A Framework on Compound Knowledge Push System Oriented to Organizational Employees

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Abstract. Organizational employees have different knowledge demands and the knowledge is compound. So how to push the right compound knowledge to the right organizational employees becomes important. This paper attempts to propose a framework for compound knowledge push system for organizational employees to solve the problem. Firstly, the compound push mechanism is given out based on the analysis of the knowledge needs of organizational employees. Secondly, after introducing the key IT, the framework is presented with the illumination of every body's function of the system. Finally, an application case is studied to illustrate the compound knowledge push system's operation mechanism based on the framework. Applying the system can give the employees all-around knowledge backing, and it will enhance the knowledge management level of organizations.

1 Introduction

In the Knowledge Economic Age, knowledge management has become a necessary method for an organization to develop and improve competence ability. With the comprehensive application of IT and the popularization of Internet, it is not only much easier for an organization to obtain knowledge from external, but also more convenient to share and create knowledge within the organization, which makes knowledge store increase sharply. Simultaneously, emergence of knowledge overloading and knowledge getting lost reflects the fact that knowledge in organization lacks effective management. In organizations, although knowledge store and knowledge source are abundant, employee's ability to obtain knowledge is seriously deficient. So how to build a knowledge push system for organizational employees to solve the above problem is urgent.

Recent years, researches on knowledge push have drawn more attention from academic circle to enterprises. Tso, S.K., Lau, H.C.W., Ip, R.W.L.[1] presented a fuzzy push delivery scheme which can 'observe' the movements of the user within the Web pages and then evaluates the personal interests and preferences of the user. With the information available from the fuzzy scheme, Web site information favoured by

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visitors can be 'pushed' to them without even being requested. Liu, L., Pu, C., Tang, W.[2] described a design of a distributed event-driven continual query system – OpenCQ. In OpenCQ, users may specify to the system the information they would like to monitor. Whenever the information of interest becomes available, the system immediately delivers it to the relevant users. Celik, A., Datta, A., Narasimhan, S.[3] proposed a new protocol - single encoding multiple decoding (SEMD) to handle secure access and subscription services for broadcast. Acharya, S., Franklin, M., Zdonik, S.[4] studied how to augment the push-only model with a 'pull-based' approach of using a backchannel to allow clients to send explicit requests for data to the server. Cai, J., Tan, K.L[5] refered an intergrated distribution-based information system(DBIS), its fist model is a data push model which delivers data stored in it to clients.

These literatures make the concept of knowledge push clear and give out the detailed explains and advice from the aspects of push forms, contents and achieving ways, but all these studies focus on knowledge push from the point of users' interests and hobby. To organizational employees, their demand of knowledge not only comes from their interest and hobby, but also comes from requires of posts and workflows. With regard to knowledge demand characteristics of organizational employees , relevant researches on knowledge push is still blank at present. So this paper attempts to propose a compound knowledge push framework for organizational employees to meet organizational employees' compound knowledge demand.

This paper is organized as following: In section 2, the knowledge push mechanism for employees is analyzed. In section 3, the key IT is introduced. In section 4, a compound knowledge push framework for organizational employees is presented and every body's function of the framework is described. In section 5, an application is given out to illustrate operation mechanism of the system based on the framework. In section 6, the conclusions are drawn.

2 Analysis on Compound Knowledge Push Mechanism

The attribute of knowledge needed by organizational employees has two sides: organizational attribute and natural attribute. Organizational attribute points that a employee who is an organizational member must master the knowledge needed by his/her post and workflow, to complete work and improve the decision level. Natural attribute points that a employee who is a natural man has the demands of obtaining knowledge from personal interest and hobby, these knowledge consists of work skills, the use of new tools and new methods, obtaining which will improve work efficiency. Simultaneously, we also can construct communities of practice on the base of personal preference, which is help for organizational culture. Because of knowledge's complexity, personal interest diversity and the concrete requirement of work surrounding, it is necessary to analyze the compound knowledge push mechanism.

2.1 Knowledge Push Based on Employee's Real-Time Interest

The existing research mainly focuses on how to scout the knowledge to meet users' needs in the vast and verified knowledge/information field, such as knowledge push via e-mail, web or channel which are booked manually by users. The above research

suppose that external environment is dynamically varying and user's interest and hobby is relatively static. However, fact is not so. User's interest may change at any time and these changes reflect on the user's actions of using computer, such as browsing web, starting up some applications. So it is not feasible to constantly revise the user's interest setup by use of traditional push technology[6]. Now we need a intelligent system to push knowledge according to employee's real-time interest which can be obtained by monitoring the real-time data flow. For example, monitor HTTP flow to get the WWW website and then further get knowledge character in this website; monitor WINDOWS system information to get the open application and obtained focus; monitoring keyboard input to get the input text. All these information constitutes the employee's real-time interest, by which system pushes related knowledge. For instance, when system acquire the information that an employee is using Microsoft Office, it will push the related information about upgrade information and use skill, which benefits to enhance work efficiency.

2.2 Knowledge Push Based on Employee's Fixed Interest

This push mechanism is similar to traditional one, by which knowledge is pushed according to the contents booked by employee in personal preference base. Firstly, an employee sets his/her preference by hands and saves it into preference base. Additionally, according to the evaluation of the pushed knowledge (which is stored in knowledge training set, including the knowledge based on real-time interest and based on fixed interest) by employee, continuously expand and revise personal preference. Finally, the system pushes knowledge based on the preference base that exactly reflects the employee's fixed interest. Methods to mine personal preference can use clustering, artificial nerve network, fuzzy logic, rough set and other technologies and methods to achieve. We also can construct communities of practice on the base of personal preference to enhance organizational culture.

2.3 Knowledge Push Based on Post

Organizational structure decides the post setup and employees in the different posts have different knowledge demands. For example, warehouse administrators need the knowledge about logistics, accountants needs knowledge about finance. So it needs to build a post knowledge demand base, contents in which point out the post knowledge characteristics, that is, which post should master what kind of knowledge and what degree of knowledge. When a employee logs in, firstly, system checks the employee's identity and then reads the employee's post information from basic information table. Secondly, determines knowledge characteristics according to the information from post knowledge demand base. Finally, scouts the right knowledge from knowledge space and push it to the employee.

2.4 Knowledge Push Based on Workflow

Organizations complete routine and perform tasks often by corresponding workflow. Workflow orients to subject and can be seen as the integration of different post based on operation logic. So the knowledge demand of post involves in workflow composes knowledge demand of workflow. Workflow application often be divided into several

phases and the knowledge demand in every phase is continuous, namely, the work in this phase depends on knowledge which is accumulated and created in last phase. System can push right knowledge to employees according to the characteristics of knowledge needed by workflow itself and its phase information. So it needs to build a workflow knowledge demand base which points out the workflow's knowledge characteristics and the address where the knowledge of different phases stores. That is to say, what kind of knowledge and what degree knowledge must have to achieve in this workflow, and locate the knowledge accumulated and created in every phase. Firstly, system interacts with workflow engine to get the workflow identity and its phase information. It finds the post involved in workflow, and then gets knowledge characteristics of the workflow from post knowledge demand base and knowledge store address in last phase from the workflow knowledge demand base. Finally, it scouts in knowledge space, which can build a knowledge buffer base to store the knowledge accumulated and created in each phase for each active workflow, and push the obtained knowledge to employees.

3 Analysis on Key Information Technology

3.1 Software Agent

Agent is derived from artificial intelligence that is generally defined as following: It is an autonomic entity which could apperceive environment and make certain judgment and reasoning of external information to conduct decision-making and activity by itself, in order to finish some tasks[7]. According to the difference of performing entities, agents can be classified into human agent, hardware agent and software agent. Among them, software agent is a software that can perform given tasks for users. It has some intelligence degree to allow to perform part of the tasks and interacts with environment in an appropriate way. It provides a new approach to solve the knowledge management problems under an open, distributed and complex web environment at present[8, 9].

The compound knowledge push system proposed in this paper is a complex and intelligent one. Identifying when employees login system, tracking employees' interest in real-time, scouting and pushing knowledge, all these need intelligent entities to complete automatically on background, and the system runs normally depending on the continuous interaction among intelligent entities as well. Software agent technology is the suitable choice for the system's realization. Based on the research on agent application and the analysis of system operation mechanism[10-12], soft agent is a better choice to achieve the system. Software agent owns some characteristics: autonomisation, reactivity, social ability, goal-guiding, intelligence, and these characteristics can fully satisfy the system's running requirements. Achieving the system needs stall a personal agent into every employee's operation platform, and stall general push agent and special agent in servers.

3.2 Knowledge Grid

Knowledge grid is put forward by Fran Berman in 2001 for the first time[13], the relatively whole definition of it is: Knowledge grid is an intelligent interconnect

environment, it can make the users or virtual roles gain, issue, share and manage knowledge resource effectively. It provides the knowledge service to users or other services and aids achieving knowledge creation, coordinating work, problem solving and decision supporting[14]. In this paper, we definite knowledge space as the store space owning the ability to deal with knowledge/information intelligently by using knowledge grid technology, in which, main store entities include knowledge base, post knowledge demand base, workflow knowledge demand base, and personal preference base. The knowledge range covered by knowledge space is extensive. It not only includes the employee private knowledge and organization private knowledge, but also includes the knowledge obtained from external. When system scouts the knowledge, the sequence of scouting is local scouting by personal agent, internal scouting by organizational agent (general push agent and special push agent) and external scouting by organizational agent. Knowledge stored in knowledge base is defined on categories set by an organization and it can be divided into concept, axiom, rule and method from simplicity to difficulty, and also can be sorted into person private knowledge, organization private knowledge and public knowledge[15]. The relation about category, degree and privileges of knowledge is shown in fig. 1.

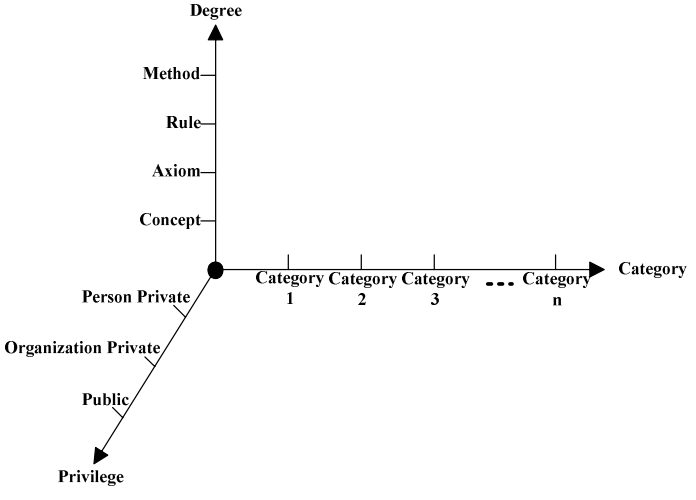

Fig. 1. Three-dimension relation about category, degree and privilege of knowledge

The knowledge category shown in Fig.1. can be sorted into more specific subclass. We can construct the inferior subclass with the same structure.

4 Structure of a Compound Knowledge Push Framework

According to the above analysis on compound knowledge push mechanism and key IT, we present a framework for compound knowledge push system. It is shown in fig.2.

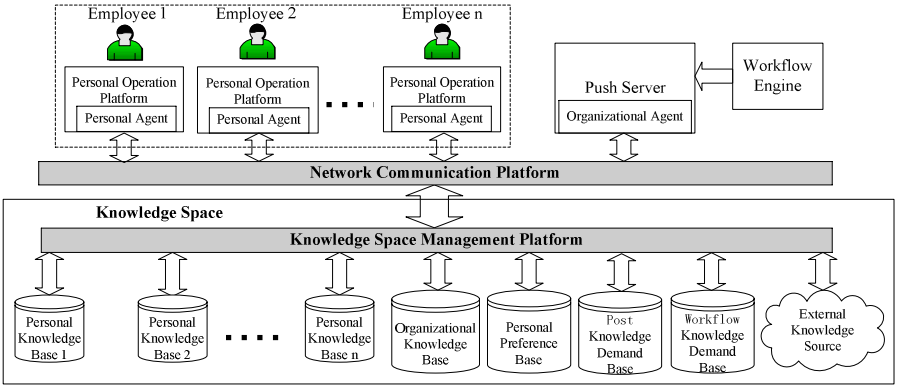

Fig. 2. A compound knowledge push framework for organizational employees

The analysis on main bodies' function of the framework is described as the following:

Knowledge Space. The knowledge/information stored in knowledge space consists of person private knowledge, organization private knowledge and knowledge obtained from external environment. The storage of knowledge is distributed. knowledge can be stored in local personal knowledge base or in organizational server(organizational knowledge base, personal preference base, post knowledge demand base, workflow knowledge demand base), even external knowledge source such as Internet. This knowledge is managed by knowledge space management platform which uses knowledge grid as its core technology. To make the system framework clear, we denote this knowledge and management platform as knowledge space. When software agent puts forward knowledge request, knowledge space management platform charges of searching knowledge and feeding back scouted results.

Personal Agent. Personal agent is installed in employee's operation platform. It has these function:

- Complete identifying(user's name, password and other secure mechanisms) and connects employees with information of post and preference.
- Track the employee's interest changing at any time, scout local knowledge and push it to employee. Send knowledge request to general agent if employee is not satisfied.
- Receive and show the scouted results of knowledge.
- Appraise the results to expand and revise personal preference.
- Use suitable mining tools and strategy to complete personal preference mining.

Organizational Agent. Organizational agent is installed in push server, and it runs on four patterns:

- Knowledge push pattern based on employee's real-time interest. Organizational agent receives knowledge request from personal agent, scouts knowledge in internal and external environment and the search is charge of knowledge space management

platform, feeds scouted results back to personal agent, expands and revises the personal preference according to the evaluation from employee and mines personal preference by using suitable mining tools and strategy.

- Knowledge push pattern based on employee's fixed interest. Organizational agent scouts external environment at regular time or at the time when external knowledge related to employee's interest and hobby varies, pushs the late information and knowledge to the employee.
- Post-based knowledge push pattern. When an employee logins system and passes the identifying by personal agent, organizational agent obtains post information from employee's basic information table, reads corresponding knowledge characteristic from post knowledge demand base, scouts knowledge in knowledge space and pushes the scouted results to the employee.
- Workflow-based knowledge push pattern. Organizational agent interacts with workflow engine to read workflow ID and current phase information, reads involved post information from workflow knowledge demand base to make sure the knowledge characteristic, simultaneously, locates the address where the knowledge stores in last phase, and pushes the related knowledge which is scouted from knowledge space to employee.

5 Case Study

We have developed a prototype of compound knowledge push system called KEMS(Knowledge Express Mail Service) based on the framework and it is used in some software development company. Figure 3 gives out the running interface of KEMS on the personal operation platform of a designer in the company. The running result of KEMS shows that all-around knowledge supporting via KEMS in software development can shorten the development cycle and improve the knowledge management level of the company.

The running of system is sustained by the interaction of personal agent with organization agent in background. The personal agent installed in employee's operation platform is client software. It interacts and coordinates with organization agent installed in server to complete the work of knowledge scouting, pushing, showing and feeding within the knowledge space, and make sure the system run normally. The operation mechanism of KEMS is shown in fig. 4.

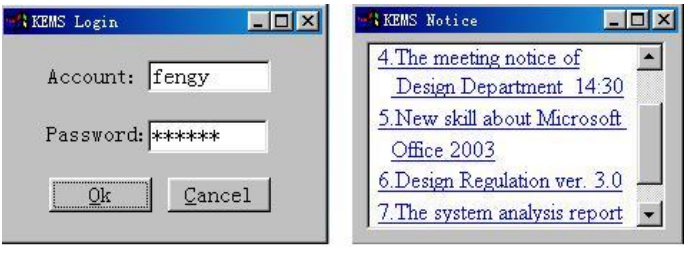

Fig. 3. Screen shot of KEMS's running interface

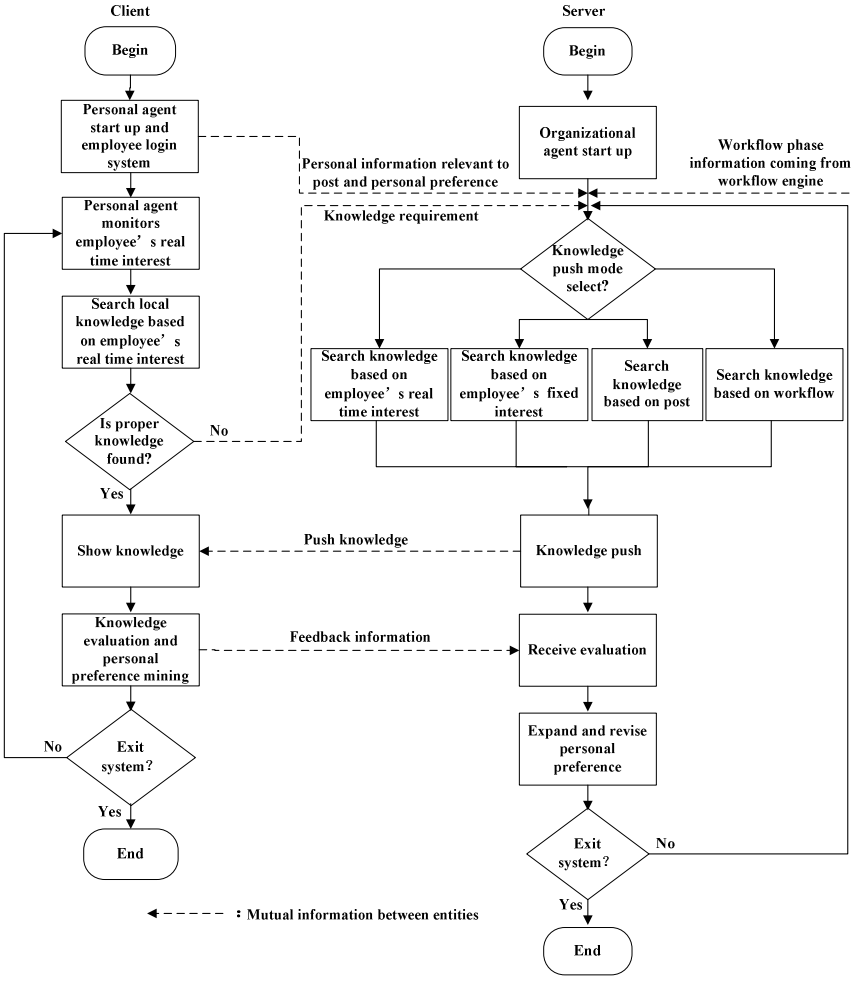

Fig. 4. Operation mechanism of KEMS

For the pushed knowledge, personal agent can deal it in many ways. The most direct way is to make it shown in the pop-up window, or saved in local disks with reminding employees to look up by notice form when employees are online. The knowledge also can be mailed to employees with the relevant notice being sent to employees' mobile phone when employees are offline.

6 Conclusions

This paper analyzes the push mechanism for organizational employee's knowledge demand, introduces the key IT, proposes a framework for compound knowledge push system, and gives out a case of enterprise to illustrate that this framework can satisfy

the employee's knowledge demands and improve work efficiency. Because of the complexity of knowledge management, research on knowledge push is in the first step regardless of theory study or practice study. Therefore, the research in this paper aims to analyze the framework for compound knowledge push system, and does some practice about compound knowledge push system based on the enterprise's knowledge demands in reality.

References

1. Tso, S.K., Lau, H.C.W., Ip, R.W.L.: Development of a Fuzzy Push Delivery Scheme For Internet Sites. Expert Systems, 16(2). (1999) 103-114
2. Liu, L., Pu, C., Tang, W.: Continual Queries for Internet Scale Event-Driven Information Delivery. IEEE Transactions on Knowledge and Data Engineering, 11(4). (1999) 610-628
3. Celik, A., Datta, A., Narasimhan, S.: Supporting Subscription Oriented Information Commerce in a Push-based Environment. IEEE Transactions on Systems, Man, and Cybernetics Part A: Systems and Humans, 30(4). (2000) 433-445
4. Acharya, S., Franklin, M., Zdonik, S.: Balancing Push and Pull for Data Broadcast. SIGMOD Record (ACM Special Interest Group on Management of Data), 26(2). (1997) 183-194
5. Cai, J., Tan, K.L.: Tuning Integrated Dissemination-based Information Systems. Data and Knowledge Engineering, 30(1). (1999) 1-21
6. Underwood, G.M., Maglio, P.P., Barrett, R.: User-centered Push for Timely Information Delivery. Computer Networks and ISDN Systems, 30(1-7). (1998) 33-41
7. Lee, J.N., Kwok, R.C.W.: Fuzzy GSS Framework for Organizational Knowledge Acquisition. International Journal of Information Management, 20(5). (2000) 383-398
8. Woodridge, M., Jennings, N.R.: Intelligent Agents Theory and Practice. Knowledge Engineering Review, 10(2). (1995) 115
9. Van Elst, L., Dignum, V., Abecker, A.: Towards Agent-mediated Knowledge Management. AMKM 2003, Lecture Notes in Artificial Intelligence, Springer-Verlag GmbH, Vol. 2926. (2004) 1-30
10. Chen, J., Wolfe, S.R., Wragg, S.D.: A Distributed Multi-agent System for Collaborative Information Management and Sharing. In Proceedings of the 9th ACM International Conference on Information and Knowledge Management (CIKM),. ACM Press, McLean, Virginia, USA. (2000) 382-388
11. Virginia, D., Hans, W., Lai, X.: Agent Societies: Towards Frameworks-based Design. Lecture Notes in Computer Science, Springer-Verlag GmbH, Vol. 2222. (2001) 33-49
12. Kerschberg, L.: Knowledge rovers: Cooperative Intelligent Agent Support for Enterprise Information Architectures. Proceedings of the First International Workshop on Cooperative Information Agents, Berlin, Springer, Lecture Notes in Artificial Intelligence, Vol. 1202. (1997) 79-100
13. Berman, F.: From Teragrid to Knowledge Grid. Communications of the ACM, 44(11). (2001) 27-28
14. Zhuge, H.: China's E-Science Knowledge Grid Context. IEEE Intelligent Systems, 19(1). (2004) 13-17
15. Zhuge, H.: A Knowledge Grid Model and Platform for Global Knowledge Sharing. Expert Systems with Application, 22(4). (2002) 313-320