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Research on Collaborative Knowledge Innovation Based on System Dynamics

Wang Xiuhong

Management Science and Engineering College,Zhengzhou Institute of Aeronautical Industry Management
Zhengzhou City,Henan Province,Chain

Abstract

Constructing the rational knowledge network is an effective means of cooperative innovation organization. But collaborative innovation organization system is relatively complicated, and knowledge itself is latent and unexpected, knowledge network is not comprehensive and accurate. This paper analyzes deeply knowledge network of organization cooperative innovation, and builds a system dynamics model about knowledge network of collaborative innovation by using the system dynamics model and function of simulation of special drawing. Accorfing to the abovr medel, we can clearly conclude the key factor in the system, and quantitatively reveal the knowledge sharing which is the most important collaborative innovation rule in knowledge organization network .

Keywords:*Knowledge Innovation, System Dynamics, knowledge network; Collaborative organization*

1. Introduction

Nowadays, along with the further shown of socialized production, no matter being in a group or outside , development is limited to the division of labor, and it is not perfect as the consciousness of a whole concept. Therefore, we need analysis the coordination organization model from the whole system. The author put the knowledge network which comes from organization coordination as a basis, and base on system dynamics model to simulate organization cooperative innovation with the result that highlight the importance of knowledge sharing. knowledge network is the sublimation of the previous knowledge management, knowledge management is the knowledge process management,such as the knowledge creation, the acquisition, storage, and sharing, which is a complicated process. Knowledge management owns the goal of the improvement of the organization's performance and the ability of organizational knowledge innovation.

Knowledge network is the new stage of knowledge management development, and the knowledge network is the relation based on knowledge of the entity which shares a common attention, and at the same time embedded in the working environment on the dynamic relation between create and share of the collective and systematic knowledge assets .We can say, the knowledge network consider more comprehensively perfect than knowledge management,because the knowledge network not only analysis the knowledge but expounds the relationship between knowledge related .

2.The structure of knowledge network of collaborative innovation organization

Knowledge network of collaborative innovation is the typical knowledge network of human-constructing under management discipline which is composed of the relationship between knowledge and knowledge subjects. This paper argues that the collaborative knowledge network is not only a static network but a dynamic cooperation process. Also it is not a layer of constant cooperation organization of the static model, but in a moment of transition state update, and not the fixed core of leadership, in a constant update and restruction. Therefore, this paper puts forward a new model of cooperative organization-decentralization organization coordinated.The structure of collaborative innovation organization knowledge network is shown in Fig 1.

Decentralization organization coordinated is diversification of professional knowledge , the unity of values.And it is a kind of inevitable trend of the more specific division of the future socialization , as well as the requirement for. more specialization and avoiding risk . This new model has solved the shortcomings of affecting the organization coordination because of the complexed management and embodies the efficient and fast required by thecooperative organization. At the same time, this weakness of the model needs to be effectively distributed in the incentive policy, takimg performance wage laws so that avoid management deficiencies.

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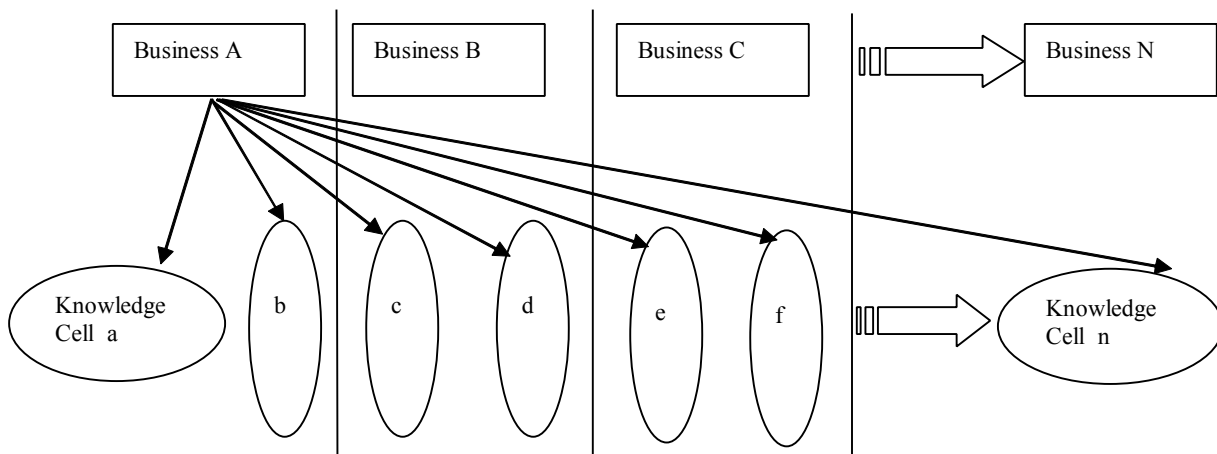ISSN (Online): 1694-0814
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Fig.1 Network structure of collaborative knowledge innovation

Concrete model has not a established core leaders, each knowledge unit does his duty,and in a large group, each knowledge unit, the carrier is research institute or a certain knowledge of scholars which controlled by different units , that is to say，the administration is in a different subordinate relationship, but it can provide the knowledge is sharing of, and unified relegated to a whole, and as long as in need, ripping related units, so that it is more clear and convenient to use the knowledge. The concrete implementation ways of the model to take online office, organizing OA system and so on, so that Sharing knowledge resources, facilitating the communication and organization of cooperative innovation.

Collaborative innovation organization includes organizational inteior or business transactions of knowledge innovation between organization, its cooperative basis is relevant knowledge、 information sharing, is the deep knowledge collaboration and innovation.In the organization of collaborative innovation, knowledge network is a unique perspective of knowledge sharing between the internal organization and organizations . As knowledge network, we have two kinds of understanding: one is associated with knowledge itself, constructing the network; the other is a social network analysis which formated by knowledge owners. This essay carries on the research by taking the first kind of understanding.

In the knowledge network,because the knowledge is latent and this decides the complexity is relatively the highest in the exchanges .So, I would put the transfer rate in the knowledge as a standard, quantization

accurately, then determines the main influenceful factors.

3. The system dynamics model

System dynamics model is a simulation method of analysising and researching on the dynamic behavior of the complex feedback System, which is a branch of System science, also a horizontal discipline which communicates natural science and social science.
The general steps of establishing the system dynamics model are: clarifying problems , drawing Cause and Effect diagram, rendering flow chart of system dynamics model, establishing a system dynamics model, simulating experiments, inspecting or modifying the parameters for the model, a strategic analysis and decision.

Basic assumptions ：
H_1: organization collaborative innovation is a continuous and gradual process .
H_2: the development and the decision-making of organization owns stability and continuity .
H_3: organization innovation expresses through collaborative knowledge innovation.

The determination of the boundaries of the system: internal factor is decisive and basic factor, while the external factor plays a supplementary role from the nature of the system dynamics. This paper mainly researches on organization collaborative innovation knowledge network, so the systematic boundary lies in the process of coordinating innovation organization, putting involved knowledge network organizations as a border. The system includes: knowledge sharing,
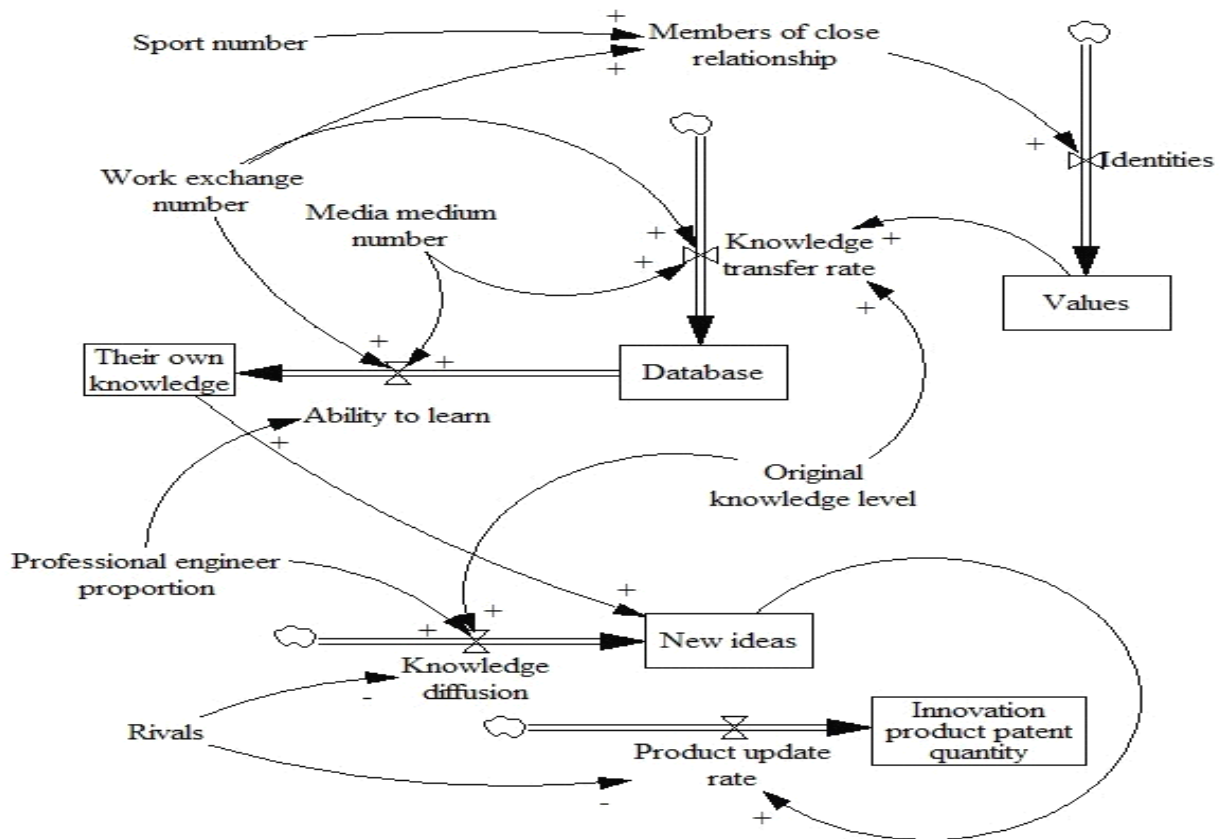
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Fig.2 Network structure of collaborative knowledge innovation

subsystem, transfering subsystem, absorbing subsystem, innovation subsystem.This mode of this paper is "knowledge sharing-transfering-absorbing-knowledge innovation," compared with the traditional mode, a sharing, transfering process are added. According to the difference between the two models,this causality of the system performance is the "knowledge sharing-knowledge transfering - knowledge absorbing - knowledge innovation",we can set up the comprehensive system dynamic model of knowledge network of coordination organization innovation. By analysising, knowledge sharing subsystem is for the contrasting between organization model and the existing cooperative innovation model; the subsystem of knowledge transfering and knowledge absorbing is consistent factors in the organization innovation, from which we can ascertain the key path of knowledge network, but the system shoud not be considered as the contrast between the former and the latter; Knowledge innovation subsystem is mainly aimed at the knowledge analysis of the knowledge network, and it is essential factors, making the problem have a more comprehensive analysis.

4. Simulation analysis

Through the above model, making us clearly understand the structure of knowledge network model of collaborative innovation organization. According to the above flow chart, let us have a simulate and analyze.

4.1 Variable selection

(1) state variable. state variable is the state variables which can accumulate input variable or output variable or both, and it changes as time. In this paper, the choice of four state variables are: values, database, their own knowledge and new ideas. State variable equation.

$$Values(t) = Values(t-1) + indentities \times \Delta t$$
$$Database(t) = Database(t-1) + Knowledge\ transfering\ rate \times \Delta t$$
$$Own\ knowledge(t) = Own\ knowledge(t-1) + Learning\ ability \times \Delta t$$
$$New\ ideas(t) = New\ ideas(t-1) + Knowledge\ diffusion\ rate \times \Delta t$$

(2)rate variable. rate variables is the variable which representes input and output variables in the state

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variable equation. In this paper including the identity, the knowledge transfering rate, learning ability, knowledge diffusion. State variable equation can be expressed by the product of state variable and the annual growth rate, such as:

$$\Delta Values = Values \times indentities$$

(3)auxiliary variables. In addition to state variables and rate variables all are auxiliary variables. The secondary variables of this paper includes the recreational activity, work exchange frequency, media medium, the proportion of professional engineers, competitor.

$$Database = Values \times Knowledge \; transfering \; rate$$
$$Own \; knowledge = Database \times learning \; ability$$
$$New \; thought = Own \; knowledge \times knowledge \; diffusion$$

4.2 Establishing model

knowledge network model of cooperative innovation organization put 2012 as the initial year.The simulation time is 2012-2017. The goal of model is mainly simulating the dynamic changes of knowledge sharing, transfering, absorption, the innovation in different modes so as to reflect the advantages of cooperative innovation organization.

4.3 Scheme design

This paper chooses two modes, namely the existing model and innovation mode, the superiority of the innovation mode can be shown through the comparison of the two models. The existing model does not considere the knowledge shareing .In this mode, defineing the coefficient of the members as 0.5, utilization of Media medium as 100%; proportion coefficient of Professional engineer as 0.01, namely every 100 employees have a professional engineer; Rival coefficient is 1. Innovation mode is model of considering shareing knowledge. In this mode, defineing the coefficient of the members as 1; utilization of Media medium as 100%; proportion coefficient of Professional engineer as 0.01, namely every 100 employees have a professional engineer; Rival coefficient is 1. Coefficient of existing model and innovation mode are shown as table 1 and 2.

Table 1: Coefficient of existing model

State variable	Frequency recreational	Activity work exchange	Medium several times media	Prior knowledge level	Competition
Values	0.25	0.2	0.3	0.5	-0.3
Database	0.25	0.2	0.3	0.5	-0.3
Own knowledge	0.25	0.2	0.3	0.5	-0.3
New thought	0.25	0.2	0.3	0.5	-0.3
Innovation product	0.25	0.2	0.3	0.5	-0.3

Table 2: Coefficient of innovation model

Auxiliary variables Rate variables	Frequency recreational	Activity work exchange	Medium several times media	Prior knowledge level	Competition
Identities	3	3	3	1	-3
Knowledge transfer rate	3	3	3	1	-3
Learning ability	3	3	3	1	-3
Knowledge diffusion	3	3	3	1	-3
Product update rate	3	3	3	1	-3

4.4 Model analysis

This paper only considered the knowledge sharing about knowledge innovation change, so at the two kind of mode, after the knowledge transfer the change trend is same, so, here we only describe the change tendency of the knowledge sharing and the knowledge transferring. Through the Vensim software , at different modes, simulation trend chart of relative amount of innovative products patent is as follows Fig. 3.

According to the theory of system dynamics entropy-increasing , the human brain system will head into disorder, and lead to chaos if not interacts with energy and information of the outside world or not to introduce and output energy and the information.

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Therefore, only by timely sharing and application for knowledge can we improve the understanding, increase the utilization rate of knowledge.

According to the predecessors' experience, the writer tries to sum up relationship between knowledge management, this type shows the relationship of people, information and sharing

$$K = (P + I_1) \times S \qquad (1)$$

$$I_2 = K \times S \qquad (2)$$

In this formula, K = Knowledge , P = People, I_1 = Information, and S = Share (Share), I_2 = Innovation. This shows, under the common values function, only the reasonable share can make knowledge network got the maximum development, and make the organization innovation multiplied the effect of collaborative purpose.
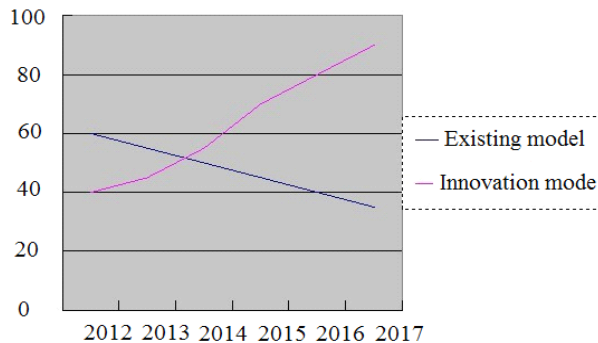

Fig.3 Simulation trend chart

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Wang Xiuhong she was born in Chen De of he bei province on April ,twenty-ninth 1974. She received her Bachelor and Master from Hua zhong Agriculture University.She has been working in the Zhengzhou Institute of Aeronautical Industry Management since leaving school. Now she is an associate professor and head of the department of industry engineering. She takes an interest in the studies of knowledge management, quality engineering and industry engineering and with 4 works and more than 30 academic theses being published.