Guibin YANG, Shulin TANG
Harbin Engineering University，China

Research on Measuring the Sharing Effect of Knowledge-based Government's Tacit Knowledge by Structural Holes Theory

Abstract. *The article uses social network structure and social network interactive as measure indicators, combining with the questionnaire investigation of behavioral science to discuss the effect mechanism of the social networks sharing with the tacit knowledge of knowledge-based government, meanwhile proposing a quantitative method to measure the influence of each members sharing with the tacit knowledge. Finally, the article provides a point of view that the similar function node fills up vacancies of social networks.*

Streszczenie. *W artykule analizowano strukturę sieci sp[ołecznościowej do uwzględniania współdzielenia sieci z zarządzaniem bazującym na wiedzy milczącej (tacit knowledge).* (***Badania możliwości pomiaru efektu współdzielenia bazującego na wiedzy milczącej z wykorzystaniem strukturalnej teorii dziur****)*

Keywords: Tacit Knowledge; Knowledge Sharing; Social Networks; Structural Hole
Słowa kluczowe: wiedza milcząca – tacit knowledge, sieć społecznościowa

Introduction

With government affairs become more knowledgeable, the government should be an intellectual organization with innovation ability, so government agencies are changing to the knowledgeable public service organizations. Intellectual government capacity consists of two parts: government departments have a static stock of knowledge and the government can promote knowledge sharing and transferring. However, because of knowledge inertia and internal viscous, the government's tacit knowledge flowing is not smooth as imagined. From the perspective of the development speed of the stock of knowledge and core competencies, if tacit knowledge is effective only in the individual range, the ability of intellectual government will be greatly reduced [1]. Therefore, promoting the sharing of tacit knowledge effectively has important implications for enhancing the ability of the Government's implementation of government.

Relationship between the Sharing of the Tacit Knowledge in Knowledge-based Government and Social Networks

1. Connotation of the Tacit Knowledge in Knowledge based Government

The government's tacit knowledge refers to the knowledge that only appears in the specific contexts and relationships which are owned by the government leaders, government officers, the experts hired by the government and those who perform the public power related with the government. It is reflected in the skill, technique, knack, experience, insight, mind mode, the tacit understanding of the group members and some knowledge which is difficult to accurately describe by language.

2. Social Networks of Sharing the Tacit Knowledge in the Knowledge-based Government

Social networks of sharing the tacit knowledge are constituted by the government organization structure, the position of the government members in social networks, and the strength of the links of these members in social networks [2]. The government organization structure refers to the density of social networks, which reflects in the order of different parts in the government agencies, space and position, state of aggregation, contact information and the relationships between the essential elements as a model, and it is an important part of the government's administrative system. Government organization structure is a typical hierarchical structure, as well as a kind of sparse social networks. The position refers to the role of the individuals in the social networks.

The strength of the links refers to the communication frequency and depth between government members and other members. The location of the joint determines the connection strength of the social networks, high communication frequency and depth is called the "strong connection" and "weak connection" vice versa.

Theoretical Framework of Government's Tacit Knowledge Sharing Effect Measure

1 The Behavioral Investigation of Government's Tacit Knowledge Sharing Effect Measure

This thesis summarizes and analyses the factors influencing tacit knowledge sharing between government agents, and designs the hierarchical structure of civil servants' tacit knowledge sharing influence factors. There are five categories: the subject factors of tacit knowledge, the object factors of tacit knowledge, the associated factors of subject and object, the own trait of tacit knowledge and external environmental factors. (See Table 1)

2 Structural Constraint Algorithm of Government Tacit Knowledge Sharing Effect Measure

This thesis uses the structural constraint algorithm to analyze the investigation result with the social network analysis, and calculates it with the network constraint coefficient for the network closure and structural holes of government tacit knowledge sharing; this coefficient refers to the affinity that a certain node links directly or indirectly with other nodes in the network, which is used for explaining individual's influence degree on the whole network. The calculation procedure [2]

Step 1, calculate the constraint of node *i* linking with node *j* ;

(1) $$CI_{ij} = (P_{ij} + \sum_{q} P_{iq} P_{qj})$$

Step 2, calculate the network constraint coefficient of node *i* ;

(2) $$CI_i = \sum_{j} CI_{ij}$$

Step 3, calculate the network effective scale.
The calculation formula is:

(3) $$\sum_{j} \left[1 - \sum_{q}^{n} p_{iq} m_{jq} \right]$$

Among them, *j* indicates the entire node that linking to node *i,* and *q* is third except node *i* and node *j*. *p* ,*m* is the redundant linking number of the individual *i* and node *j*.

Step 4, calculate the hierarchy.

Hierarchy reflects the constraint that the node *i* afford from the neighboring node comes from the degree of the individual node, The calculation formula of the hierarchy is [3]:

$$(4)\quad H_i = \frac{\sum_j \left(\frac{CI_{ij}}{CI_i / N}\right)\ln\left(\frac{CI_{ij}}{CI_i / N}\right)}{N\ln(N)}$$

Step 5, calculate the betweenness centrality.

Betweenness centrality is the algorithm used to estimate the degree of individuals controlling the tacit knowledge. The calculation procedure is [4].

Step 1 calculate the communicating capacity of point x_i controlling x_j, x_k;

$$(5)\quad b_{jk}(x_i) = \frac{g_{jk}(x_i)}{g_{jk}}$$

Step 2 Sum up the entire node that passing point x_i;

$$(6)\quad C_B(x_i) = \sum_{j<k}^{n}\sum_{j<k}^{n} b_{jk}(x_i)(j<k\ i\neq j\ i\neq k)$$

Step 3 calculate the relative betweenness centrality of point x_i;

$$(7)\quad C_B'(x_i) = \frac{2C_B(x_i)}{n^2-3n+2}$$

Table 1. Government's Tacit Knowledge Sharing Effect Measure Index

Types of Variables	Variable Level	State Level
Subject Factors	Sharing Willingness	Need fulfillment, Altruism, Protection awareness.
	Sharing Capability	Encoding capacity for knowledge of the knowledge provider, The master for information feedback of knowledge receiver.
Object Factors	Absorptive Capacity	Knowledge relatively leading degree, Educational level.
	Absorptive Willingness	Adjust self knowledge structure.
	Relational Trust	Believe the other party is kind, Believe their capacity, Believe the other party is trusty, Believe their openness.
Associated Factors of Subject and Object	Linking Intensity	Interaction frequency, Mutual benefit degree, Mutual trust degree.
	Network Density	Third-party linking quantity.
	Network Range	The unit number of directly linked with individual.
	Network Centrality	The ratio of linking quantity and total sample of certain individual with surrounding individuals.
Knowledge Trait	Knowledge Trait	Complexity, Specialty.
External Environmental Factors	Governmental Culture	Whether the government owns the culture encouraging tacit knowledge sharing.
	Governmental System	Whether the government owns the tacit knowledge sharing system.
	Governmental Organization Structure	Whether the governmental organization structure is good for the tacit knowledge sharing.
	Tacit Knowledge Sharing Platform	Whether the government owns the tacit knowledge sharing platform.

Empirical Study

1. Sample Selection and Data Collection

This article takes civil servants in the government department of Heilongjiang Province in China as survey targets. 65 individual samples are randomly selected and are asked to honestly fill in the questionnaires which are designed according to the improving index structure of Table 1.

2. Data Processing

Returned questionnaires will be anonymous counted, and handling out 65 with 57 returned. The community graph of tacit knowledge sharing is produced by the research findings (See Figure1).

The results are shown in Table2, by using the software to measure two network structure indices of structural constraint and betweenness centrality of the community graph, and merging the two measuring values.

3. Result Analysis

(1) Data Analysis of Behavioral Science

More than half of government officials are familiar with their tacit knowledge which necessary condition of government to implement tacit knowledge sharing and fill in the tacit knowledge vacancy caused by the mechanism of civil servants circulation. But the results that more than sixty percent of civil servants don't understand other members' tacit knowledge very well show that government departments have a very obvious authority limit, which is the basic reason of the collaboration inefficiency in Existing governments. Therefore, the government reform should focus on the collaboration during the business, and promote the overall tacit knowledge sharing.

The research shows that most people will exchange their tacit knowledge with others only for benefit driving. It proves that the motivation of the tacit knowledge sharing between members of the government's is utilitarian, non-voluntary or under cultural incentives, which is not conducive to enhancing the quality of government members' tacit knowledge. Neglecting the importance of tacit knowledge (33.33%) and that the tacit knowledge can't be accurately expressed (29.82%) are the major obstacle to the tacit knowledge sharing.

The majority of civil servants (73.68%) believe that experience can stimulate their tacit knowledge, while expertise (59.65%) and most willing to seek help from the experienced people (54.39%), which indicates that the important role of the experience in the tacit knowledge sharing. Meanwhile, the main bodies of tacit knowledge sharing usually are leaders. The grass-root employees rarely have the opportunity to put forward their views in the social network.

(2) The Calculation Results Analysis Based on the Structural Holes

Figure 2 shows that the Government's tacit knowledge sharing in social networks has four obvious levels, this result is consistent with the status quo of the existing government bureaucracy. Intermediate potential of the human community map is 0.380, indicating that the majority of the members need other members as a bridging point for tacit knowledge and lack of face-to-face to pass tacit knowledge, which explains the inefficiency of government tacit knowledge sharing.

Number 45,8,14,6,31 are the "bridge" members, they have the largest number of structural holes, occupy part of connection location of the structure holes, so they have formed the Simmel joint and severally. The structure holes which across the dense zone, occupies structural hole in knowledge sharing or the recipient, they have the opportunity to come into contact with the two heterogeneous sources of information, with access to information and comparative controlling advantage, so it can promote knowledge transfer, therefore external social networks and boundary people can bring the change and innovation for the organization.

Shown in Table 2, the network of number 1, 57, 50, 56, 7 are large in scale, and have more structural holes, they are core members. Because of the strategic position and others have high dependence on them, these members have more formal authority and more informal power, so they have influence on controlling the flow of information and determine the effect of the government's tacit knowledge sharing [5].

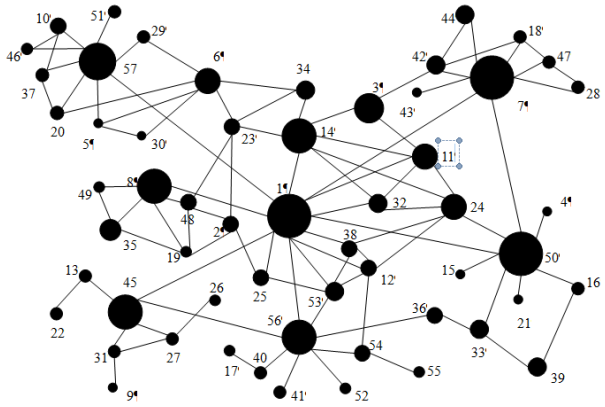

Fig. 1. Community Graph of Tacit Knowledge Sharing

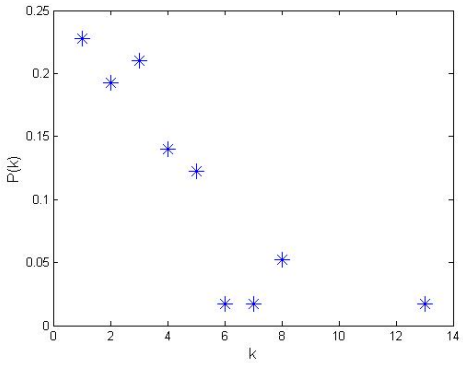

Fig 2. Tree-like Chart of Structural Leveling Measurement of the Community Graph of Government Tacit Knowledge Sharing (Partly)

Table 2. Partial Results of Structural Holes and the Central Index of Government Tacit Knowledge Sharing in Social Networks

	Degree	EffSiz	Effici	Constr	Hierar	Detwee	nDetwee
1	13.000	11.615	0.893	0.131	0.030	434.434	0.2821
57	8.000	7.250	0.906	0.223	0.065	145.992	0.0948
50	8.000	7.750	0.969	0.132	0.002	126.434	0.0821
56	7.000	6.714	0.959	0.155	0.005	121.506	0.0789
7	8.000	6.750	0.844	0.250	0.047	119.658	0.0777
45	4.000	3.500	0.875	0.334	0.024	108.416	0.0704
8	5.000	3.800	0.760	0.396	0.042	74.536	0.0484
14	6.000	4.333	0.722	0.310	0.016	54.054	0.0351
6	5.000	4.600	0.920	0.249	0.019	34.496	0.0224
31	4.000	3.500	0.875	0.334	0.024	32.186	0.0209
5	3.000	3.000	1.000	0.333	0.000	26.642	0.0173

Conclusions

This article measures the tacit knowledge sharing effect from the perspective of the "structural holes" and discusses the Government's tacit knowledge sharing behavior by analyzing the network of social relations. After analyzing, the following conclusions will be reached:

1. On the one hand, we can introduce other people from external organization to reduce the centrality of the knowledge of individual; on the other hand, culture tacit knowledge source from the inside can speed the flow of knowledge.

2. Put tacit knowledge sharing into government cultural construction. Establish a strong culture of sharing, form the same values and code of conduct step by step, speed the exchange of knowledge among the members of the government to shorten the knowledge distance, making tacit knowledge needs to take the initiative to find a source of knowledge, insight and identify their own needs hidden knowledge carriers.

3. Government departments should train staff within the organization or introduce the one who has the similar functions of social networks from outside to replace the losing talents, so as to achieve the purpose of repairing tacit knowledge sharing in social networks.

This work was financed by the research fund of Social Science Fund Project of Heilongjiang Province (08E008); Natural Science Fund Project of Heilongjiang Province(G201114); Special Fund Project of the Central University Basic Research and Operating Expenses (HEUCF120903).

REFERENCES

[1] Bartlett K. (2003) Towards a true community of scholars: undergraduate research in the modem university. J., Journal of Molecular Structure-Theochem., (666), 707-711

[2] WANG Dan (2008) A Comparative Study on Algorithm of Structural Holes. J., Modern Information., (09), 153-156

[3] WAN Ying (2011) The Sharing Strategy of Tacit Knowledge Based on Method of SNA. D., Shenyang Normal University., (2011), 20-25

[4] YANG Bo (2007) Research on Characterizing and Modeling the Structure of Complex Social Networks. D., Shanghai Jiaotong University., (2007), 41-47

[5] Cross R, Liedtka J, Weiss L (2005) A practical guide to social networks. J., Harvard Business Review., 83 (3), 124-150

***Authors**: Associate prof. Guibin YANG, Harbin Engineering University，P.R.China, NO.145, Nantong Street, Nangang District, Harbin,150001,E-mail:yangguibin1975@163.com; DR. Shulin TANG Harbin Engineering University，P.R.China, NO.145, Nantong Street, Harbin,150001,E-mail: tangshulin00.student@sina.com*