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Knowledge Flows Automation and Designing a Knowledge Management Framework for Educational Organizations

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ABSTRACT

One of an important factor in the success of organizations is the efficiency of knowledge flow. The knowledge flow is a comprehensive concept and in recent studies of organizational analysis broadly considered in the areas of strategic management, organizational analysis and economics. In this paper, we consider knowledge flows from an Information Technology (IT) viewpoint. We usually have two sets of technological challenges that prevent the knowledge flow efficiency in the organizations: the passive kind of present knowledge management technologies and the information excess problem. To get the efficient flow of knowledge, we need high exactness recommender systems and dynamic knowledge management technologies that automate knowledge transportation and permit the management and control of knowledge flow. In this paper, we combine and make upon the information management systems and workflows presented in literature to generate technologies that address the serious gap between current knowledge management systems. Also, we propose a knowledge management framework for educational organizations and use this framework in a real situation and analyze the results. The weakness of knowledge flow infrastructure is one of the most important barriers to knowledge sharing through an organization. The proposed technology in this paper provides a new generation of knowledge management systems that will permit the efficient flow of knowledge and conquest to the technological constraints in knowledge sharing across an organization.

1. Introduction

A dynamic confine of the organization need to prepare an environment where personnel can share ideas, provide each other with interrelationship and reuse prior tasks [15].

New organizations have become more complicated units with various interrelationships and the efficient knowledge flows management in such organizations needs powerful tools to get, share and control the knowledge of all sectors across the organization.

In other words, knowledge has a great role among the most critical factors in the transformation of organizations as dynamic systems.

In information society, the success of organizations depends increasingly on how they use their knowledge capitals and mange their knowledge processes [11].

In this paper, we tend to consider knowledge flows in the organization from an IT viewpoint. As you know, IT provides various tools that can strongly use in

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knowledge management. Available tools for knowledge management include Decision Support Systems (DSS), expert systems, computer networks such as intranet and extranet, document recommender systems and a wide variety of knowledge representation tools.

In the organizations, the major portion of knowledge is tacit and therefore organizations must build knowledge management systems, such as knowledge repositories or knowledge recommender systems to retain the maximum available tacit knowledge in personnel minds and make it available to the people who need it [11].

2. Literature Review

In this section, we consider related literature in information gathering and retrieval systems that form the infrastructure of the technologies discussed in this paper.

2.1. Information Filtering Systems

In general these systems can be classified into collaborative and content based systems [14]. The first category, i.e. collaborative systems make decisions based on ratings adopted by a group of experts or usual people. The basic point in this category is the similarity of preferences among a group of people or consumers is a forecaster of the future demands or interests of an individula user. On the other hand the second category, i.e. contenet based techniques are mainly rely on user profilesc and the data gathered in documents to make a decision to share the document [7].

2.2. Knowledge Flow Analysis and Management

Different researchers have been introduced and discussed about knowledge flow models fom various points of view. For example, Nissen introducded a dynamic model to classify the knowledge flows in a business that has two sets of processes. Horiaontal processses that characterize the kind of workflow and vertical processes that cross-process activities [13]. Zhuge introduced a knowledge flow model that analyze the state of knowledge sharing in a team environment [22].

2.3. Recommender Performance Analysis

Retrieval perfomance can be categorized in algorithm-oriented and query-oriented. The focus of first category, algorithm-oriented is on improving ranking, likeness measures and new mechanisms to illustrate and interpret document corpora [1]. Another important aspect in this discussion is predicting query performance that has been approached from several different directions. The predictors can be classified as query-based and retrieval-set-based predictors [18].

3. Evaluating a Concept Space Approach to Knowledge Distribution

Designing a knowledge management system or framework in organizations have different aspects. One of an important aspects in this area is designing the knowledge distrubution mechanisms. These mechsanisms are designed to distribute applicable knowledge to the related users in a timely manner. Mailing lists is one of the most commonly used mechanism to distribte applicable information to users [21]. Although by choosing a plain mailing list, organizations may encountered with some risks. For example flooding the mailboxes with unrelated information or not delivering related information to users who are not contribute to the list.

3.1. Organizational Concept Space

We can extend conceptual clustering techniques by integrating user relevance information with concept scale to get organizational concept space [20]. Clearly, this concept consists of an relevance matrix and a likeness network. The relevance matrix is a two dimensional matrix with subjects along one dimension and users along another dimension. A diagram of the refining process is given in figure 1.

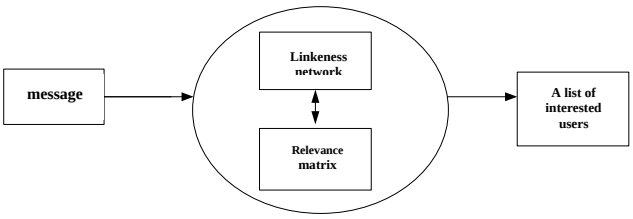

Fig. 1. Overview of the OCS approach [20]

3.2. Data Collection Method

3.2.1. User Profiles

Here we explian an example of OCS approach. The first step in this approach is data collection. In this example the profiles of the users are getting from faculty and university websites. The criterion of the selection is availability of their research topics and research profiles were collected to illustrate a wide variety of area of study. An example of user profile is illustrated in Figure 2.

A User Profile from the Source	Topics Extracted
software assessment and characterization, software development processes, software engineering education and practice, application of information technology to education	*software assessment, software characterization, software development processes, software engineering+ education + practice information technology +education*

Fig. 2. Sample user profile Call for Papers [16]

Call for papers (CFP) from reliable journals and international conferences is the input of the system. A typical CFP includes a brief introduction of the conference or journal and a list of proposed topics.

3.3. Similarity Network

We developed a basic likeness network from subjects in the areas of database systems, software and hardware engineering, E-business, computer networks, artificial intelligence, human machine interaction and information systems. Also when generating user profile more subjects were added. The resulting likeness network had four floors and about 140 subjects. Figure 3 illustrates a piece of likeness network under the subject "database".

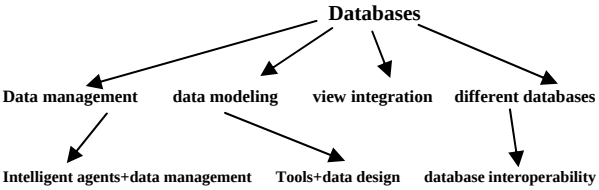

Fig. 3. A sample similarity network [16]

3.4. Interest Matrix

A relevance matrix (140×10) was generated to introduce the fascinates of the user in each of the subjects.

The important instances for the faculty users included databases, software engineering, Aritificial Intelligence, computer networks and IT management. Subjects that were mentioned in the profiles were given a value of 1 and related topics were given a value between 0 and 0.9 based on the proximity of the subject to a mentioned subject of interest. The relevance values were designated based on the majority of the subject [9].

4. Proposed System Architecture

To test the organizational concept space we are using Java programming language plus Oracle database on a wondows 2003 Server platform. The procedures and algorithms were implemented using Java programming language and SQL statements [2]. Because this is a conceptual implementation, we do not respect to computational power in this specific study. The relevance network, relevance sets and the user relevance matrix were implemented as releational tables.

The schematic of the system is shown in figure 4. The main components of the system include a message analyzer and an OCS module [14].

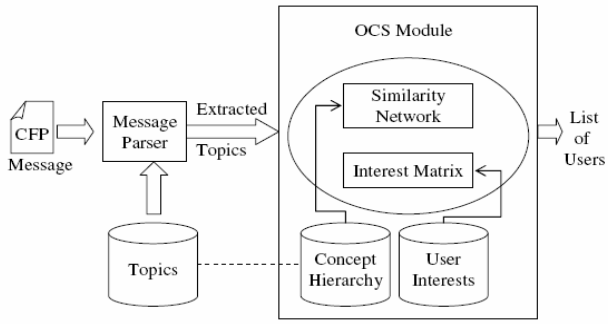

Fig. 4. System architecture [16]

4.1. Enabling Task Centric Document Recommendations

In this section, we consider a pattern that supports enterprise knowledge flow: task-centric document recommendaion. The concept of task-centricity stress that the transport of documents to users is based on the tasks choose for them. We propose a schematic for this pattern that is shown in figure 5. The proposed system combine a document advisor with a workflow management system (WFMS) and has features that distinguish it from current knowledge management systems [4]. First, it does not require the design time and second the query generation process in this architecture is automati, which enables proactive shipment.

4.2. System Architecture

The key parts of the system include a document advisor that is concisely integrated with a workflow management system. This recommender part provides the workflow management system with a list of the docuyments related to the task [6]. After this step the documents are recommended to the users through organizational units via network user interfaces.

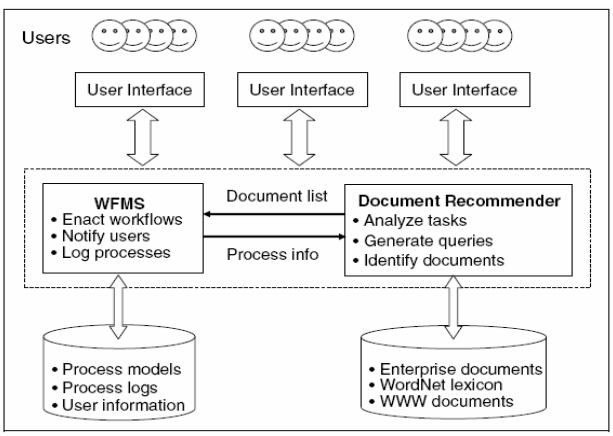

Fig. 5. System architecture for task-centric document recommendation [16]

5. A Workflow Centric Approach to Automating Knowledge Flow Processes

The meaning of knowledge flow concept refers to knowledge transfer among knowledge workers across firm boundries. Figure 6 illustrate the knowledge flow concept. In this transfer knowledge flow process means that sequence of tasks that need to be performed. Although it is obvious that in order to improve productivity of knowledge sharing in the organization knowledge flow processes should be automated. No frameworks designed precisely for this purpose [8].

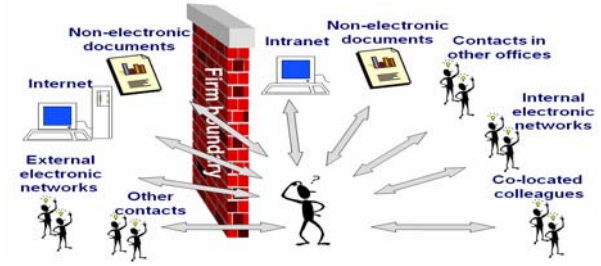

Fig. 6. Schematic of knowledge flow

In order to automate, manage and control the knowledge flow processes, we introducde knowledge workflow. A fromal representation of knowledge flow proceses that possible the automation, management and controlling of knowledg flow processes in a firm.

5.1. Knowledge Workflow Approach

The requirements of knowledge flow is integrating information retrieval procedure with workflow systems. For example, as shown in figure 7 consider the list-server-based knowledge flow process when improved with intelligent services. In the list-server-based knowledge fow process, various experts that are contacted are unconcerned with the message.

The user is also conquered with multiple responses. In the intelligent improved knowledge flow peocedures, we have three sets of services [17]. The use of Filtering service stops the distribution of the message, whereas the use of summerization and aggregation services stops excessing the user. Each of these mechanism have specific tasks. While information retrieval sections provide finding services, workflow systems arrange mention of the appropriate service and automate the routing and transport of the documents [12].

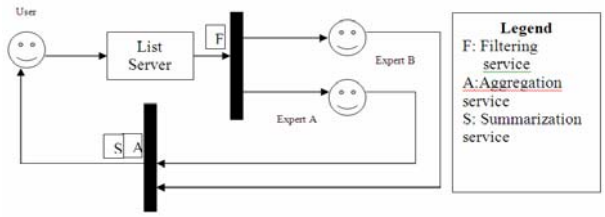

Fig. 7. An enhanced list server based knowledge flow process [16]

The knowledge flow automation with this procedure has various advantages: (1) it saves time by concurrently beginning differenet resources to answer to the knowledge enquiry; (2) it prohibits overwhelming the user with replies after persuading the request; (3) finishing the knowledge flow also prevents from reworking, i.e. responding to requests that have already persuaded; (4) reduce the information overload problem by correct routing and preventing requests from being routed to experts that are not applicable to the given enquiry; (5) it enables knowledge organizaton and codification [5].

5.2. A Formal Framework for Knowledge Workflow Management

To perform the knowledge workflows, we suggest a structure for knowledge workflow management and control. This system can interact with users through a company and composed of four important compinents: (1) a modeler, (2) an intelligent engine, (3) an expertise positioner and (4) an intelligent document advisor.

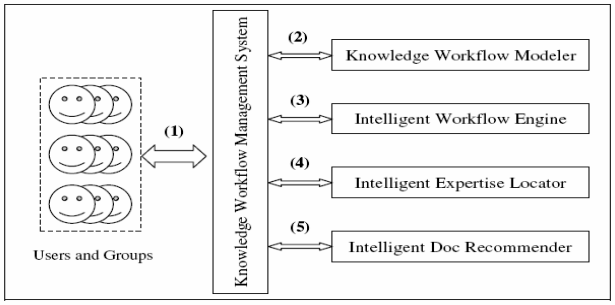

Fig. 8. Architecture for knowledge workflow management system [16]

Each of the above sections have specific tasks. The information finding engine is used to achieve document recommendation, aggregation and other finding related functions. The intelligent positioner is used similarly to the role-intention function in established workflow systems. The system uses multiple sources of information to recognize related experts. The knowledge workflow modeler collects patterns to expand a workflow that meet the given demand. The knowledge workflow is completed using a state-machine-based workflow engine [3].

We apply an intelligent workflow engine beacause it is suitable for achieving workflows in which the control flow and series of events cannot be controlled at design time and is based on the output of intervening events and input from the user. In the suggested structure, the state-machine-based workflow performs an example level pattern that is produced by knowledge workflow management system [10]. We formally identify the different system components (see figure 8) and relevant concepts, which could be used as the foundations for different types of system analysis. Important topics for future research are:

- Conformation of the competence of the state-machine workflow illustration;
- Inspection of differences and other problems related to the dynamic enlargement of knowledge workflow patterns
- Recognition of knowledge workflow patterns, including basic patterns and merge them to generate complicated knowledge workflows
- Restriction of data overwhelm by managing and controlling the power of knowledge flows at the consumer and system levels

6. Case Study: Knowledge Management System for an Educational Organization

Based on the above discussions, we consider the management system in an educational organization, i.e., Iran Technical and Vocational Training Organization (Iran TVTO) that is attached in the appendix. The Iran Technical and Vocational Training Organization is responsible for training workers and equipping them with technical and vocational skills. Given the volume of activities in this organization, creativity and innovation in the knowledge management system and information retrieval comprehensive system are essential. Thus, we suggest this framework to utilize knowledge in educational organizations, i.e., the pattern of identifying, evaluating, organizing, storing and utilizing knowledge to meet the needs and goals in educational organizations, especially for the Iran TVTO. Then, we evaluate this framework for the organization.

To evaluate the proposed method, we designed a questionnaire and distributed it to top managers in the organization. Then, using Cronbach's Alpha test from the SPSS software application, we consider the justifiability of this framework. The results of this experiment show that this questionnaire is useful. Based on the managers' suggestions, the most important factors for a robust knowledge management framework are organizational culture and human resources, management and technology. The result of the questionnaire are provided in the tables below.

Tab. 1. Results of the Cronbach's alpha test

Case Processing Summary

		N	%
Cases	Valid	40	100.0
	Excluded[a]	0	.0
	Total	40	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.760	.755	11

Tab. 2. Results of specifying preferences by using AHP method and Expert choice software

topic	Percent
Organizational culture & human resources	60.2
Management	27.9
Technology	11.9
Sum	100

Inconsistency= 0.01

In the next phase of our survey, we considered the readiness of the organization to implement our knowledge management representation by designing another questionnaire that consists of questions for those three areas. Analysis of this questionnaire reveals the current situation of organization in each of these areas. Figure 8 shows the current and ideal knowledge management situations in the organization. Also, for the justifiability test we use the Cronbach's alpha test again. Table 3 shows the results of this test.

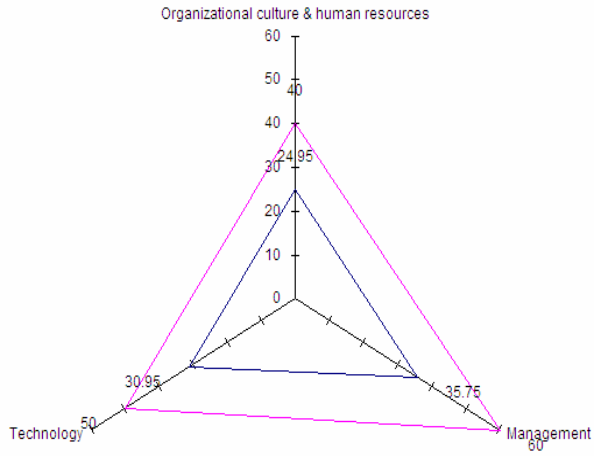

Fig. 9. Comparison between current & ideal situations of KM in the organization

Tab. 3. Results of the Cronbach's alpha test for questionnaire 2

Case Processing Summary

		N	%
Cases	Valid	20	100.0
	Excluded[a]	0	.0
	Total	20	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.969	.970	30

6.1. Suggestions for Improving KM Situation in the Organization

As we can see, the current situation of KM in the organization is mediocre and can be improved by implementing the following:

- *Creating a KM section in the organization*
- *Soliciting the aid of top managers in KM activities*
- *Assigning the required resources to develop KM in the organization*
- *Developing preferences for KM in the organizational culture and human resources*
- *Developing a learning culture, information allotment and group working*
- *Adjusting the service and personnel premium system in the organization to realize KM and the creation and classification of knowledge*
- *Evaluating personnel based on the results of researches and other knowledge in the organization*
- *Creating mechanisms that convert personnel tacit knowledge to explicit knowledge*
- *Creating a closer relationship between customers and the product design based on customer needs*
- *Developing computer networks and data mining technologies*
- *Creating a knowledge portal in the organization*
- *Developing necessary technologies to search and retrieve knowledge in the organization*

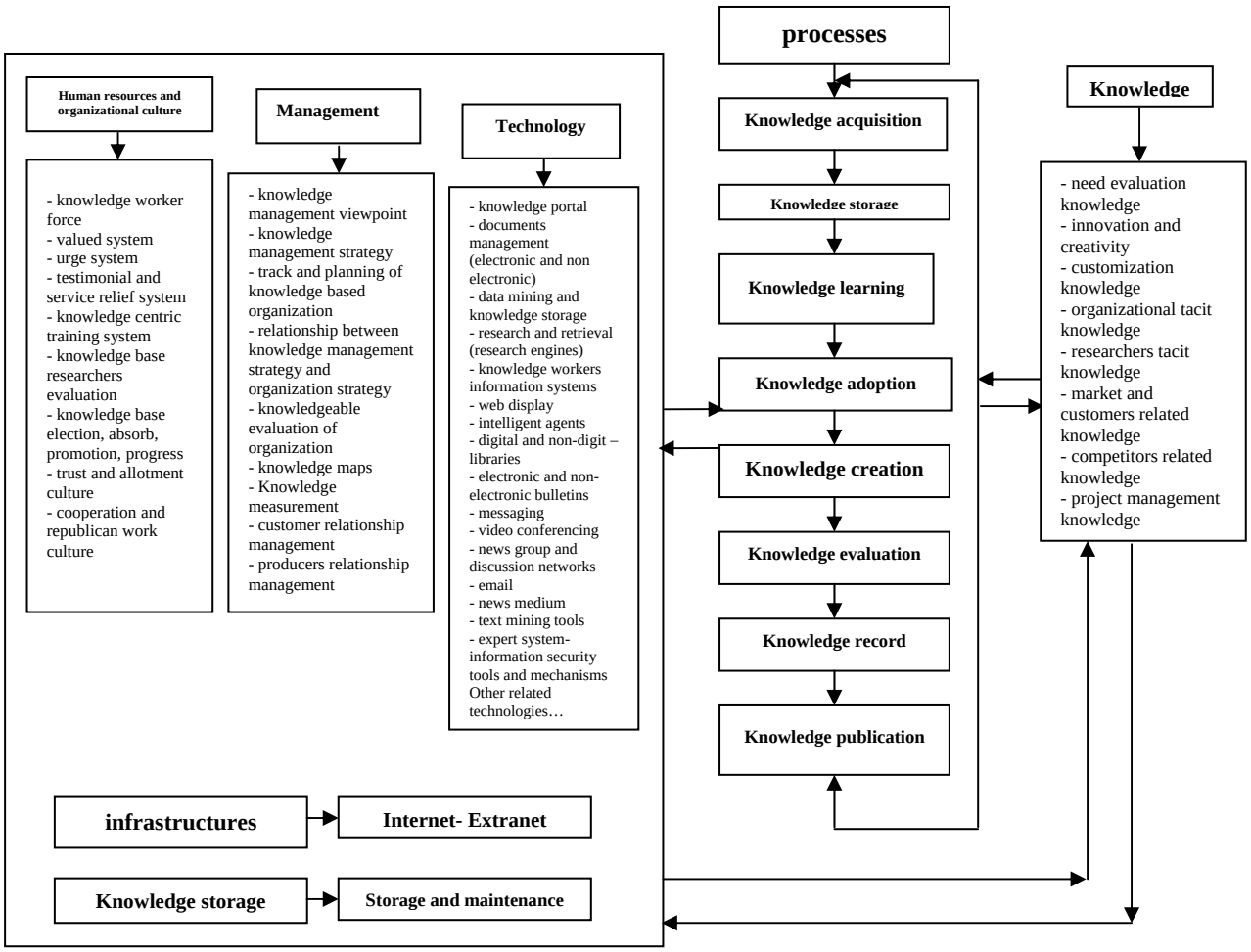

Fig. 10. Proposed framework for utilizing knowledge management in educational organizations

6.2. Creating a Real KM System

To create a sample KM system, we suggest a web-based system based on knowledge-building and Nonaka-Takeuchi models. Using web based software provides easy access to the personnel. The following subsystems are included:

- Knowledge cycle system
- Knowledge evaluation system
- Testimonial system
- Knowledge map system
- Knowledge packeting system
- Reporting system
- Question cycle
- Evaluating Organization knowledge situation
- Knowledge documentation

A schematic model of the system is shown in figure 11. Using this software and KM system, we see substantial changes in the evaluation indices of the organization.

In this framework and proposed software, the implemented KM system considers both the structure and culture of the current technology [19]. To evaluate the proposed system, we identified two sets of indices. The first set of indices indicates desirable changes, and the second set of indices is the percent change based on questionnaires distributed before and after the system was implemented. The results are shown in table 4.

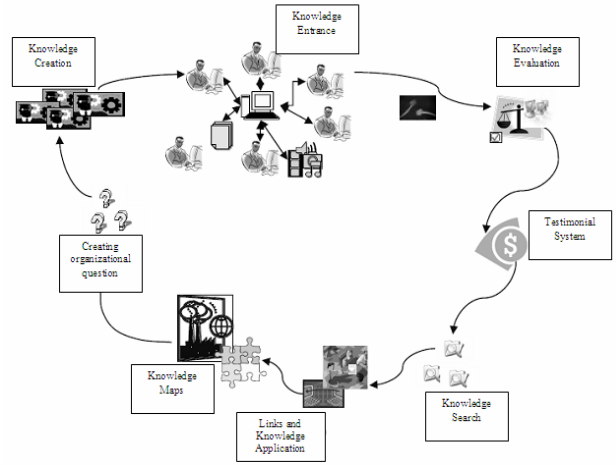

Fig. 11. Schematic representation of the proposed KM system

Tab. 4. Results from Implementing KM in the organization

Topic	Index	Percent of Change (%)
Human (Culture)	Valuation of organization to personnel knowledge	33.20
	Notification of personnel knowledge	15.14
	Cognition of best respondents to problems	12.97
	Knowledge exchange to other section personnel	9.23
	Sensing the importance of acquisitive experiences in organizational improvement	4.15
	Knowledge improvement by engagement in the organization	3.25
	Doing works by groups	3.18
	Emphasis on personal experiences in doing works	-1.23
Technology	Effective relationship with experts of organization	29.95
	Cognition the knowledge weakness points in special fields	
	Cognition the producing knowledge in the past and preventing from reproducing existent knowledge	16.29
	Improvement work processes by using systematic knowledge bank	3.18

7. Conclusions

In this paper, we discussed about three related topics that improve new technologies aimed at automating the flow of knowledge in the firms. In the first study, we illustrated a test to assess the influence of organizational concept space (OCS) on the correctness and remember of a knowledge diffusion algorithm in the subject of diffusing call-for-papers to a set of related users. In the second study, we proposed a type of documant commendation technique that enable automatc commendation of related documents without necessity for either user affiliation or design time statement of document needs.

In the third study, we proposed knowledge workflow to automate the flow of knowledge in a firm. The proposed technique is the first such research at automating knowledge flows extrior a formal business process. We discussed that the traditional workflow pattern is don't adequate for supporting knowledge workflows instantly appropriate to a conflict between the dynamic and probabilistic nature of knowledge workflow and the fixed model pattern of a traditional workflow engine.

Moreover, we proposed a structure for knowledge workflow management systems that composed of an intelligent engine, a modeler, an intelligent skilfulness locator and an intelligent document advisor. Also, based on these discussions, we proposed a knowledge management framework for learning organizations and used this framework in a real situation, i.e., the Mazandaran Technical and Vocational Training Organization. Finally, we analyze the noticable results.

We think that the enquiry generation and other related techniques proposed in this paper compose a basis group of qualifying technologies to enable indiscriminate discovery and sharing of knowledge in firm circumstances and will enable the improvement of a new generation of knowledge mangement.

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