Study on Sticky Information in Research Cooperation on SD Model

Zhao Xianglian[1,a*],Zhu Wenqing[2,b*],Wu Hao[3,c*]

[1,2,3] Economics and Management College, Nanjing University of Nanjing University of Aeronautics and Astronautics , 210016 Nanjing, China

[1,2,3]annie1144@163.com

Key words: system dynamics model; research alliance; sticky information; information management

Abstract: The research alliance is an emerging technology innovation model, it will contributes to reduce its internal information stickiness play value and improve the efficiency of the research alliance. The paper analyses research alliance operation mode, summed up the research alliance within the research alliance of viscous factors and to promote its operation and development of power source, combining the basic theory and methods of system dynamics model was established through the system's analog and simulation of the related proposals. The results show that sticky information peripheral variation presented in the research alliance, establish an incentive mechanism will help to reduce the sticky information.

Introduction

As an emerging technology innovation model, the research alliance takes an important strategic position in the process of economic development, which has been affirmed by the developed countries since the 1990s. With the rapidly development of information technology, the third technological revolution marked by information technology contributed to the development of university-industry cooperation, information transmission and feedback plays a more and more important role in the research alliance. Sticky Information is one of the factors hindering information transmission, related to the realization of information value function. For university-industry cooperation, it will do great contribution to improve its efficiency and promote its sustainable development if we can reduce its internal information viscosity.

Literature review

The idea of sticky information was firstly brought up by Von Hipple[1],who believes that every information needed in the technology problem solving process. This concept has been cited in the following research, Cohen and Levinthal [2] studied the cause of sticky information on the basis of the former, they put forward the idea that sticky information may be associated with the characteristics of information providers and searchers.

Domestic scholars point out that sticky information refers to information that "difficult to acquire, transfer and apply". Dong-qin Li [3] analyzed sticky information from the angle of developing new products, she believes that sticky information should be divided into two types, controllable and uncontrollable, and that developing user innovation toolkit is an effective way to solve sticky information problem. Zhao-guo Bi[4] focused on the importance of information sharing in university-industry cooperation, he brought out that build a functional framework of university-industry cooperation information platform can reduce sticky information.

In the study of sticky information, domestic and foreign scholars mostly research from the causes and the effectiveness of sticky information, rarely from the angle of university-industry cooperation, and most of them lack of quantitative research. This article took the perspective of system dynamics to analyze the cause of sticky information in the research alliance, and have quantitative research through the system modeling and simulation on causing factors of sticky information.

The basic hypothesis and conceptual model

Basic hypothesis

The influence factors of sticky information in university-industry cooperation are mainly two kinds: one is the alliance benefit in this cooperation, the other is the interest of each parties in the alliance. This paper puts forward three hypotheses.

Hypothesis 1: The internal sticky information has negative effect to the university-industry cooperation alliance overall interests.

In university-industry cooperation, the cooperation alliance hope that all parties can cooperate and communicate smoothly, in order to improve the overall strength of the alliance, to reach expected goals and take a dominant position in the competition with other cooperative alliance.

Hypothesis 2: The internal sticky information has positive effect to the university-industry cooperation alliance interests of each party.

In university-industry cooperation, each party can be instinctively resistance to information sharing based on their own interest, this kind of behavior increases the degree of sticky information. But with the gradually increasing of sticky quantity, the interest of the whole alliance will be affected. Therefore, no matter the research institutes, schools or enterprises would prefer that the sticky information in university-industry cooperation can be managed at a certain level.

Hypothesis 3: The information gap among university-industry cooperation parties has negative effects to the university-industry cooperation internal sticky information.

In university-industry cooperation, research institutions, schools and businesses are reluctant to fall at the end of the alliance.

Conceptual model

Based on the above assumptions, this article constructs the concept model of university-industry cooperation alliance internal sticky information according to the related influence factors, as shown in the figure below.

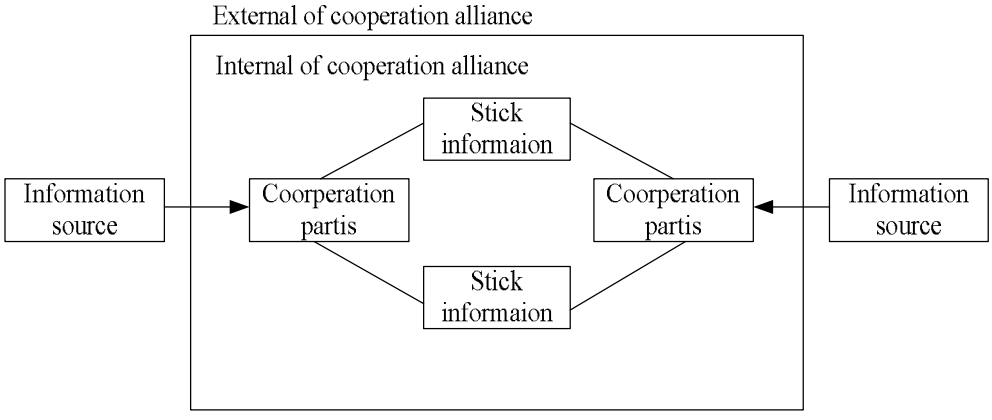


Fig. 1 University-industry cooperation alliance internal sticky information conceptual model

Figure 1 shows the formation cause and running state of sticky information inside the university-industry cooperation alliance. The overall interests of cooperative alliance are the main driving force for information to spread and exchange in all parties. For the sake of every party's own interest, they need to continually absorb new information through outside sources, improve their information amount, thereby giving impetus to the ascension of overall cooperation alliance information amount.

System dynamics model

Based on the conceptual model above, this paper uses system dynamics model to transform sticky information into quantitative model for analysis.

Causal relations in university-industry cooperation alliance internal sticky information system

This article determines the basic framework of the sticky information in the university-industry cooperation alliance system, through the analysis of the causal feedback relations. This paper can get the system's causal relationship diagram by running an integrity analysis through the system in figure 1, as shown in figure 2.

There are 5 feedback loops in figure 2, two negative feedback loops and three positive feedback loops. Among them, the negative feedback loops include:
(1) Participated party's information potential energy →participated party's information potential energy difference → new information receiving content →participated party's information potential energy
(2) Information potential energy in cooperation alliance →information potential energy difference in cooperation alliance→ information sharing amount →information potential energy in cooperation alliance
The positive feedback loops include:
(1) Participated party's information potential energy →participated party's information potential energy difference → new information receiving content →information distortion quantity →participated party's information potential energy
(2) Information potential energy in cooperation alliance →participated party's information potential energy difference →new information receiving content →participated party's information receiving amount →information potential energy in cooperation alliance
(3) Information potential energy in cooperation alliance →expected information potential energy in cooperation alliance →information potential energy difference in cooperation alliance →information sharing amount →information potential energy in cooperation alliance

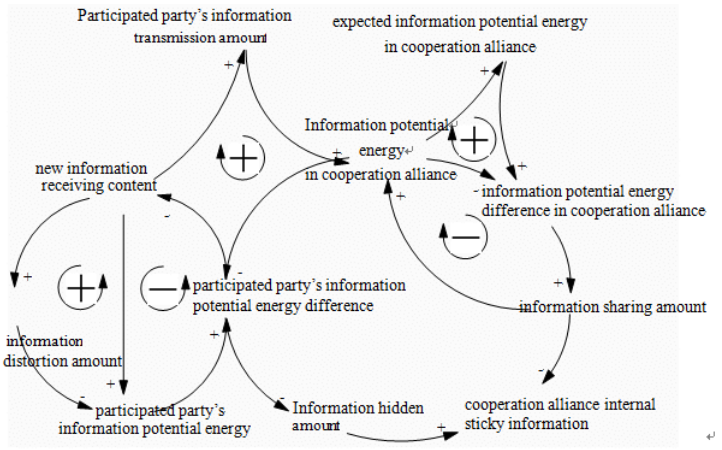


Fig.2 Causal relations in university-industry cooperation alliance internal sticky information system

Although causality graph can reflect the basic relationship among various factors of cooperation alliance sticky information, but it can't express the specific quantitative relations among factors .However, the flow chart of system dynamics can clearly describe system internal structure and use quantitative relations to do decision-making simulation, as shown in figure 3.

From figure 3 we can see that the flow chart includes 2 state variables, 3 decision variables, 6 instrumental variables and 4 constants. Among them, state variables are information potential energy in cooperation alliance (UIL) and participated party's information potential energy (PIL);decision variables are new information receiving content (MRI), information distortion quantity (IDM) and participated party's information transmission amount (PMIT); instrumental variables are information potential energy difference in cooperation alliance(UIM), participated party's information potential energy difference (PIM), information sharing amount (MSI)，information hiding amount (MHI), university-industry cooperation alliance internal sticky information (UIS) and expected information potential energy in cooperation alliance (EILT);constants are sharing coefficient (SC), hidden coefficient (HC), information conversion rate (ITR) and distortion rate (DR).

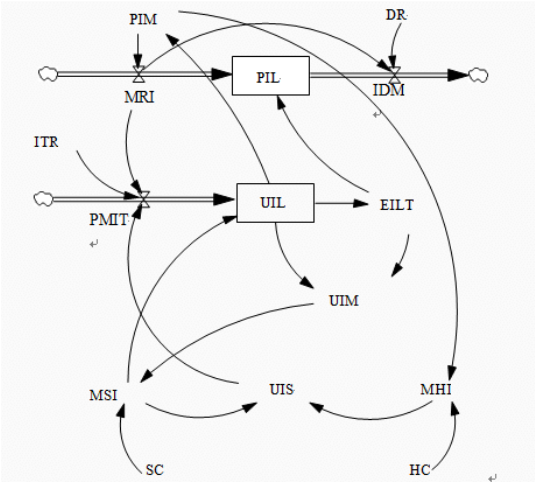


Fig.3 Dynamic flow chart of university-industry cooperation alliance internal sticky information system

Sticky information influence factors formula derivation

This paper shows the following three points based on the above hypothesis:

(1)Considering the overall interest of university-industry cooperation alliance as the starting point, MSI is advanced with the growth of potential energy difference, the increasing trend will become more and more obvious, which is mainly affected by two factors: firstly, the increasing trend will get more obvious while the university-industry cooperation alliance information potential energy difference gets bigger; secondly, the increasing trend will be more obvious with the addition of the superfluous information which can be shared.

(2) Take the interest of participated parties into consideration, MHI will increase with the narrow of PIM, this increasing trend mostly influenced by information hiding amount, the more amount of information is hidden, the less it can inhibit participated party's information potential energy difference.

(3) The reduction of PIM can increase MRI. With the PIM increasing, the growing trend of MRI will get lower. Since the parties that can produce information potential energy difference are those who with more information, the situation PIM<0 will not exist.

This paper gets the following formula based on the above assumptions and deductions:

$$\frac{dMSI}{dUIM} = SC \times UIM \times (1 - MSI) \quad (1)$$

$$-\frac{dMHI}{dPIM} = HC \times MHI \qquad PIM \geq 0 \quad (2)$$

$$-\frac{dMRI}{dPIM} = ITR \times MRI \qquad PIM \geq 0 \quad (3)$$

The paper gets the following results after solving the differential equation:

$$MSI = SC \times (1 - e^{\frac{-UM^2}{2}}) \quad (4)$$

$$MHI = HC \times e^{-PIM} \quad (5)$$

$$MRI = ITR \times e^{-PIM} \quad (6)$$

Information distortion is objective existence in transmission and receiving. "Assume that the distortion information potential energy is related to the receiving information potential energy, the more it received, the more will the information be distorted." IDM is affected by MRI. EILT will increase in a trapezoidal trend with the growth of UIM, when a university-industry cooperation alliance is about to get the predetermined goal, the university-industry cooperation alliance will set a new goal based on its own development requirement and reality situation. This paper sets the initial value of university-industry cooperation alliance information potential energy to be 1, uses p as the difference value from expected information potential energy in cooperation alliance to information potential energy in cooperation alliance when the alliance sets up new goals. This paper gets the following formula based on the above assumptions and deductions:

$$IDM = DR \times MRI \quad (7)$$

$$EILT = EILT \quad EILT - UIL > P \quad (8)$$

$$EILT = EILT + 1 \quad EILT - UIL \leq P \quad (9)$$

Due to the influence of information broadcast's influencing factors such as media, equipments and approaches, MSI and MHI have a certain limit. Therefore, this paper set their value scope into [0,1].

SC can be influenced by the media, approaches, sharing information itself and information lag party's information receiving ability, so this paper set it as constant 0.8. HC can be influenced by the willing degree of the advanced party, internal information sharing incentive mechanism and the importance degree of the advanced party, so this paper set it as constant 0.8. ITR can be influenced by the amount of information the alliance have and the length of the expected goal of the alliance, so this paper set it as constant 0.5. DR can be influenced by the importance of the information and information broadcast method, this paper set it as constant 0.3.

Claim K as the current moment, J as the moment before k, DT as the time interval between K and J, this paper gets the following formula:

$$UIL_K = UIL_K + DT \times (MSI_J + PMIT_J) \quad (10)$$

$$PIL_K = PIL_K + DT \times (MRI_J - IDM_J) \quad (11)$$

$$MSI = SC \times (1 - e^{\frac{-UM^2}{2}}) \quad (12)$$

$$PMIT_J = (ITR - UIS) \times MRI \quad (13)$$

$$MRI = ITR \times e^{-PIM} \quad (14)$$

$$IDM = DR \times MRI \quad (15)$$

$$PIM = PIL - UIL \quad (16)$$

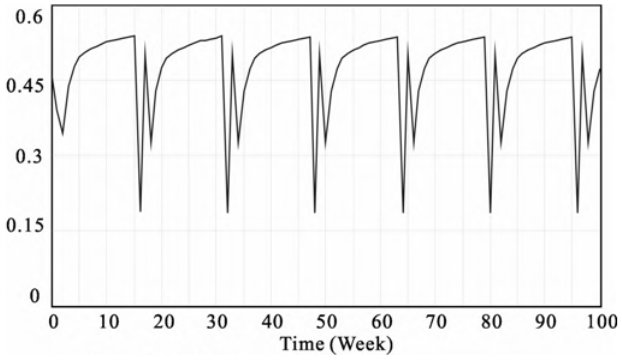
$$UIM = EILT - UIL \quad (17)$$

$$MHI = HC \times e^{-UIM} \quad (18)$$

$$UIS = MHI - MSI \quad (19)$$

The simulation results and analysis

This paper set the initial value of UIL as 0.1, PIL as 0.2, p as constant 0.04 to simulate, simulated time as 100 weeks. The simulation result is shown in figure 4.



Changing situation of cooperation alliance internal sticky information: scheme a —

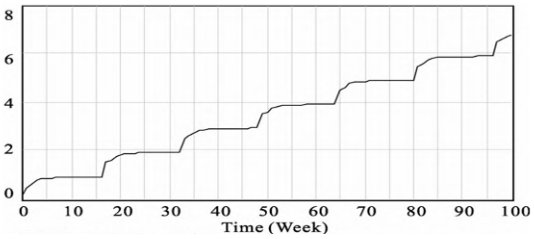
Fig. 4 Changes in information potential energy

We can see from figure 4 that, university-industry cooperation alliance internal sticky information presents a cyclical trend over time. This paper mostly analyzes the change law of the

university-industry cooperation alliance internal sticky information within one period in detail. We can know from figure 4, figure 5 and figure6, one cycle period can be divided into 4 specific stages: growing, stable, fluctuation and decline. Sticky information change is different in every stage, the paper will analyze each stage in the next part.

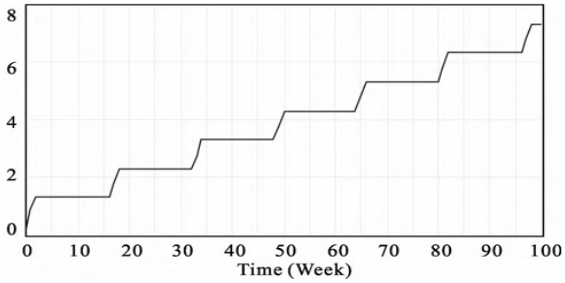
(1)Growing stage, sticky information gradually increasing from a fast speed to a lower speed. In this stage, participated party's information potential energy appeared linear growth, information potential energy in cooperation alliance made an exponential increase. (2) Stable stage, which is relatively short, mostly affected by the difference value between expected information potential energy in cooperation alliance and the currently information potential energy in cooperation alliance. The bigger the difference value is ,the shorter is the lasting time of stable stage.(3) Fluctuation stage. Change of university-industry cooperation alliance internal sticky information appears to be firstly decreased and then increased. Cooperation alliance take incentive measures, such as reward the information sharing parties, to reduce the loss of overall alliance interest brought by information potential energy difference among parties. At this point, the increasing of information potential energy in cooperation alliance will cause the reducing of participated party's information potential energy difference.(4) Decline stage, sticky information will fall rapidly. In this stage, the alliance set up a new goal with a matching incentive measure to encourage information sharing and receiving new information, which can lead to the rapidly decreasing of sticky information.

We can see form the figure that information sticky variance can become a base to research the change of information potential energy.



Cooperation alliance information potential energy: scheme a —

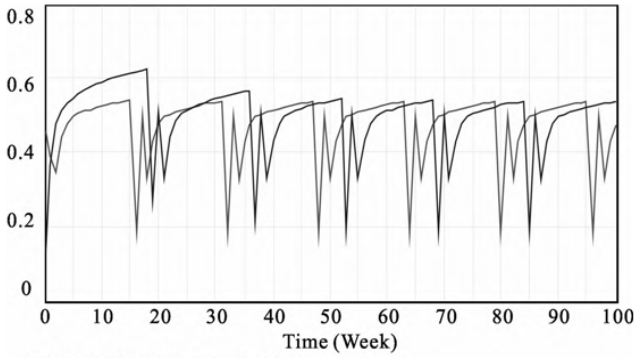
Fig. 5 Changes in information potential energy in cooperation alliance



Participated party's information potential energy: scheme a —

Fig. 6 Changes in participated party's information potential energy

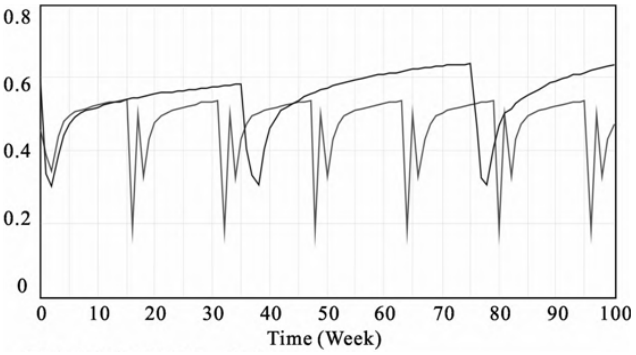
We can learn through the above analysis that the sticky information model in this paper can not only reflect the function of participated parties and cooperation alliance, but also the changing trend of university-industry cooperation alliance internal sticky information, which confirms that this is an effective model. Uses figure 4 as scheme a to compare with other schemes, scheme b and scheme c change the initial number of PIL into 0.8, SC into 0.4 without changing other numbers, the results are showed in figure 7 and figure 8.



Cooperation alliance internal information potential energy: scheme b —

Cooperation alliance internal information potential energy: scheme a —

Fig.7 Situation after changing the initial number of participated party's information potential energy



Cooperation alliance internal information potential energy: scheme c —

Cooperation alliance internal information potential energy: scheme a —

Fig.8 Situation after changing sharing coefficient

Through the adjustment of PIL and SC, we can see:

(1)Enlarging the initial number of PIL will enhance the university-industry cooperation alliance internal sticky information at some point, but it will not make much difference in the long run. This means that if the alliance hires a information screening and collecting expert, the initial value of sticky information will shrink, the peak of sticky information will increase, but it will not last very long.

(2)SC can obviously promote the decline of university-industry cooperation alliance internal sticky information. SC's main influence factors are: participated party's information absorbing ability, information's complexity,information broadcast media and the communication level among participated parties.

Therefore, improve the comprehensive quality of both the alliance and joined parties, enhance the ability to receive and absorb information, builds an information sharing incentive mechanism, improve the information conversion efficiency, reduce the degree of information distortion can all effectively reduce the sticky information in cooperation alliance. However, when information potential energy increases rapidly, university-industry cooperation alliance internal sticky information will be relatively large fluctuations, needed special attention and control during this period.

Conclusions

This paper combines qualitative analysis with quantitative analysis, uses system dynamics method to found university-industry cooperation alliance internal sticky information simulation model,

analysis the operation mechanism of cooperation alliance internal sticky information by dynamic simulation. Research results show that sticky information inside cooperation alliance appears to be changing periodically, building incentive mechanism can help it to reduce. The model has several disadvantages due to the limitation of time and space: the influence factors considered in the model are not quiet comprehensive, the breadth of the model can still be worked on. The issue of sticky information in university-industry cooperation alliance will cause the attention of more and more scholars with the development of information management simulation in system dynamics model.

References

[1]VonHippleEric“Sticky information” and the locus of problem solving: implications for innovation[J].Management Science, 1994,40(4):429－439.
[2]Cohen,Wesley M.,DanielA.Levinthal(1990).Absorptive capability: A new perspective on learning and innovation[J].Administration Science Quarterly,1998,35(1):128－152.
[3]Li Dongqin,Huag Xiaochun.On The Information “Sticy” in New Pruduct Developmet,Science& Technology Progress and Policy, 2005(1):69-71.
[4]Bi GuoChao.The disscission about building university-industry cooperation platform [J].Pioneering with Science & Technology Monthly, 2013(1):3-5.
[5]Zhong Yongguang, Jia Xiaoqing,Li Xu.System dynamics[M].Beijing:Science Press,2012.
[6]Forrester J W.Principle of systemes[M].Cambridge MA:Productivity Press,1968.
[7]James M Lyneis.System dynamic for market forecasting and structural analysis[J].System Dynamic Review.2000(2):68-77.