

Domain Knowledge Actively Recommendation System Based by Process-Driven and Rough Set

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Abstract

Recommend knowledge to staff who need in the work can improve work efficiency, knowledge application and innovation. Enterprise knowledge is described in three dimensions: knowledge attribute, process and domain. Based on this, domain knowledge actively recommendation architecture based by process-driven and rough set is construct, while domain knowledge and rough set active recommendation method is proposed. We will use this architecture to analyze employee, domain, and process. Then will using rough set to analyze the rules from logs of using knowledge. Combination with requirement of employees, process data and the rules to achieve recommend the accurate knowledge.

Keywords: *Rough set; Knowledge recommendation; Process-driven*

1. Introduction

Wang Jun [1] thinks that on the knowledge economy, knowledge is becoming important resource for increasing companies. Regarding knowledge as the most important companies' resource, how to recommend the right knowledge to the right people is more important. How to recommend it by their requirement? And to improve the innovation of knowledge has become the focus of academic and business circles. This paper argues that the nature of knowledge recommendation is recommend the right knowledge to right people at the right time. When we put the knowledge, business processes and people together, we can obtain the righter recommendation. In addition, there are lots of intersection domain of the different processes. We use rough set to analysis the inter-relationships. The problem comes from a particular domain in the enterprise. So the domain knowledge becomes more important on the recommendation system. So we proposed a method that domain knowledge actively recommendation based by process-driven and rough sets. Firstly we construct the process and set the fit employee. Then employee can customize their interests. Meanwhile they can write down experience of the work. System gathers the information to the database. Using rough set to obtain the recommendation knowledge. The test result shows the method of this paper is more accuracy. And the employee's feedback is well.

2. Related Work

Knowledge recommendation can be divided into the three categories:

Knowledge recommendation system based on user interest mining personalized:

This section is currently hot research topic. Yu Li, Liu Lu [2] reported e-commerce recommendation analyzes the system, including recommended system-related technologies models and problems.

Knowledge recommendation system based on jobs requirement:

This part of the job or function as long as the needs of employees and the knowledge required for analysis, according to job requirements and related functions to push the hands of users. Yong Feng [3] analyzed post knowledge of the needs of a knowledge-based organization, we give a knowledge-based organization for the post of Knowledge Push System architecture.

Knowledge recommendation system based on process-driven:

This part of the latest research, relatively few studies compared to the previous two parts of this section. Gan [4] reported origin and development of knowledge Process outsourcing. Liao [5] reported study on business process knowledge retrieval. Jiang [6] reported research on knowledge push service for produce designer. Xiang [7] reported technology for product design knowledge push based on ontology and rough set to open a new gate. Cai [8] reported business process reengineering based on knowledge flow optimization.

3. The Description Method of Domain Knowledge Based Process

For a description and classification of knowledge, lot of experts and scholars give a different classification. British Polanyi 1958 [9] in the human knowledge "personal knowledge" put the knowledge divided into two categories: explicit knowledge which is can use the words, images, *etc.* to express their idea and tacit knowledge which is rooted in the internal organization, has not been expressed. OECD (Organization for Economic Cooperation and Development) gives a classification of knowledge: know-what, I know why knowledge, know Quebec's knowledge, know-who on the book named "knowledge-based economy [10].

Domain knowledge actively recommendation system based by process-driven and rough set is driven by process, and using rough set to analysis the flow characteristics, staff characteristics, intellectual property and other domain. Recommend the right knowledge to the right people at the right time. Therefore, we should describe the knowledge from knowledge categories, domain and processes. As shown in Figure 1.

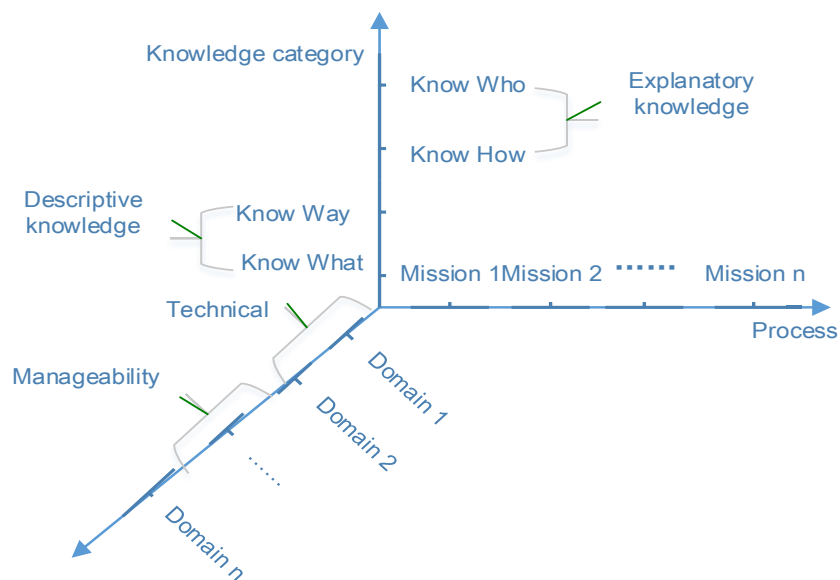


Figure 1. Knowledge Three Dimensions (Knowledge Categories, Processes, Domain)

4. The Recommendation Architecture of Domain Knowledge Based Process

Domain knowledge actively recommendation system based by process-driven and rough set, can be considered from the following four levels: user level, knowledge resource level, domain level and process level. First, the process level drive by knowledge resources and domain level using rough set to match the relevant knowledge. Then recommend the knowledge that which in need to the user level. Users submit or evaluate the review to knowledge resource level. All levels' major functions:

User level: Most of users are employees, they are the main part of business creation and application of knowledge, and is the target of knowledge recommendation. Users can evaluate, feedback, and release knowledge. And can also set the domain of their attention, which is associated with the domain level.

Knowledge resource level: Knowledge resource level is composed of company knowledge, staff knowledge and outside the enterprise network's knowledge. We put it into factual knowledge, principles knowledge, technique knowledge and experience knowledge.

Domain level: It's middle level between user level, knowledge resource level and process level. Because of professional categories, companies having difference knowledge on the domain. Domain level can be reduced to match the range of knowledge.

Process level: Process level is the start position of recommendation. Process mainly refers enterprise workflow. Process generated by the enterprises' needs. It can be divided into several independent sub-processes according to the requirements. It can be assigned to the respective employees. And each sub-process corresponds to some domain property.

5. Domain Knowledge Actively Recommendation Based by Process-Driven

Firstly, we create the process by companies' requirement. Then divide process into sub-process based by human and material resources. The process of recommendation can be divided into server and client.

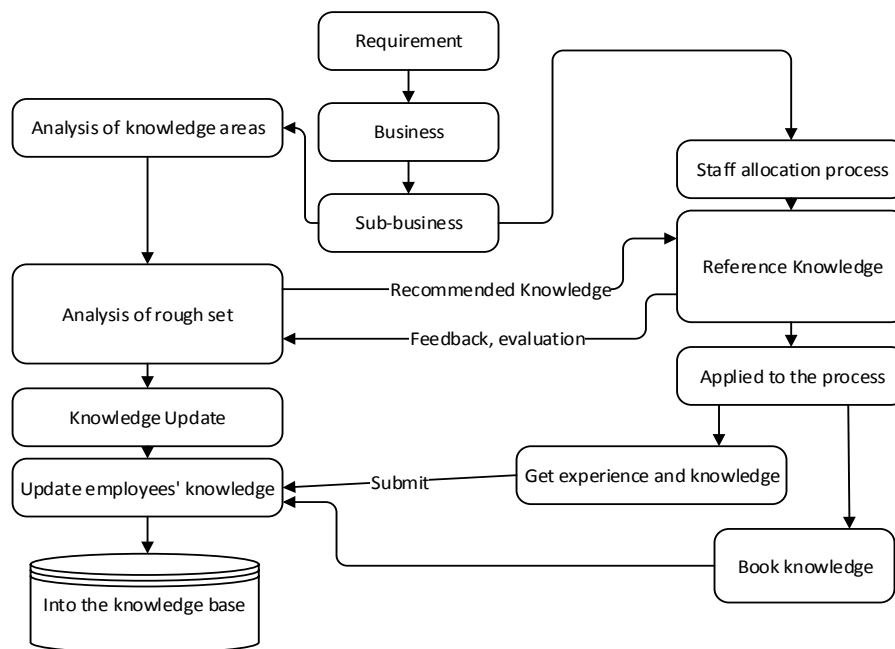


Figure 2. Push Process

Server: All the data are stored on the server, it's divided into three parts, process data, user data and knowledge data. Process data is obtained according to the needs of the process. Most user data is user information and its usage log. Knowledge data is uploaded log by users and businesses accumulated knowledge information. When a new sub-process is built or stored in the database, it will trigger the system. Then the system will be analyzed domain of the sub-process, and using rough set analysis the knowledge. Meanwhile system will put the top rank to the users. Users will feedback and evaluation of knowledge to help improving the matching algorithm. The server will be updated according by the employees' feedback, to filter out less useful knowledge and less golden knowledge.

Client: Most function of client is employees to use. The employees can read knowledge which is service recommend, evaluation, feedback and publish knowledge. And it can customize their interests and hobbies. So the server can make the recommended knowledge that we all interest.

6. Knowledge Matching Model Construction Based on Rough Set

6.1 Basic Theory of Rough Set

Decision tables are special and important knowledge representation system. Most decision-making problems can be expressed decision tables which is a tool that plays an important role in the rough set.

What is decision table? Set $S = \langle U, R, V, f \rangle$ is a knowledge representation system, U is the universe finite set of objects showing $\{[x_i]_R | x_i \in U\}$, R represents a finite attributes set, $R = C \cup D, C \cap D = \emptyset$, C is condition attribute set, D called decision attribute set. V is attribute value set $V = \bigcup_{a \in A} V_a$, V_a is a property of a value range. $f : U \times R \rightarrow V$ is an information function which assigned a specifies the property value U from each object x . Decision table is that who have conditional attributes and decision attribute's knowledge representation system.

Definition 1: Set U is domain, if $R = U \times U$, then called R is a relation on U .

Definition 2: Set R is a relation on U , if satisfy of the three properties, then called R is an equivalence relation on U .

Reflexivity: Any $x \in U$, there are $(x, x) \in R$

Symmetry: If $(x, y) \in R$ then $(y, x) \in R, (y, x) \in U$

Transitive: If $(x, y) \in R$ and $(y, z) \in R$, then $(x, z) \in R, (x, y, z) \in U$

Definition 3: For a subset of attributes $P \subseteq R$ and $P \neq \emptyset$, then the intersection of all P equivalence relation is called a P indistinguishable on the relationship (indiscernibility relation or difficult to distinguish relationships), denoted $IND(P)$, abbreviated U/P .

Definition 4: set $K = (U, R)$ is a knowledge system, $X \subseteq U, R(X) = \{x \in U | [x]_R \subseteq X\}$ positive region called X , denoted $posR(X) = R(x)$

Definition 5: in $S = \langle U, R, V, f \rangle$ this knowledge system, the condition of the property C associated with decision attribute D (also called dependency) to:

$$r_c(D) = \frac{\text{card}(\text{pos}_c(D))}{\text{card}(U)}$$

Where: $\text{card}(U)$ denote the number of elements in U .

Definition 6: The condition attribute C for decision attribute D valid values:

$$\text{Sig}(c) = r_c(D) - r_{(c-\emptyset)}(D)$$

Definition 7: Reduction definitions: Given an information sheet $IN(M,N)$, if the attribute set $A \subseteq B$ satisfying $IND(B) = IND(A)$, called B is a reduction of A 's. Referred to as $red(A)$, $B = red(A)$.

6.2 Knowledge Matching Model Based on Rough Set

Quad $S = \langle U, R, V, f \rangle$ is a knowledge recommendation decision expression system. $U = \{u_1, u_2, \dots, u_i\}$ represents the knowledge set that based of relevant knowledge corresponding of process in the domain, and each element represents a knowledge record; R represents a finite attributes set, $R = C \cup D, C \cap D = \emptyset$, C is called condition attribute set that for the process itself. D called decision attribute set which targets is to be achieved for this property.

Construction of knowledge matching model based on rough set is reduction. First, calculated dependence between condition attributes and decision attributes. Then calculate the RMS (root mean square), thus completing the recommended knowledge matching model based on rough sets. Here's the steps:

Step 1: Employee customization. Employees set up their posts, then booked their areas of interest.

Step 2: Decision table fill. According to the conditions of the properties it has been determined that C co-decision attribute D populate the decision table.

Step 3: By definition 2, were calculated in condition attributes C domain U equivalence class U/RC and decision attribute D in U on the equivalence classes U/RD , determine whether there is equivalence classes generated in the decision table If the presence of the transgene in step 4, otherwise go to step 2.

Step 4: Find the reduction attribute set. A definite decision table which is not all of the conditions is necessary, but remove excess property does not affect the decision-making results.

Step 5: Determine i and $i + 1$ this derived attribute reduction set is the same, if same, then the reduction end, otherwise, go to Step 6.

Step 6: Calculate the dependence of step 4. By definition 4-6 the dependence is

$$r_{c_i}(D) = \frac{\text{card}(\text{pos}_{c_i}(D))}{\text{card}(U)}$$

Step 7: Calculate the degree of importance was about to condition the property. Importance of property can be understood as the condition after the removal of property c_i , changes in the magnitude of the effect of the decision, the greater the change, indicating that the property more important. To obtained the degree of importance by the definition 6.

Step 8: Right renormalization. The importance of each condition attribute dimensionless normalized to obtain weighting factors, namely:

$$w_i = \frac{\text{Sig}(c_i)}{\sum_{i=1}^n \text{Sig}(c_i)}$$

Step 9: Construction of knowledge requirement model. Knowledge is defined as a 5-tuple, and each group can be understood as being involved in the domain of knowledge (a property of knowledge). RMS of knowledge property can be understand by that the contribution of complete the process which is employees' requirement on their jobs. The employees' knowledge model is as follows:

$$Q = \begin{bmatrix} q_1 \\ q_2 \\ \vdots \\ q_i \end{bmatrix} = \begin{bmatrix} w_{11} & w_{12} & w_{13} & w_{14} & w_{15} \\ w_{21} & w_{22} & w_{23} & w_{24} & w_{25} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ w_{k1} & w_{k2} & w_{k3} & w_{k4} & w_{k5} \end{bmatrix}$$

q_i is represent how much the employees need i knowledge. $w_{kj}(1 \leq j \leq 5)$ is represent how much employees k need knowledge's domain c_j . Extract the knowledge needs vector $q_i = [w_{k1} \ w_{k2} \ w_{k3} \ w_{k4} \ w_{k5}]$. Sort by its value .Put top 10 to recommend to the employees.

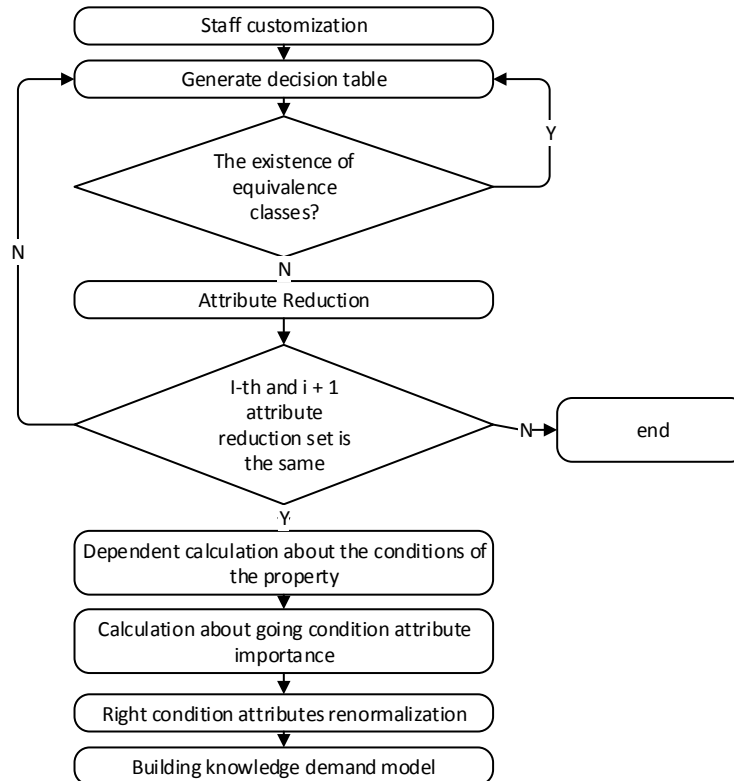


Figure 3. Construction of Model Flow Chart

7. Conclusion

Based on the J2EE platform, ssh architecture, Oracle, glass fiber manufacturing, develop an enterprise knowledge recommendation system. We establish a knowledge recommendation system based by process-driven and rough set. We construct the enterprise knowledge, and implement the algorithm on our system. Figure 4 is the main interface for enterprise knowledge sharing platform. Figure 5 is a related process module domain knowledge recommendation system, including: posted knowledge (Figure5a) select knowledge (Figure.5b); check knowledge (Figure.5c), and recommended knowledge (Figure 5d).

Knowledge is one of the key resources in the knowledge economy era. Improve the utilization of corporate knowledge effectively and promote knowledge innovation of employees, is the key to gain competitive advantage in the enterprise. In this paper, domain knowledge actively recommendation algorithm based by process-driven and rough set were presented, this algorithm can improve efficiency of recommend the knowledge. Meanwhile it can promote knowledge innovation help staff to get knowledge. The study is a useful complement to the theory of knowledge recommendation and provides a new way for enterprise knowledge management and application. However, research on corporate knowledge recommendation is not a lot, and there are many issues to be further studied, such as evaluation of enterprise recommendation effect, domain knowledge matching algorithm and other issues.



Figure 4. Main Interface for Enterprise Knowledge Sharing Platform

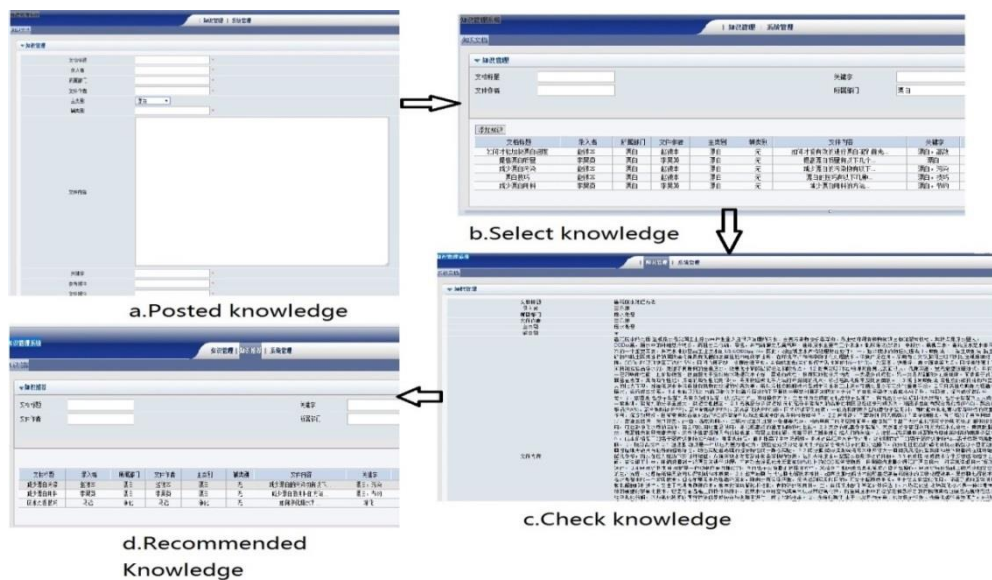


Figure 5. A Related Process Module Domain Knowledge Recommendation System

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