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Research Article

Agent-Based Supernetworks Model of University Knowledge System

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A novel supernetworks framework of knowledge system based on complex networks is proposed for presenting the multidimensional, multilevel, dynamic complexity characteristics and initiative, adaptability, and purposefulness of knowledge mainbody in the university. This model differs from the existing knowledge diffusion method. In order to make good use of abundant information of the mainbody and improve the performance of knowledge diffusion, agent-based model and supernetworks method are adopted to exploit the complex correlation among the knowledge mainbody, knowledge carrier, and knowledge element. Firstly, the agent-based supernetworks model of knowledge diffusion was established by use of complex adaptive system theory and supernetworks analysis method. Secondly, the multilevel structure definition of supernetworks and knowledge networks of mainbody, element, and carrier in the knowledge system were described in detail. Thirdly, for verifying the validity of the model, a local search operator was designed, which can improve the effectiveness and efficiency of knowledge diffusion. Experimental studies based on synthetic datasets show that the proposed method can exhibit good performance, especially providing theoretical and practical guidance for establishing harmonious relationship between students and teachers.

1. Introduction

At present, knowledge plays a crucial role in all walks of life, so knowledge management has already become the latest trend of the economic growth and becomes an important part of the economy life. For all the knowledge activities, there are the three most important factors, knowledge innovation, knowledge transfer, and utilization, to affect the economy development. Because colleges and universities are the main platform of knowledge and theoretical innovation center and have intensive intellectual resources and strong innovation ability, knowledge diffusion and exchange activities must have the support of all levels in an organization. With the rapid development of society and economy, colleges and universities play other important roles, such as the centers for knowledge innovation, the incubator of knowledge corporations, and the intellectual support of high and new technology, which make functions of colleges and universities more extensive and have brought greater demands for knowledge management. How to make university knowledge organization systems serve society and economy better is the key problem that should be solved in the current emergency.

Knowledge system consists of all kinds of knowledge elements and their relations, which is open, nonlinear, and far from equilibrium system. According to the system engineering theory, the elements and relationships of knowledge system could be abstracted into nodes and edges, so we can build the network model for all levels of knowledge to further analyze the internal mechanism from network perspective. Knowledge networks, as a concept created and promoted by contemporary economists from Sweden in 1955, refer to the institutions and activities involving the production and distribution of scientific knowledge [1].

With the rapid development of complex network theory and application cases in different fields, complex network provides a new perspective and methods for analyzing the knowledge networks, especially, as the WS small-world networks model [2] and the BA scale-free networks model [3] proposed; the study on knowledge network is achieving a climax at home and abroad. Cowan [4–8] has finally arrived at conclusion that the structure of small-world networks is the best for knowledge diffusion between individuals by examining the influence of networks structure such as regular networks, random networks, and small-world networks. By introducing average knowledge stocks and knowledge variance, Kim and Park [9] modeled knowledge diffusion based on social networks analysis and investigated the impact of networks structure on the performance of knowledge diffusion; the last results show that the small-world networks are the most efficient and equitable structure for knowledge diffusion. Chu [10] built the new model on dynamics of behavior of knowledge communication based on complex networks by perfecting the behavior rules (pull and push) in Cowan models. Morone and Taylor utilize the rules to simulate the knowledge propagation in a general face-to-face network [11]. Jianxun constructed a knowledge propagation dynamics model to systematically discuss the dynamic evolutionary problem of knowledge propagation based on complex networks [12]. Li and Sun thought that within a group the increase of the knowledge of individual relied on the efforts of individuals and the knowledge spillover effect brought by the nearest individuals in the neighborhood [13]. By applying the complex networks theory and organization, Wanly and Hu made final conclusions that knowledge propagation was closely related to the spreading speed of knowledge in organization, the success probability, and the attitudes of knowledge owners [14, 15].

Exhibiting the dynamic evolution of scientific knowledge, the knowledge network has been studied extensively as a complex networks system. Homogenous network model was used to build up knowledge network for the transfer of knowledge, which could not really reflect the complex dynamics of knowledge generation and dissemination in the social networks. Aiming at meeting the actual situation of knowledge system which consists of knowledge elements, knowledge mainbody, and knowledge carriers, the supernetworks concept was introduced to establish the knowledge network model. Nagurney and Dong [16] define the supernetworks as networks of networks. The prevalence of supernetworks in the world is illustrated by multimodal transportation networks, complex logistical networks, electric power generation and distribution networks, multitier financial networks, and software technology social networks. Supernetworks theory brings together optimization theory, networks theory, game theory, multicriteria decision-making, and dynamic system theory. The supernetworks were utilized to depict how flows and prices evolve on two, three, or more networks that are integrated as a system and how the flows on the different networks interact. Many applications of supernetworks have been identified such as Nagurney [17], Nagurney and Dong [16], Nagurney et al. [18], and Nagurney and Toyasaki [19], especially the application of knowledge supernetworks [20]. Based on the characteristics of knowledge intensive and organization management theory, the knowledge supernetworks model was built to demonstrate the power of the supernetworks framework in abstracting decision-making and allowing for multicriteria decision-making as well as the determination of the optimal production of the knowledge products through the optimal allocation of resources in the paper [21].

With intensive intellectual resources and strong innovation ability, universities are china's main force for knowledge innovation, communication, and innovative personnel training. Because of the social features in the process of economic development, universities are abstracted into the adaptive, self-organization evolutionary complex systems. For knowledge system, there are many factors that influence knowledge diffusion, including knowledge element networks structure, knowledge carrier networks topology, and the characteristics of knowledge mainbody, such as the age, personality, literacy, interest in learning, and active thinking, which directly determine the topology structure of knowledge networks and the behaviors of mainbody for transmitting and absorbing knowledge.

Exploring and mining the inner mechanism and dynamics of knowledge networks, it will be better for us to master the dynamic characteristics of student's knowledge structure, improve the most effective ways of collecting, putting in order, preserving, and disseminating knowledge, reach rapid uniform distribution of knowledge networks, inspire teachers and students with innovating knowledge, and build harmonious networks environment of knowledge dissemination.

In this paper, we present a novel supernetworks framework of knowledge system based on complex networks, to detect heterogeneity of the nodes (knowledge element, knowledge mainbody, and knowledge carrier) and the complexity of internal structure and interactions among them in the university knowledge organization systems. The knowledge supernetworks model was built based on the multiagent system theory and complex networks method, which incorporates three subnetworks and various related elements into one structure and view the problem in a systematic way, namely, knowledge mainbody networks, which are composed of knowledge receptors, knowledge disseminators, and interaction between them; knowledge element networks, which are composed of knowledge elements and the interconnections among them; and knowledge carrier networks, which are composed of the carriers of knowledge, and the interaction among them.

This paper proceeds as follows. Section 2 defines the knowledge networks by exploring the characteristics of university knowledge system; Section 3 establishes the knowledge supernetworks model; Section 4 makes a simulation experiment and analyzes the result. Based on it, this part draws a conclusion.

2. Knowledge System Definition

Knowledge elements, knowledge mainbody, and knowledge carrier are the knowledge resources of the university organization management, which display more and more the characters of complex nonlinear system along with environment changes; that is to say, the university knowledge management is essentially a complex adaptive system of knowledge dissemination. Because of knowledge elements, knowledge mainbody and knowledge carrier are being complex

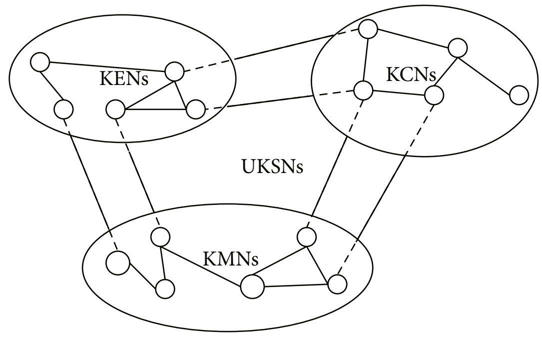

Figure 1: Sketch of university knowledge supernetworks system for knowledge diffusion.

interactions among related elements, and therefore we can describe the relationships by networks model, in particular, for effectively describing the nodes with different nature properties and the links with different topology networks, and that the university knowledge supernetworks (UKSNs) model was built to embody the complex networks system with multilevel, multitiered, multidimensional, multicriteria, and multiattribute (Figure 1).

Definition 1. Knowledge element networks (KENs) are defined as a two-tuple $G_k = (V_k, E_{k-k})$, where $V_k = \{ke_1, ke_2, ke_3, \ldots, ke_n\}$ is the set of the nodes for knowledge elements and the n represents the node numbers in the knowledge element networks. $E_{k-k} = \{e_1, e_2, e_3, \ldots, e_m\}$ is the set of the edges in the knowledge element networks, and the m represents the number of edges in the knowledge element networks, where $e_k = r_{ij} = (ke_i, ke_j)$; if there is the same knowledge core between ke_i and ke_j, then $r_{ij} = 1$; otherwise, $r_{ij} = 0$.

Definition 2. Knowledge mainbody networks (KMNs) are defined as a two-tuple $G_p = (V_p, E_p)$ as follows. $V_p = \{p_1, p_2, p_3, \ldots, p_n\}$ is the set of mainbody in the knowledge mainbody networks and n represents the number of persons. $E_{p-p} = \{(p_i, p_j) \mid i, j = 1, 2, 3, \ldots, m\}$ is the set of edges in the knowledge mainbody networks and (p_i, p_j) represents similar research, or knowledge communication and cooperation between the mainbody p_i and the mainbody p_j.

Definition 3. Knowledge carrier networks (KMNs) are defined as a two-tuple $G_m = (V_m, E_m)$, where $V_m = \{m_1, m_2, m_3, \ldots, m_n\}$ is the set of knowledge carriers in the knowledge carrier networks and n represents the number of knowledge carriers. $E_{m-m} = \{(p_i, p_j) \mid i, j = 1, 2, 3, \ldots, m\}$ is the set of edges in the knowledge carrier networks and (p_i, p_j) represents the interaction between the carrier p_i and the carrier p_j.

Definition 4. Knowledge supernetworks system is defined as a six-tuple $UKSNs = (G_p, G_k, G_m, E_{p-m}, E_{p-k}, E_{m-k})$ as follows. G_p is the knowledge mainbody networks. G_k is the knowledge element networks. G_m is the knowledge carrier networks. E_{p-m} is the mapping from the knowledge mainbody networks G_p to the knowledge carrier networks G_m; namely, $E_{p-m} = M(p) \cup P(m)$, where $M(p_i) = \{m_j \mid m_j \in V_m, \theta(p_i, m_j) = 1\}$ as follows.

① $M(p_i)$ stands for the set of mainbody p_i owning the knowledge carriers.

② $\theta(p_i, m_j) = 1$ means the mainbody p_i owning the knowledge carrier m_j, $j = 1, 2, 3, \ldots, n$, and n is the number of knowledge carriers.

Consider $P(m_i) = \{p_j \mid p_j \in V_p, \phi(m_i, p_j) = 1\}$ as follows.

① $P(m_i)$ is the set of knowledge mainbody p_j owning the knowledge carriers.

② $\phi(m_i, p_j) = 1$ means knowledge mainbody p_j owning knowledge carrier m_i, $j = 1, 2, 3, \ldots, n$, and n is the number of knowledge mainbody owning knowledge carrier m_i.

E_{p-k} is the mapping from the knowledge mainbody G_p to the knowledge element networks G_k; namely, $E_{p-k} = K(p) \cup P(ke)$, where $K(p_i) = \{ke_j \mid ke_j \in V_k, \varphi(p_i, ke_j) = 1\}$ as follows.

① $K(p_i)$ represents the set of knowledge mainbody p_i owning the knowledge elements.

② $\varphi(p_i, m_j) = 1$ means the knowledge p_i owning the knowledge element ke_j, $j = 1, 2, 3, \ldots, n$, and n is the number of knowledge elements.

Consider $P(ke_i) = \{p_j \mid p_j \in V_p, \psi(ke_i, p_j) = 1\}$, where

① $P(ke_i)$ is the set of knowledge mainbody owning the knowledge elements;

② $\phi(ke_i, p_j) = 1$ means knowledge mainbody p_j owning the knowledge element ke_i, $j = 1, 2, 3, \ldots, n$, and n is the number of knowledge agents owning knowledge element ke_i.

E_{m-k} is the mapping from knowledge carrier networks G_m to knowledge element networks G_k; namely, $E_{m-k} = K(m) \cup M(ke)$, where $K(m_i) = \{ke_j \mid ke_j \in V_k, \sigma(m_i, ke_j) = 1\}$ as follows.

① $K(m_i)$ represents the set knowledge carrier m_i including the knowledge elements.

② $\sigma(m_i, ke_j) = 1$ means knowledge carrier m_i including knowledge elements ke_j, $j = 1, 2, 3, \ldots, n$, and n is the number of knowledge elements.

Consider $M(ke_i) = \{m_j \mid m_j \in V_m, \tau(ke_i, m_j) = 1\}$ as follows.

① $M(ke_i)$ stands for the set of the knowledge element ke_i owning the knowledge carrier.

② $\tau(ke_i, m_j) = 1$ means the knowledge element ke_i being included by the knowledge carrier m_j, $j = 1, 2, 3, \ldots, n$, and n is the number of knowledge carriers owning knowledge element ke_i.

Definition 5. Knowledge mainbody in knowledge supernetworks is defined as agent; namely, $Agent = (Mark, Cate, Loca, Pers)$, where $Mark$ is the identification of agent for distinguishing between agents. $Cate$ is the classification of agent in the knowledge supernetworks model and $Cate \in \{1, 0, -1\}$; $Cate = 1$ shows that agent is the knowledge disseminator (such as teacher), $Cate = 0$ represents that agent is the knowledge receptor (such as student), and $Cate = -1$ means that agent is the manager or other. $Loca$ is the cognitive abilities for agent perceiving situations. $Pers$ is the qualitative attributes of agent in the process of knowledge diffusion; that is, $P = (re\_s, know, ab\_\alpha, re\_\beta, \lambda, in\_\iota, at\_\psi)$ as follows.

re_s is the relationship strength of agent and its surrounding other agents.

$know$ is the knowledge levels of agent, and $know[k]$, $k = 1, 2, \ldots, n$,. means the amount of knowledge of agent owning the Nth kind of knowledge element.

ab_α is the absorption coefficient, while agent acts as the knowledge receptor; it means the ability of agent absorbing new knowledge.

re_β is the release coefficient, while agent acts as the knowledge disseminator; it means the ability of agent releasing their knowledge.

λ is the happiness index and represents the satisfaction of agent for the current environments.

in_ι is the innovation coefficient of agent in knowledge supernetworks.

at_ψ is the outdated coefficient of agent in knowledge supernetworks.

3. Knowledge Supernetworks Model

In university organization system, knowledge system mainly includes tacit knowledge and explicit knowledge. Explicit knowledge can be encoded by specific means and forms for learners to master, and tacit knowledge cannot be encoded and expressed by the fixed pattern, but it can certainly be mastered for learners through certain channels. Based on the characteristics of university knowledge system, in this paper, the two ways of knowledge diffusion were mainly considered, namely, interpersonal interactive mode (person-person) and person-carrier interactive mode (person-carrier-person).

(1) Interpersonal interactive mode means knowledge interaction between knowledge receptor and knowledge disseminator. In evolution process of university knowledge supernetworks system, the knowledge level of each node (agent) can affect the knowledge level of their neighbor nodes, and the knowledge level of each node was under the influence of the neighbor nodes.

In the time t, we randomly choose $Agent_i$ and assume that its knowledge level in field k is $know_i[k]$, and the knowledge level of his neighbor $Agent_j$ is $know_j[k]$; then $Agent_i$, as the knowledge disseminator, must satisfy the conditions as follows: ① $know_i[k](t) > know_j[k](t)$; ② $re\_s_{ij}(t) > 0$; ③ $0 < \lambda_i(t) \le 1$. When the knowledge system is evolving with the simulation time series, the knowledge level of $Agent_j$ will change in accordance with the following formula:

$$know_j[k](t+1) = know_j[k](t) + ab\_\alpha_j \times re\_\beta_i \times \left[know_i[k](t) - know_j[k](t)\right]. \quad (1)$$

Sometimes, the knowledge elements in the field k of the teachers, as the knowledge disseminator, are dynamic increasing with the following formula:

$$know_i[k](t+1) = know_i[k](t) \times \left(1 + in\_\iota_i\right). \quad (2)$$

Meanwhile, in knowledge system, the knowledge level of knowledge receptors and knowledge disseminators would outdate as follows:

$$know_i[k](t+1) = know_i[k](t) \times \left(1 - at\_\psi_i\right) \quad (3)$$

$$know_j[k](t+1) = know_j[k](t) \times \left(1 - at\_\psi_j\right). \quad (4)$$

(2) Person-carrier interactive mode means that the teachers, as the knowledge disseminators, enforce coding by knowledge carriers (such as documents, books) and the students, as the knowledge receptors, learn knowledge by knowledge carriers in the university knowledge supernetworks system. In the simulation time t, we randomly choose the teacher $Agent_i$ to carry out knowledge innovation in the field k, so the knowledge level of the teacher will change as formula (3). Based on the dominance of tacit knowledge, the new knowledge element was transferred in the knowledge supernetwork system, and the knowledge elements of the knowledge receptor $Agent_j$ will change as follows:

$$know_j[k](t+1) = know_j[k](t) + know_i[k](t) \times in\_\iota_i \times \sigma_i \times ab\_\alpha_j. \quad (5)$$

σ_i is the dominance rate of tacit knowledge for $Agent_i$.

In the knowledge supernetworks system, the amount of knowledge stock for $Agent_i$ in the field k at the simulation time t is

$$know_i(t) = \sum_{k=1}^{n} know_i[k](t). \quad (6)$$

In the knowledge supernetworks system, the average knowledge stock for networks system at the simulation time t is

$$\overline{know}(t) = \frac{1}{N}\sum_{i=1}^{N} know_i(t). \quad (7)$$

In knowledge supernetworks system, the variance of knowledge stock for networks system at the simulation time t is defined as follows:

$$\sigma(t) = \frac{1}{N}\left[\sum_{i=1}^{N} know_i^2(t) - N\overline{know}^2(t)\right]. \quad (8)$$

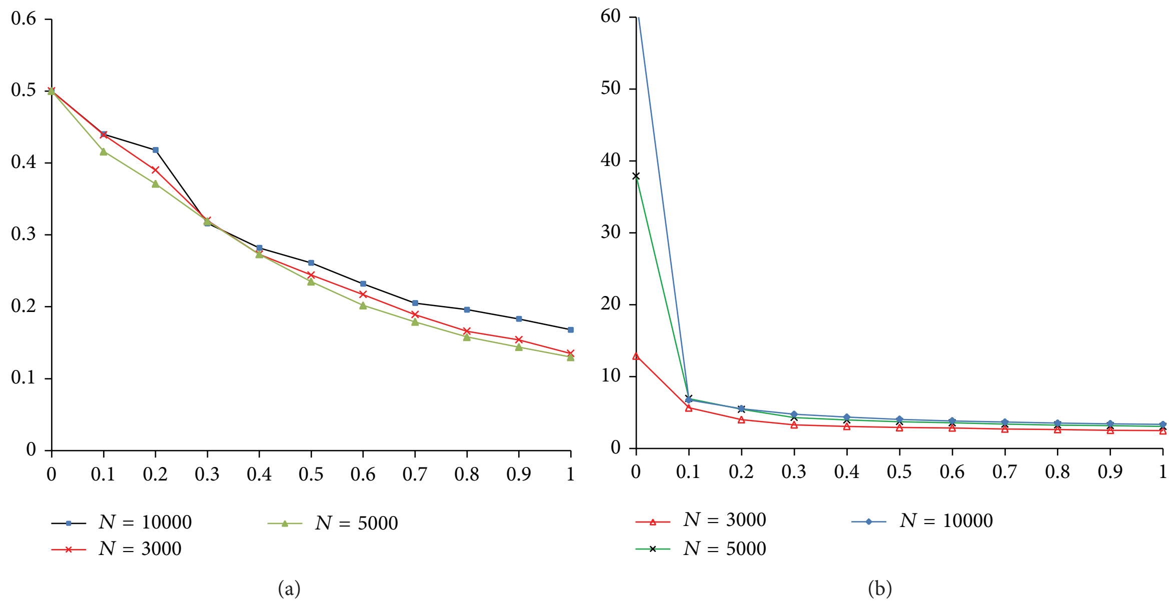

Figure 2: Comparison of the CC and APL in different sizes of university knowledge supernetworks system.

4. Simulation and Results

Based on the natural division of complex objective systems on certain level, agent-based modeling can establish the corresponding agent model, which describes the complexity of knowledge diffusion networks and the dynamics of the interactions among agents by multiagent interactions. In the university knowledge supernetworks system, in order to fully demonstrate the properties of intelligence, adaptability, intentionality, learning, and interactive collaboration, the networks model was designed and modeled by multiagent simulation platform software Netlogo. In particular, for the sake of analyzing the influence of network topology on networks sizes, we run the model of university knowledge supernetworks system in different networks sizes (the different number of nodes), as shown in Figure 2 for the comparison of clustering coefficient and average path length of knowledge supernetworks model in different networks sizes with different rewiring probability. The horizontal axis in Figure 2(a) is rewiring probability p and the vertical axis in Figure 2(a) is clustering coefficient (CC). The horizontal axis in Figure 2(b) is rewiring probability p and the vertical axis in Figure 2(b) is average path length (APL). From the comparison graph (Figures 2(a) and 2(b)), we can see that there are not obvious correlations between networks size and networks statistical properties for the generation algorithm of knowledge supernetworks system model in the same rewiring probability p, so that the simulation of university knowledge supernetworks system model will be analyzed in the same networks size ($N = 5000$) with the complex networks theory and methods.

(1) The Influence of Knowledge Transition Pattern on Knowledge Diffusion. For fully exploring the influence of the knowledge transition pattern on knowledge diffusion efficiency in the university knowledge supernetworks system, we run the system model in different modes of knowledge diffusion, such as interpersonal interactive mode (p-p), person-carrier interactive mode (p-c-p), and mixed mode (mixed), as shown in Figures 3 and 4.

The horizontal axis in Figure 3(a) is the simulation time ($*1000$) and the vertical axis in Figure 3(a) is average knowledge stock (AKS) in university knowledge supernetworks system. The horizontal axis in Figure 3(b) is the time series ($*1000$) and the vertical axis in Figure 3(b) is average knowledge stock (AKS) in knowledge mainbody networks of university knowledge supernetworks system. The results, shown in Figure 3(b), indicate that there are the significant differences in knowledge diffusion efficiency based on different knowledge transition pattern in the university knowledge supernetworks. Knowledge stock is static and represents knowledge repertory level of a system at a time point and reflects status of producing knowledge and innovative potential of a system. For the interpersonal interactive mode (p-p), knowledge is directly communicated between knowledge disseminators and knowledge receptors, so knowledge transfer path is the shortest and knowledge diffusion is the highest effective. For the person-carrier interactive mode (p-c-p), firstly, knowledge is transferred from knowledge disseminators to knowledge carriers by means of knowledge externalizing and encoding; then knowledge receptors acquire the useful knowledge from the knowledge carriers. Because of the indirect way in knowledge diffusion from knowledge disseminators to knowledge receptors, the knowledge transfer path gets longer and the knowledge diffusion gets significantly slow and ineffective with the time. The mixed mode (mixed), which integrated the interpersonal interactive mode (p-p) and the person-carrier mode (p-c-p) based on the specified proportion (in the university

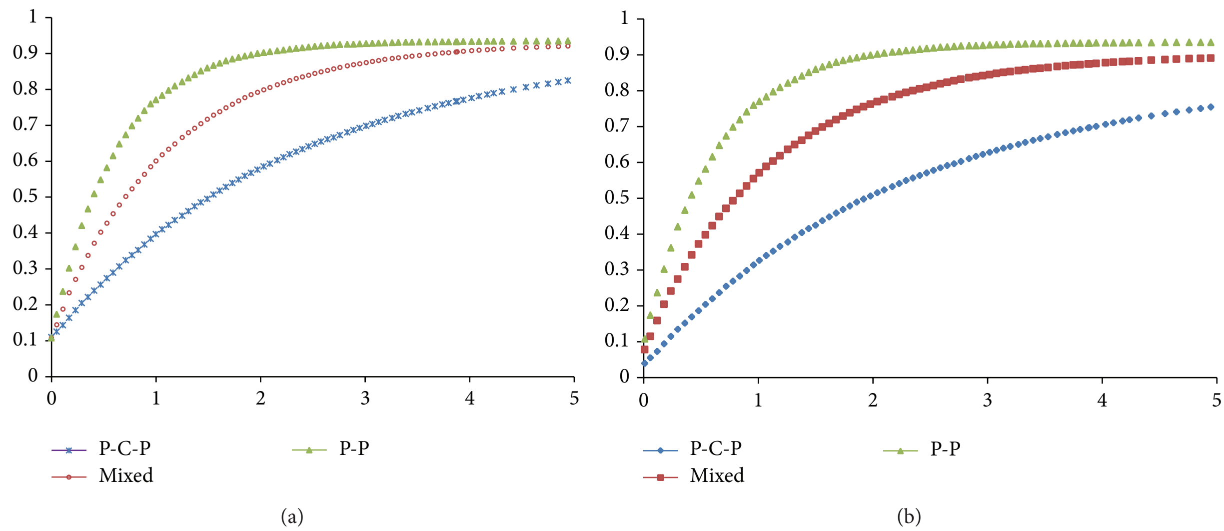

FIGURE 3: The influence of knowledge transfer pattern on AKS in university knowledge supernetworks.

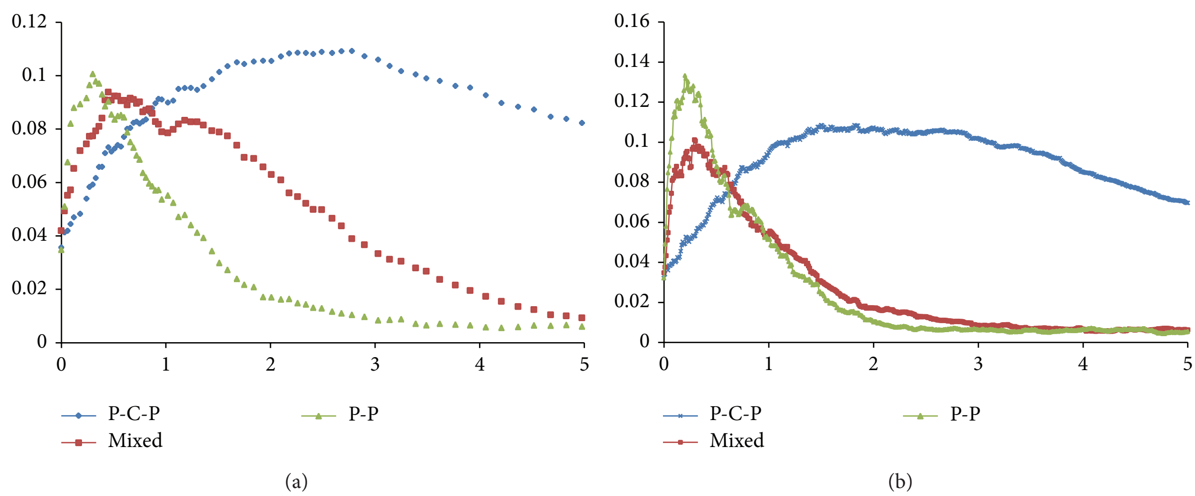

FIGURE 4: The influence of knowledge transfer mode on VKS in knowledge supernetworks system and knowledge mainbody networks.

knowledge supernetworks model, both of all is 50%), embodies the good compromise for knowledge diffusion between interpersonal interactive mode and person-carrier interactive mode. The results, shown in the Figure 3(a), indicate the changed trends of average knowledge elements stock for the different knowledge diffusion patterns with time series. The major difference between Figures 3(a) and 3(b) is the initial knowledge stock in the externalizing process of innovation knowledge.

The horizontal axis in Figure 4(a) is the simulation time (∗1000) and the vertical axis in Figure 4(a) is variance of knowledge stock (VKS) in university knowledge supernetworks system. The horizontal axis in Figure 4(b) is the time series (∗1000) and the vertical axis in Figure 4(b) is variance of knowledge stock (VKS) in knowledge mainbody networks of university knowledge supernetworks system. As can be seen from Figures 4(a) and 4(b), we can find that when the time is lesser than 300, the variance of knowledge stock in knowledge supernetworks and knowledge mainbody networks has a sudden increase, and the rate of change for different mode reaches 50%, 60%, and 70%. When the time continues to increase, the variance of knowledge in knowledge supernetworks and knowledge mainbody networks will go down in the modes of p-p and mixed, but the variance of knowledge stock in knowledge supernetworks and knowledge mainbody networks will continue to increase for a long time in the mode of p-c-p. The internal factors, which caused the various variance of knowledge stock in different knowledge diffusion patterns, are the heterogeneity of network nodes. In particular, the network nodes include not only the nodes which represent knowledge disseminators and knowledge receptors in the knowledge mainbody networks but also the nodes which represent knowledge elements and carriers in the knowledge element networks and knowledge carrier networks, meanwhile the results demonstrate that the heterogeneity of networks topology exercises a great

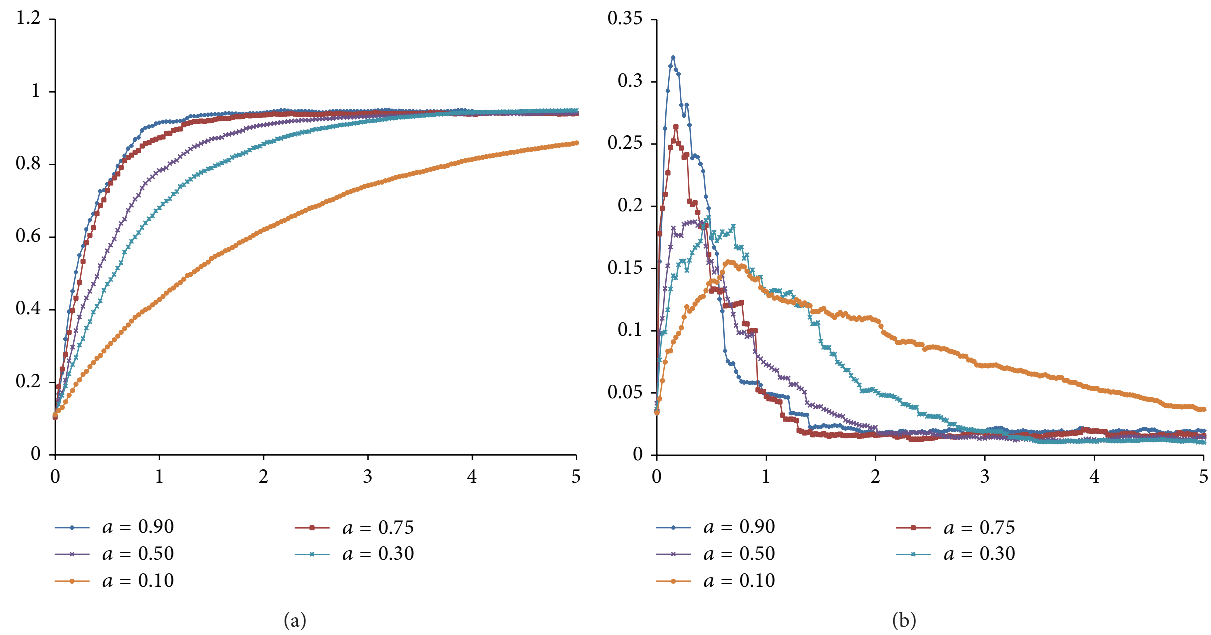

Figure 5: The influence of individual idiosyncrasy on efficiency of knowledge diffusion ((a) represents the knowledge absorption coefficient of knowledge receptors).

influence on knowledge diffusion. Because of higher demand in the process of knowledge diffusion, it is certainly far-from-equilibrium for knowledge diffusion in knowledge mainbody networks. In interpersonal interactive mode, the conditions and the circumstances are relatively easy for transferring knowledge, and it provides an easy and efficient way to communicate knowledge between knowledge disseminators and receptors. So, there is the rapid growth of knowledge stock in the knowledge supernetworks system. The trend of variance of knowledge stock rises in the early stages, and then gradually smoothes, which means the intense shock of the variance of knowledge stock in a short time period; then the variance of knowledge stock will gradually slow decline with simulation times. Because of introducing the mechanisms of knowledge innovation and knowledge elimination in the knowledge supernetworks model, the knowledge stock of system will achieve a relatively stable status in the end.

(2) The Influence of Individual Idiosyncrasy on Efficiency of Knowledge Diffusion. The process of knowledge diffusion is influenced by learning capacity of knowledge receptors, reputation of knowledge disseminator, conditions of communication between members, and so forth. The university supernetworks system, which is composed of the knowledge element networks, knowledge carrier networks, and knowledge mainbody networks, possesses the probabilities of knowledge learning, knowledge innovation, knowledge communication, and knowledge spreading. The knowledge receptors and the knowledge disseminators, which form the agents of the knowledge mainbody networks, individual idiosyncrasy, such as physical condition, personal emotion, and external environments, will have a big impact on the knowledge digestive and absorptive capacity of knowledge receptors and the knowledge release capacity of knowledge disseminators in the process of knowledge diffusion.

The horizontal axis in Figure 5(a) is the time series ($*1000$) and the vertical axis in Figure 5(a) is variance of knowledge stock (VKS) in university knowledge supernetworks system. The horizontal axis in Figure 5(b) is the time series ($*1000$) and the vertical axis in Figure 5(b) is variance of knowledge stock (VKS) in knowledge mainbody networks of university knowledge supernetworks system. Based on the different knowledge absorption coefficient a of knowledge receptors, Figure 5 shows the knowledge evolution process in the special external environments. The results, shown in Figure 5, indicate that the ability to accept knowledge (knowledge absorption coefficient) for knowledge receptors directly affects the knowledge stock, the growth speed, and efficiency of knowledge mainbody. While the knowledge absorption coefficient a is less than 0.5 in the knowledge supernetworks model, the evolution process of knowledge diffusion was considered to be slow, even lumbering, which means knowledge diffusion was inefficient, and the overall vibration of knowledge system was in balance; the system knowledge increment maintained a constant rate of vibration for the rest of simulation time. So, it is very difficult to create new balanced knowledge distribution and harmonious dynamic environments in the knowledge supernetworks system. On the contrary, while the knowledge absorption coefficient is more than 0.5 in the knowledge supernetworks model, the evolution process of knowledge diffusion has rapid progress, which means knowledge diffusion was more efficient. Owing to the knowledge stock of knowledge mainbody (knowledge receptors) increasing rapidly, the knowledge distribution is imbalanced in the early stage; then, it was fast reaching a new equilibrium; the system knowledge increment maintained a constant rate of vibration for the remainder time.

5. Conclusions

According to multidimensions, distribution, and dynamics of the university knowledge system and initiative, adaptability, and purposefulness of knowledge mainbody (agent) in knowledge diffusion, in this paper, the knowledge supernetworks model of the university knowledge diffusion was established by complex adaptive system theory and supernetworks analysis method, and further the multilevel structure of supernetworks was defined and analyzed in detail. The university knowledge supernetworks system was formed by knowledge element networks, knowledge mainbody networks, and knowledge carrier networks. After the knowledge supernetworks model based on Netlogo platform was run for time after time, the author put forward the feasibility scheme that could meet the teaching and administration of actual circumstance. The results of simulation in Netlogo indicate that the process of knowledge diffusion between knowledge receptors and knowledge disseminators is dynamic complex interactive process. We find that the simulation results match the real law of knowledge diffusion in the university, which verify this paper's analysis on the factors influencing the knowledge diffusion of knowledge mainbody. It shows that the individual idiosyncrasy in the knowledge mainbody networks is an important factor for us to construct the harmonious environment of knowledge diffusion. Future research will aim at improving efficiency and applying proposed knowledge supernetworks model to process real-life university knowledge networks.

Conflict of Interests

The author declares no conflict of interests. The author has no financial or personal relationships with other people or organizations that can inappropriately influence the work.

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