state. As enterprises continue to make knowledge innovation and continue to uptake the knowledge from the surrounding environment that may be used, on the one hand, this can avoid its own system tends to static equilibrium; the other hand, it can maintain normal activities. If the internal knowledge systems become a static equilibrium, which means the suspension of the enterprise innovation phenomenon, enterprises will lose their competitive edge and facing elimination and death. So in enterprises activities, knowledge creation, exchange and inhibition of entropy tends is its main content. The enterprises create or intake low knowledge entropy from outside, then turn it into a high-entropy knowledge and exchange out of enterprises. Enterprise is o maintained, developed and grow rely on the constantly waste entropy process.

4.3 The Pathways of Knowledge Creations

Knowledge creation is a symbiosis with the raising activities, knowledge is able to meet the various needs of the people, any knowledge can as knowledge products produced for human consumption. But, strictly speaking, not any knowledge can participate in or lead to innovation, that is to say from ideology into practical form, extended from the individual form to a social form, and create new products, new relationships and new behavior. Knowledge creation is both knowledge production to meet the needs of the innovation and meet the needs of specific subject knowledge production, such as the subject of innovation production -enterprise, always accurately grasp and predict user needs as the first task, and this information as the center, research and development suitable knowledge and technology and melt with the product or service innovation. The pathways of Knowledge creation including:

(1) Combination

Through a combination of knowledge, theories and techniques of the different disciplines creating new knowledge. According the differences of combination, it can be divided into: progressive changes through gradual adjustment and incremental improvement of existing knowledge and acquire new knowledge; through the use of the information collected to continue the existing knowledge re-integration in order to acquire new knowledge breakthrough-type changes.

(2) Exchange

When limited resources owned by different actors, the mutual exchange of resources has become a prerequisite of the combination of resources, managers can make full use of the complementary knowledge grasped by researchers, theorists and thinkers to accelerate knowledge creation activities, therefore, by the exchange the resources of these actors it can acquire new knowledge, including personal and collective knowledge transfer. Typically, the creation of new knowledge occurs through social interaction and co-operation.

4.4 Knowledge Creations Mechanism

Because the enterprises are in a non-isolated system, their knowledge creation must depend on the internal and external business:

(1)Knowledge creation within the enterprises

Internal knowledge creation mechanism is closely related with the internal distribution of knowledge and learning mechanism. An enterprise is usually made up of a number of departments, these departments rely on the knowledge base is usually different. Such as the production department is to create and utilize the technical knowledge connected with the production process, while the sales department is mainly to create and use the knowledge associated with the transaction. In this way, the different departments associated with different techniques, also associated with the performance of the different tasks, thus constitute a knowledge domain based on different knowledge. Therefore, from knowledge point of view, the main task that an enterprise faced is to coordinate and utilize the knowledge of the different knowledge domains. When a new knowledge creation process involves a number of departments across the knowledge base, knowledge coordination, coordination of tacit knowledge becomes very important.

Knowledge creation within the enterprise include: Firstly, articulating the knowledge creation process that involves new knowledge to allow to be evaluated and discussed; secondly, develop a new concept of knowledge through the connection and recombination about the clear knowledge base, and internalizes it into the management of technology systems and the management of employees;

Finally, this new created knowledge be transferred and modified through the process of learning and socialization to run a smaller cost.

(2) The exchange of knowledge between the enterprises and the external environment

From the perspective of knowledge creation, the introduction of external knowledge can be shown the important role: first to provide the necessary market and technical information for knowledge creation, and it is important clue to identify innovative target in innovation decision-making and clear innovation target; second to provide implantable creation way for knowledge creation, and achieve the shift of knowledge creation paradigm in order to adapt to the new competitive opportunities; once again to promote the transformation and processing of knowledge, especially from tacit knowledge to encoded explicit knowledge, and improve the knowledge utilization efficiency.

5. KNOWLEDGE CREATION MODEL

The core of the theory of the second law of thermodynamics is not reversible, this irreversibility of the system is that regardless of the initial conditions, along the entropy is increasing, the state will move in the direction that more and more chaotic, more and more disordered and toward to the ultimate balance state, it is the most essential feature of all real systems. From the system point of view, the thermodynamic system has many similarities with the knowledge creation of enterprise, such as uncertainty, a large number of sexual and irreversibility determined that it can be connected between the systems.

Any enterprises are open systems, internal control should be conditional on the input and output of the environment, must continue to exchange knowledge with the external environment, under the interaction between the internal units, increased negative entropy makes the increase of order degree higher than the increase of disorder, and this is the process of the formation of the ordered structure and produce new energy. Only when this exchange is in equilibrium, the continuous improvement of the knowledge structure and the increasing levels of management can be maintained, as to say the continue increase of Negative entropy value. Otherwise, the system will not be able to run, and the deployment of internal knowledge will have difficulty, the value of entropy will increase.

The mathematical expression of the knowledge entropy model:

$$K_i = \sum_{j=1}^{n} D_j K_j$$

j is the variety factors that affect the system of enterprise knowledge producing negative entropy, D_j is the weight of the factors of knowledge negative entropy that enterprises introduced, S_j is the negative entropy value of the factors.

$$K_j = D\sum_{j=1}^{n} P_j InP_j$$

Enterprise knowledge entropy equation of open system is:

$$K = K_i + K_e$$

K_i is the internal knowledge entropy, K_e is the knowledge entropy that enterprise exchange knowledge with the external.

Environmental knowledge is absorbed by the open state enterprises and dissipate in it, this time K_e<0. As long as the process, the entropy is still increasing, then $K_i > 0$. This time compared entropy and negative entropy, there still have two possibilities:

(1) if $|K_e| < K_i$, then $K = K_e + K_i > 0$

Show that the negative entropy absorbed by the open state enterprises is not enough to offset the entropy formed in the internal of the enterprises, the knowledge system has been aging and hinders the innovation and development of enterprises, the enterprises will be faced with bankruptcy.

(2) if $|K_e| > K_i$, then $K = K_e + K_i < 0$

This is the process of negative entropy, which makes open state enterprises change the disorder into order, or higher degree of order, orderly operation and prosperity. Therefore, enterprises can be completely open, self-transformation, and gradually exchange with environmental knowledge, overcome confusion in the interaction of the various elements of the internal, so that enterprises overall negative entropy promote the sustainable development of enterprises.

CONCLUSION

American scholar J. Rifkin and T. Howard thought that: the next historical period, the law of entropy will replace Newton's laws as the main norms and dominant. Philosophers, politicians, scientists, military strategists, economists, educators, as well as theologians will have pursuant to this rewrite the books, the result is bound to reveal the secrets and cooperate connections of the natural and social sciences, and generate new ideas leap, lead to the development and progress of human society. In fact, the application of entropy spread very quickly, and it has been expanded from the natural sciences to the social sciences. According to the principle of entropy, any enterprises will be accompanied by the gradual reduction of the effective knowledge and the gradually increased of entropy, it is necessary to continue to carry out knowledge creation and knowledge transfer, to promote sustainable and healthy development of enterprises through the increase of negative entropy.

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