A Network System for Knowledge Sharing in Learning Organization

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ABSTRACT

This paper argues that applying the application of a knowledge management framework to learning organizations. Proposing and building a network system that shares individual knowledge as well as converts them into group knowledge. In this study, the dual scaling method and the spring model are used for building and visualizing the relation of documents. By applying the principles of structured document, organizational knowledge is created. Then this paper introduces an ongoing project that is to develop a network system, which integrates individual knowledge and shares it with other member automatically.

Keywords: knowledge sharing, structured document, system realization.

1. INTRODUCTION

Research on knowledge sharing [1] came into being in the early 1990s. It has gained very tremendous and quick development in past more than decade. Although the information technologies play an important role in knowledge sharing, there still are two problems lead to few success stories of organizations that realize effective sharing and usage of knowledge through knowledge sharing system. The first one is the brain drain that are the loss of knowledge stored in an organization due to restructuring; the second one is the failure of integrating people and information technology through re-engineering that was the focus on human knowledge. To solve the above two problems effectively, we design and develop a network system with structured documents [2]-[4].

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*The research is supported by 21st COE (Center of Excellence) Program “Study of Scientific Knowledge Creation” of JAIST, a funds by Ministry of Education, Culture, Sports, Science and Technology (MEXT, Japan)

Based on traditional knowledge sharing system, the elements set of documents structure [5] is: {title, author, published year, abstract, keyword, content}. From the structure we can know that the documents couldn’t carry any personal experiential knowledge, so, documents should be described that users have filtered and collected for their own purpose could be viewed as knowledge, which has been extracted from the information. Base on these ideas, we re-design the structure of documents as follows: {title, author, published year, abstract, keyword, content, {readers’ knowledge}, document location}, and the subset {readers’ knowledge} include elements such as reader’s name, comments, reader’s research fields, etc.

The network system proposed in this paper uses three types of individual knowledge. The first one is the document information that researchers filtered by themselves, this document information is the knowledge that has been extract from volumes of document data; the second one is the documents that were used as references when reading other documents; the third one is the information generated by researchers who had written document information into hierarchical bookmarks for themselves. For sharing/integrating this collected individual knowledge easily, we built a structured document model with bookmark. Dual Scaling Method [6] and Spring Model [7] are also used in network system. In this paper, using Dual scaling as a method to integrate categories created by members, calculate the correlation to all documents and support clustering activities through visualizing documents in space. Using Spring Model method to visualize space on a graph structure. As a result, we were able to achieve integrated and visualization of documents information through dual scaling and sharing of document bookmarks.

As the network system realization, considering the system could be transplanted easily, we adopt Apache Tomcat as Application Server and JDBC as Middleware. Tomcat has its own platform. It just needs to compile once but runs anywhere. In addition, JDBC can connect database only via its URL. All these virtues can make application programs independent from platforms. In the aspect of the system expansibility, by applying

factory and proxy, which are two of twenty-three design patterns, the oriented interface programming can be achieved. By using above these methods and technologies, it is possible for system users to track their historical records, besides, they are able to efficiently locate documents relevant to their needs. The personal reading information as a kind of knowledge stored and shared by building structured documents. The validity of this prototype system has been proved through its application in material science lab, Japan Advanced Institute of Science and Technology.

2. DUAL SCALING AND SPRING MODEL

As mentioned above, a structured document play an utmost role in the knowledge sharing system. In this study, we try to use Dual Scaling and Spring Model to cluster and visualize documents

2. 1. Dual Scaling

Dual scaling is an extension of Japan's "Hayashi's Theory of Quantification" Type III, and is also commonly referred to as correspondence analysis. By assigning weight to categories (rows) and items (columns), weight is a single correlation axis is projected according to their dispersions, in this way, it is possible to show the correlation through items and categories in the same correlation axis space. When performing analysis on characteristics that are line up as such, dual scaling provides benefits such as the "ability to visualize the correlative positions of extracted clusters" and the "ability to simultaneously visualize the relative positioning between items and categories. " When using dual scaling, to cluster and visualize documents, we analyze using a cross table made of members' bookmark categories (items) and documents, to analyze the cross table we use Quantification type III, which is separated into the three methods of dual scale analysis, principle component analysis, and canonical correlation analysis. The difference between these methods is that for square matrices eigenvalue decomposition is used while for $n \times m$ matrices singular value decomposition is used; these calculations take members' bookmark categories as the item and documents as the category. Since the number of data points is always changing for item, the dual scaling is used. In the bookmark category and document calculation results, the more documents are registered in the same category, the more the correlation strengthens and the more it nears the coordinates. By visualizing these coordinates, a cluster can be recognized documents close to each other, and from these clusters new frames of reference can be discovered, and of course we can expect outcomes such as discovering documents with a strong relation.

2. 2. Spring Model

Spring Model is one way to draw an undirected graph, and at the peak for quality 0 ring, by substituting springs according to force mechanics to discover the ring's resting state, we determine the appropriate layout. In this system, in consideration of draw result stability and calculation times, the Magnetic Spring model was selected, the aesthetic point considered are:

- Equal length of all sides
- Minimum number of intersections of sides
- Symmetry
- Equal distribution around the peak
- The sides are aligned in a certain orientation or direction

These five standards are especially characteristic of this algorithm and points why appropriate for drawing a significance graph.

2. 3. A New Solution Using Spring Model to Visualize Interrelated Documents

The Spring Model is subject to intuition, our solution is that define Turning Effort working upon the sides, which control the orientation and direction of the sides. To implement Turning Effort, we set the sides as Magnetic springs which have directional magnetic properties, and presume that the entire graph sits in a magnetic field, therefore, it is possible to represent the magnetic field as vectors whose orientation and strength are derived from each point on the plane. For our calculation, for one way Springs, by applying the magnetic field to the north of the space, the direction of the graph aligns downward. For Bi-directional Spring Model (document *A* is a reference of document *B* and document *B* is a reference of document *A*), the magnetic field is oriented toward the east of the space. By setting the magnetic field, more referenced documents appear at the top, and documents that should be read together are drawn on a horizontal line. By updating coordinates one by one, it is possible to set coordinates for final nodes (documents), a more specific calculating algorithm is shown below:

```
Set initial position for each node:
Normalizing loop:
 {
  For i = 1 to [number of nodes]
  {
   For j = 1 to    [number of nodes]
     If: node 1, node j is linked then
```

f_s, which receives i from side(link)

calculate spring(strength);

f_m,which receives i from side(link) calculate

spring(spin force from the magnetic field);

$f_i += f_s + f_m$;

Else

For node j, f_j, which receives i,

calculate(non-adjacent peak strengh);

$f_i += f_j$;

}

}

Move node i to θ f_i; (θ is a constant)

}

One reason we chose to adopt the magnetic spring model is that the graph structure is clustered to a certain extent, since each closed graph forms a group, is possible to cluster from a slightly different perspective than clustering (through categorization).

3. KNOWLEDGE SHARING IN THE NETWORK

In the recent years, many firms and institutions are pursuing the goal of becoming learning organizations, a learning organization may be thought as an organization that focuses on the developing and utilizing its information and knowledge capabilities in order to create high-valued knowledge, to change the behaviors, and to improve bottom-line results.

First of all, the individuals need the knowledge work support, so, knowledge sharing becomes more important in the whole life cycle of knowledge, it refers to the various activities to share (implicit knowledge)-personalities of each member of the organization or share experiential knowledge, specifically, this includes communication through activities such as informal brainstorming or chatting during break times.

3. 1. Knowledge Sharing Factors in the Sytem

In the computer science and artificial intelligence fields, efforts to support or human knowledge activities with computers were already underway, however, according to recent survey results, while satisfaction with knowledge sharing is high for items such as “able to find the information I need”, since satisfaction is hovering around 50% for items related to “knowledge sharing” revealing that the current generation of knowledge sharing system can not be regarded as a complete success because which, as the dimension of information technology, knowledge sharing include three factors[8] as follows:

1) ***Knowledge Repositories:*** aiming to capturing knowledge found in concrete documents such as notes, reports and presentations and store them in repositories. In the past, these were used to capture external knowledge (market, technical, legal or commercial knowledge) but more recently this include entering into the repository explicit knowledge captured from within the organization. The knowledge repository works by storing explicit knowledge such as documents in a server with large storage capacity and extracting and using this knowledge when needed, the technology requires a database for storing structured explicit knowledge as well as search function to allow extracting required knowledge from vast collection of knowledge in the database.
2) ***Knowledge Access and Transfer:*** aiming to provide access to knowledge or enhance sharing of knowledge between individuals. Unlike the knowledge repository that deals with the knowledge itself, knowledge access focuses on those individuals who possess knowledge as well as prospective users of this knowledge. Lists and diagrams indicating the location of knowledge are used to find the individual processing the required knowledge and efficiently transfer this knowledge to another person.
3) ***Knowledge Environment:*** Knowledge environment attempts to create environments that foster knowledge management, which can raise members’ positive attitude to knowledge sharing.

3. 2. A Technical Solution to Share Knowledge in the Sytem

As mentioned above, knowledge is a belief that has been validated through a person’s experience, Information is meaning or significance made up from data, while knowledge is the process of recognizing this information and acting upon it. Based on traditional knowledge sharing system, the documents structures are shown below.

- Title
- Author
- Published Year
- Abstract
- Keyword

- Content

From the structure we can know that the documents couldn't carry any personal knowledge, so, documents should be described that research members have filtered and collected for their own purpose could be viewed as knowledge which has been extracted from the information found in volumes of research paper data. Base on these ideas, the structured documents are shown as follows:

- Title
- Author
- Publish Year
- Abstract
- Keyword
- Document Location
- Readers' Knowledge
    1) Reader's Name
    2) Comments
    3) Research Fields

Of these items, it is important to record Document Location, since this system shares document information, in order to allow members other than the provider of the information to find the document, it is necessary to record where one must go to find it. Reader's Knowledge is especially important for the new system comers. With this characteristic, the system is the knowledge sharing system other than information sharing system. Our solution is composed of three interrelated phases, as shown in Fig.1.

Phase 1:Member register. Research members register into database information about user name, his or her interested research domain and the information about documents they have read. This information filtered by each staff member for his/her own research goals.

Phase 2:Forming group. We believe that knowledge sharing should be a group activity. When a new member registers, the system will give him a group by his interested research domain automatically.

Phase 3:Knowledge sharing. In this phase, members can read the documents information and knowledge about the documents, which are provided by other members. They also can share their knowledge to other related members through the structured documents. Knowledge here means two aspects: one is the comments and weights that given to the document, it is explicit knowledge, the other are the documents mapping to a member, system can form a documents related map automatically.

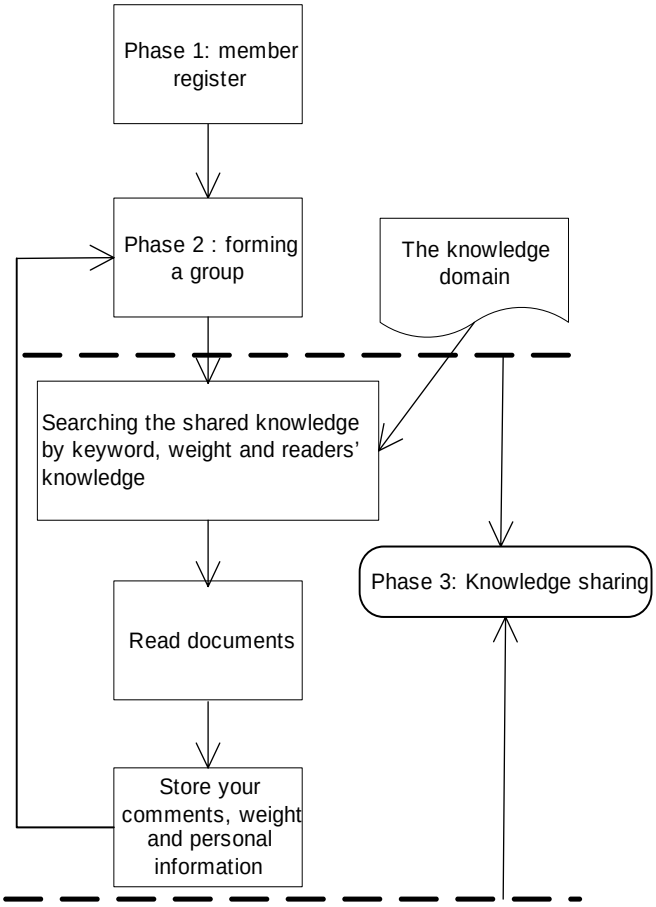

Fig. 1. Solution for knowledge sharing in the prototype system

4. A NETWORK SYSTEM REALIZATION

As a project supported by the JAIST COE Program titled "technology creation based on knowledge science", a network system for knowledge sharing is under developing. The benefits of using the system include:

- Helping researchers in managing their personal knowledge
- Helping research member in searching his/her group/lab's research knowledge
- Helping group/lab in packing up individual knowledge to group knowledge
- Building group knowledge archives that can be used as the source of data mining (knowledge discovery)

The system is a web-based system. Basically, users only need a web browser, such as Internet Explorer or

Netscape, and an Internet connection to access it. The following is the main techniques used for developing the system:

- *Tomcat [9]*. We use Tomcat 5.1 as the web server. Tomcat is the servlet container that is used in the official Reference Implementation for the Java Servlet and Java Server Pages technologies. Tomcat is developed in an open and participatory environment and released under the Apache Software License.
- *SQL Server 2000 [10]*. We use SQL Server 2000 as the background database server. SQL Server 2000 is a popular DBMS (data base management system) developed by Microsoft.
- *Struts[11]*. Struts is an assistant developing tool of design patterns. It provides Model-View-Controller (so called MVC) pattern in developing web site. The structure of struts application server show in Fig. 2, It also provides a set of supporting classes.
- *JSP (JavaServer Pages) [12]*. JSP technology enables Web developers and designers to rapidly develop and easily maintain, information-rich, dynamic Web pages that leverage existing business systems. As part of the Java technology family, JSP technology enables rapid development of Web-based applications that are platform independent. JSP technology separates the user interface from content generation, enabling designers to change the overall page layout without altering the underlying dynamic content.
- *Java Servlet [13]*. Java Servlet technology provides Web developers with a simple, consistent mechanism for extending the functionality of a Web server and for accessing existing business systems. A servlet can almost be thought of as an applet that runs on the server side--without a face. Java servlets make many Web applications possible.

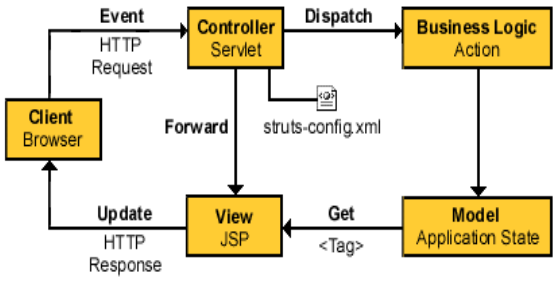

Fig. 2. Structure of struts application server

Fig. 3 shows the interface of the entrance of the system. We provide both English version and Japanese version. As shown in Fig. 4, members were asked to create bookmarks and comments organized according to their information categorization methods and to input document into information into these categories, bookmark and comments on this screen are those of the currently logged in user, and it is possible to browse bookmarks created by users who had shared their own bookmarks and comments.

From the document titles in the bookmarks, it is easy to browse document information which are shown in Fig. 5, in the document information screen, in addition to basic document information, it is also possible to see which books we refereed when reading this document. By sharing bookmarks and comments with other members in this way, we can know which books distinguished superiors have read and learn about their system of organization.

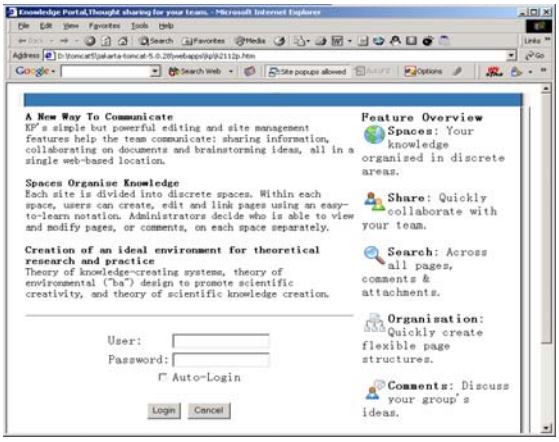

Fig. 3. The entrance of the system

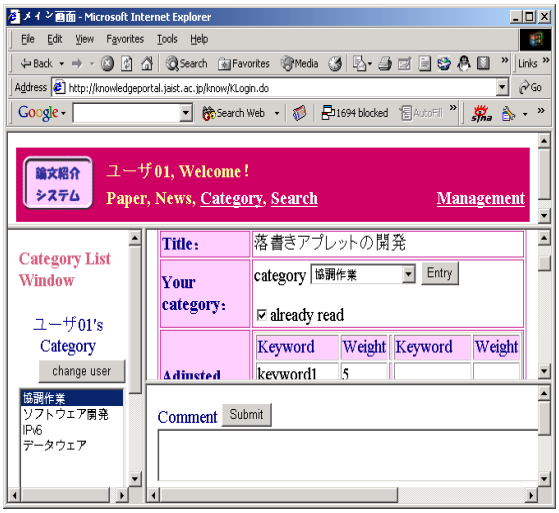

Fig.4 An example of adding bookmark and comments

Fig. 6 is the drawings of links between documents using the Spring Model. Links between documents are based on “other documents which are useful” information which members recorded when they registered the document information. As shown in Fig. 6, it is possible to discover important documents that have many links. Since documents we have already read are shown in gray, this becomes a history of which documents we have already read, and by following paths to the splitting to books we have not read, we can expect unforeseen discoveries of materials. Also the directed graph faces downwards, by reading the documents shown in the top, new members could systematically read documents to a certain extent.

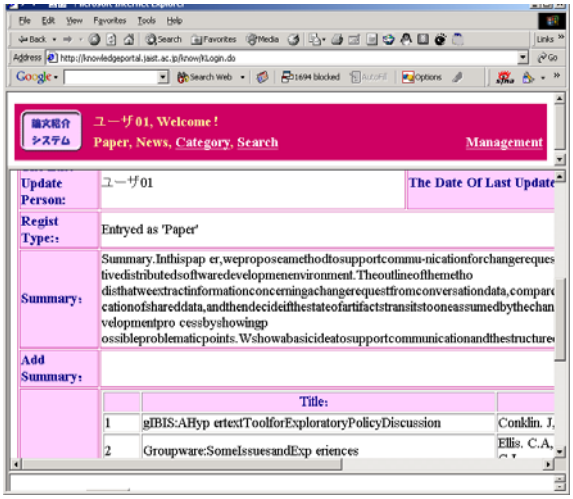

Fig.5 Browsing of literature information

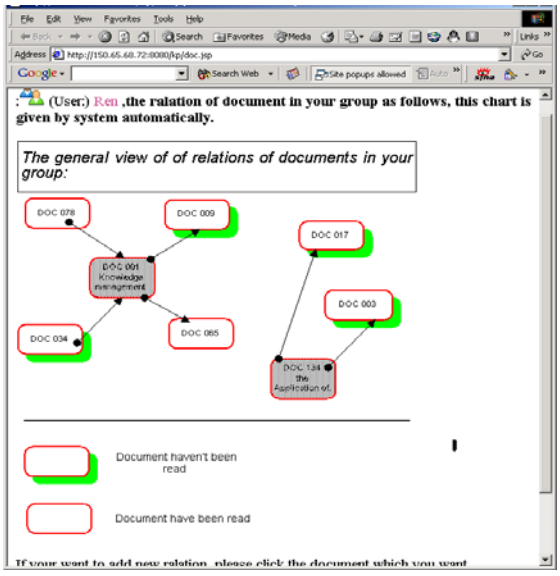

Fig. 6 Visualization of relation of documents

Users can share bookmarks and comments to other members, and they can reply those comments online, as shown Fig. 7 shows that three your personal knowledge at list, you can select any to share in your group by clicking the “share it”, the more detailed information can be seen by clicking their titles.

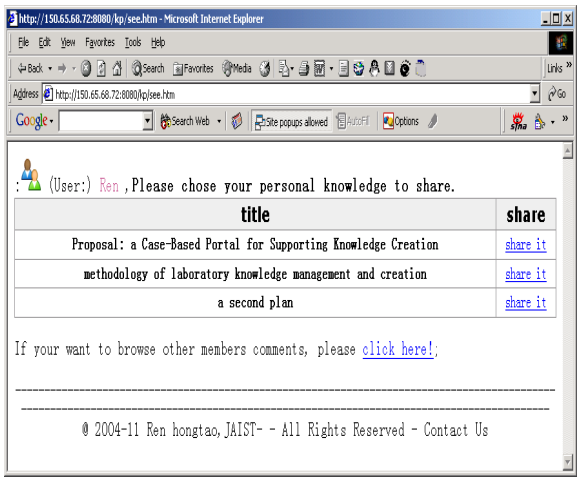

Fig.7 the interface personal knowledge management

5. CONCLUSION

This paper put forward a solution for knowledge sharing based on the structured documents technology, introduced a network system. In practice, we found that system is more welcomed by junior members than senior members. It seems the benefits of system for junior members are obvious than those for senior members. Senior members are more likely to believe that they can search documents by themselves without other members’ comments. So, sometimes, they don’t like to share their own knowledge in the group. Finding a properly mechanism to inspirit members share their experience and knowledge will be the important target in the future.

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