A User Behavior Model of Organizational Knowledge Support

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Abstract

In this paper, we analyze user behaviors in accessing to organizational knowledge. As results of this analysis, some interesting accessing patterns are observed. Based on these patterns, we propose a user behavior model called "Hurdle Jumping Model". Factors of this model are *purpose of the use* , *expectation to the service* and *clue of the use.* These factors have a close relation to cooperation in a group. They can be supported by reinforcing or noticing of themselves. For example, it is possible that a consumer who is a free rider on knowledge, turns into a producer by noticing of the activity of knowledge sharing to extend the scope of *purpose of the use.* Finally, we show an implementation which promotes knowledge sharing by noticing.

1 Introduction

Recently, while the computerization has spread in an office, distributed information has become various. Among such information, we especially focus on a certain form of information named, "organizational knowledge". This knowledge can be considered to be a main issue in a group work due to the following viewpoints.

- An organization consists of many sorts of people who have various background, habit and skill. These differences lead to several gaps (e.g., opinion gap). To overcome these gaps, it is necessary to share organizational knowledge among members in the organization.
- When an organization grows, organizational knowledge, which is inherited or interchanged among the members, is one of the factors for the organization growth.
- There are the roles of a producer and a consumer arising in knowledge sharing process. These roles easily influence members' mental states.

"Organizational knowledge" mentioned here means *information* which has an effect on management and maintenance of an organization. Here, how should such organizational knowledge be shared?

- In the past, the transmission of the organizational knowledge was accomplished by interactions among the human beings such as "learning from one's dictation" and "learning from watching other people". The advantage of these methods is its flexibility in the following two points. (1) The transmission contents accord with the acquisition level of the companion. (2) The transmission methods accord with the companion situation. However, these methods have some defects as shown below.
  - Even if one wants to get some knowledge, he might not be able to find out an instructor who knows such knowledge immediately. According to this, the ability to draw out storage knowledge at any time is required.
  - In general, people feel awkward with asking the same thing repeatedly. In other words, the capacity to refer some certain knowledge again and again is required.
  - It is difficult to ask for teaching one thing by changing the angle of the question. In other words, the ability to draw out knowledge from different angles is required.
- Recently, the asynchronous and distributed types of work has spread in an office. Accordingly, a new way of knowledge sharing which satisfies these forms is needed.

FISH [1] and GoldFISH [2] are two services which are proposed to resolve the above problems. "User Centered Design" is a design approach which makes much account of the user behavior in

the groupware [3]. GoldFISH is designed based on a belief that the cycle of "design, implement, observe and evaluate user behavior " must be repeated in order to realize a useful groupware, and so some experiments on GoldFISH to observe how organizational knowledge is shared are currently continued.

In order to achieve the purpose of clarifying the structure of organizational knowledge sharing and promoting knowledge sharing, a social science viewpoint is introduced into these observation. To get information about patterns of user behavior, we analyzed five thousands records obtained within twelve months from GoldFISH. The analytical results reflected the environment of users and we gained interesting patterns of accessing to the organizational knowledge. Then, we propose a user behavior model called "Hurdle Jumping Model" based on the result of the user behavior analysis. Furthermore, based on this model, we implement a method to support knowledge sharing which makes use of Knowledge Awareness [10].

2 An Observation of Organization Knowledge Access Patterns

2.1 Target for the Analysis

In [4], Rogers described a gatekeeper, a liaison, an opinion leader, and a cosmopolite as individual roles of the communication in an organization. In our view, these roles can be considered to be the same things and so the sharing forms in knowledge sharing process. And, there are many consumers who receive the benefit from the knowledge sharing in the organization. In this paper, we study how to accelerate knowledge sharing process in an organization by observing the behavior of such consumers. Because in general, consumers are in passive situation of knowledge sharing process and they seem easily to be influenced by some producers and mediators.

In the concrete, we analyzed the retrieval and referential process which is a part of the consuming process in GoldFISH. Generally, GoldFISH stores some knowledge in the form of cards with multiple keywords and text.

These cards are periodically linked automatically to each other, based on fulltext search. Therefore users can easily refer some related knowledge (Figure 1).

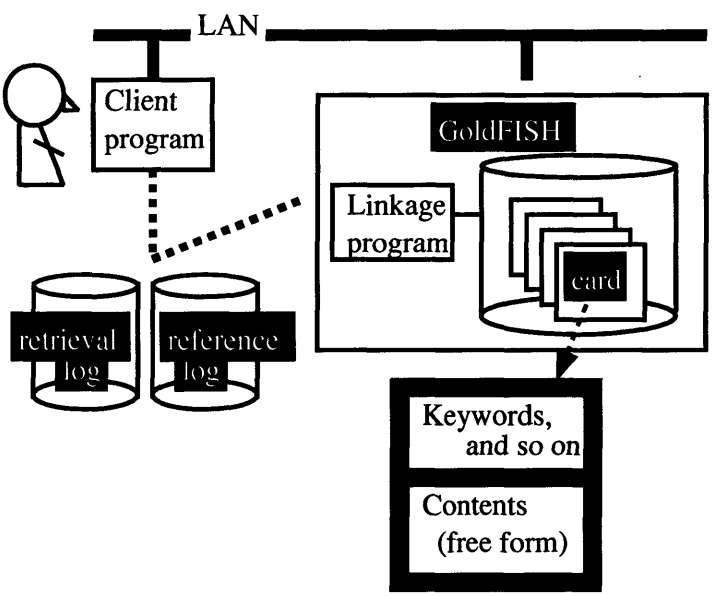

Figure 1: Outline of GoldFISH

2.2 Analysis Method

The analysis objects are retrieval and referential logs (about five thousands records) taken in twelve months. We divide them into three equal periods: service introduction period, middle period and the latest period.

Analysis Procedure

The following procedure is carried out for each user.

1. Merging retrieval and referential logs into one behavior log. Figure 2 is an example of a behavior log. Here, P denotes a retrieval record and S denotes a reference record. A retrieval record consists of four elements, which are the identifier (of P), the retrieval date, the retrieval time, the results of retrieval (OK or NG), and the numbers of candidates for referring in case of success and retrieval keyword. A reference record consists of four elements which are the identifier (of S), the reference date, the reference time, the referred card-ID and the keywords with card.

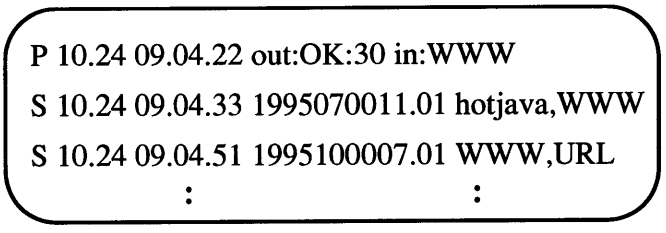

Figure 2: An example of behavior log

2. Dividing the behavior log in "the continuation behavior time" interval into some separated blocks . First, we set "the continuation behavior time" at 20 minutes empirically.
We define "the continuation behavior time" as the interval time of any following action.

   - from a retrieval act to a retrieval act
   - from a retrieval act to a reference act
   - from a reference act to a reference act

   This process is necessary for analyzing patterns of behavior. Because it is possible that all of the behavior log is considered as a result of only a series of retrieval and reference act without "the continuation behavior time".

3. Translating the above blocks into some numerical values according to the following definition:

   -50 : one retrieval failure

   0 : one retrieval success

   1 .. n : the referencing order until one retrieval success

4. Classifying the results into some certain types.

5. Repeating the above procedure (from 1 to 4) by resetting "the continuation behavior time" at 4,5,10 and 40 minutes .

2.3 Results of the Analysis

- The difference of type distribution by "the continuation behavior time" was not especially observed in any users.

- The following types of some characteristic behavior (the details are the following) were obtained(Figure 3).

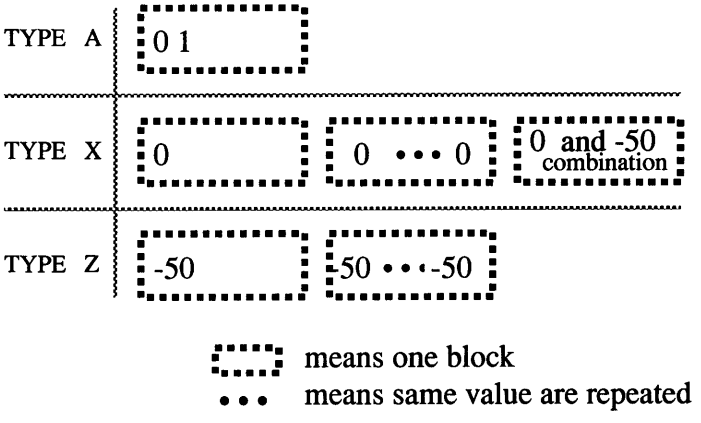

Figure 3: Numerical Values of Three Types

  - Type A : One reference after one retrieval success.
    The retrieval success to one reference is only one time.
  - Type X : This type is occurred with repetition of retrieval success and failure, but no reference act even if it succeeds in the retrieval.
  - Type Z : This type is occurred with one retrieval failure (including the continuation of failure).

- The difference of type distribution by the difference of a user is not especially observed .

- Table 1 shows that type A accounts for about 50 % of all types for almost all users.

  min means the minimum of type A ratios are calculated for each user. *max* means the maximum of type A ratios are calculated for each user. *mean* is the average of type

Table 1: The type A account for all types(%)

statistics	"the continuation behavior time"				
	4	5	10	20	40
min	30.8	30.8	27.8	27.3	26.7
max	86.7	86.7	86.7	86.7	76.9
mean	50.6	50.7	48.8	48.3	46.3
median	47.6	48.1	45.8	46.1	45.3

A ratios are calculated for each user. *median* is the middle value of type A ratios are calculated for each user. Table 2 shows the ratio of type X and type Z in the case that "the continuation behavior time" is 4 minutes.

Table 2: The type X or Z account for all types(%)

	min	max	mean	median
X	0	28.6	16.0	17.7
Z	0	5.6	2.8	2.9

- The time-series transition of type distribution isn't especially observed in any users.

3 The User Behavior Model

3.1 Internal Factors

We consider that internal factors that cause the differences in user behavior are *purpose of the use*, *expectation to the service* and *clue of the use.*

- *purpose of the use*

  The followings are *purpose of the use* in order of the strength of the knowledge acquisition requirement. (1) The knowledge, which a user needs to refer, is decided in advance. (2) The knowledge, which a user looks for, is accidentally found out. (3) A user meets some knowledge. The other purposes are (4) killing time and (5) confirming the context provided by himself. When the acquisition requirement of a user is strong, even if the retrieval fails, the possibility that the user will try the following retrieval is high. In short, the *following processing* increases. Here, the *following processing* means another retrieval or reference act.

- *expectation to the service*

  This factor is the degree of a user's expectation that the service can give him the target knowledge. Sometimes, the user does not have a conviction whether or not the target knowledge is stored in the service. During using the service, the user concludes whether this service is useful. This decision is effected by frequency in use and the diffusion of the service in the group. In other words, the user can expect that the target knowledge may be provided in the service, because there is a large amount of knowledge interchange when the service is actively utilized, or there is a certain person who may know the knowledge the user needs in the group. If the expectation is low, the user breaks off his act after a few retrieval failures. Conversely, if the expectation is strong, the user adheres to retrieve in spite of several retrieval failures.

- *clue of the use*

  This means how a user obtains the desired knowledge. In the retrieval act, an user asks himself a question "Which clues should I use to look for the retrieval keyword?". These clues are usually collected from the neighborhood of the user. Table 3 shows the classification of these clues. In general, the degree of certainty of the "assumption" class is lower than the other two classes. When the clue is certain, the retrieval and the reference are apt to success, so that the *following processing* decreases. On the other hands, when the clue is uncertain, the retrieval tends to fail, and the expected result is not obtained even if the retrieval succeeded, so that some *following processing* actions are repeated.

Table 3: The classification of clues

oneself	one's own provided
	the last time use
the others	quotation from news, and so on
	to imitate / ask the other person
assumption	broader / narrow concept
	indirectly related concept
	a shot in the dark

3.2 The Hurdle Jumping Model

We propose a model named "Hurdle Jumping Model" (Figure 4) based on the above analysis. The outline of this model is shown as follows.

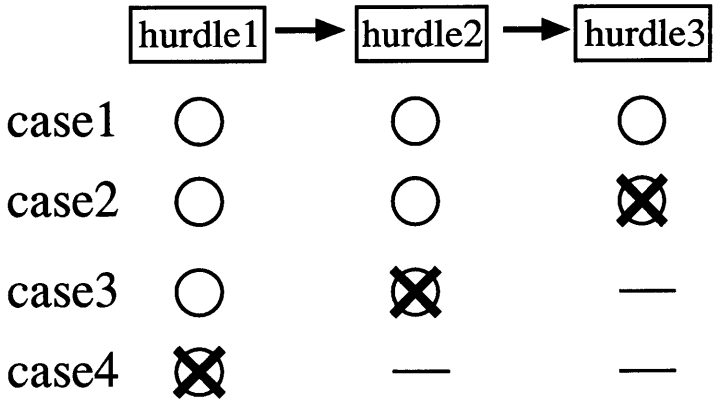

Figure 4: Hurdle Jumping Model

- People clear hurdles, which are the obstruction in achieving a purpose, so-called the knowledge reference.
- We define that when one knocks a hurdle, he cannot advance to the next hurdle until he jumps once more and he succeeds. If he jump hurdles completely, he can refer target knowledge without any support. Otherwise, some help is needed.
- The final goal is "a reference to the desired knowledge". Here, we do not pay attention to a question whether one is satisfied with the result of referring or not. Then, we define that the retrieve act is a part of a process to achieve the final goal.

Three hurdles are as follows.

hurdle 1 (purpose): Is the target of the acquired knowledge is clear?

hurdle 2 (expectation): Can I get the necessary knowledge from the service?

hurdle 3 (clue): How can we draw the knowledge out?

The following shows, four cases related with the question whether it is possible to jump over these hurdles (also, refer to Figure 4).

- *CASE 1* : Because the *clue of the use* is clear, the retrieval success rate is high. There are few retrieval acts which are related with the reference in a series of behaviors. Also, the number of references from candidates is limited, because the target of the acquired knowledge is clear.
- *CASE 2* : As the *clue of the use* is uncertain, the retrieval tends to fail. Still, a user goes on retrieving with patience, so the *purpose of the use* is clear and the *expectation to the service* is strong. However the possibility of getting unexpected candidates would be high even if it succeeds by chance. There is an action that a user doesn't select candidates to refer, because the result was unsatisfactory.
- *CASE 3* : A user wants to get knowledge. However he tends to stop retrieving when the retrievals fail consecutively, due to low *expectation to the service.*
- *CASE 4* : The user cannot use it almost, because the *purpose of the use* isn't clear.

Which case the user indicates depends on the situation. We consider both behavior types and these cases.

- The behavior in case 1 leads to the behavior type A.
- The possibility of the behavior in case 2 leading to the behavior type X is high.
- The behavior in case 3 falls into the behavior type Z.

3.3 What kind of support is needed?

If a user cannot jump over a hurdle, some support is needed to retry. We consider that if the failure of jumping is caused by the lack of factor of the "Hurdle Jumping Model", the support for reinforcing or noticing of the factor, named *awareness*, is effective.

Awareness means *the ability of the group members to know the existence, state, and activities of others in the group* [7]. There are some awareness supports in real-time, such as *gaze awareness* [8] and *Interest Awareness* that supports an informal communication [9]. In the case of knowledge sharing on a long-term basis, a concept of *Knowledge Awareness* was proposed by

Yamakami [10]. He described the point of awareness as *(1) knowledge existence, (2) interaction* and *(3) meta-knowledge.* In this study, we apply this concept to support each behavior type. In the concrete, we propose the following supports.

- In the type X (*CASE 2*), the problem lies in the point that the *clue of the use* is limited in one person, though there are some acquisition requirements. Therefore, the support should provide the opportunity for encountering with the clue, in other words, providing *the chance of knowledge awareness.*

  ⇓

  For example, presenting the clue which was used, when the other person referred knowledge.

- The type Z (*CASE 3*) is affected by low *expectation to the service.* Therefore, the support should promote the noticing of the activity of knowledge sharing in the neighborhood to increase *expectation to the service.*

  ⇓

  For example, providing knowledge that was referred well in a group, in order to appeal the utilization of the service. At this time, if a user does not know about this knowledge, it gives such an oppressive feeling that he does not know them, even though the others know them. Oppositely if he knows, it gives a sense of affinity to see the same one.

- The case of passive behavior that is no use (*CASE 4*) is caused by the lack of the *purpose of the use.* The support facilitates the intellectual inspiring to make the use of the service actively. It aims to stimulate the latent knowledge awareness to activity by providing cards in season and appeal handiness.

The ratio of the A type that is no failure of jumping over the hurdle was accounted for about 50 per cent of all types and the keyword that is referred on a short period time is identical mostly. Further references of knowledge tend to show a concentration on the short time[5]. Therefore the above situation leads to the result that a user refers the same card repetitively until acquiring the identify knowledge, named locality of references. In short, the user wastes time and labor each time of typing retrieval keywords and choosing candidates. Therefore, we provide the following support.

- In the type A (*CASE 1*), if jumping hurdles are just the same each time, remove them.

  ⇓

  The support provides the cards that a user saw the latest.

4 Implementation of "Hurdle Jumping Model" Support Functions

To evaluate the propositions in Section 3, we implement the support function *GGG* (Grasping Knowledge from Fish Globe for GoldFISHes) on GoldFISH.

GGG has basic function I with three accompanying functions, II, III, IV. Each function was implemented with Perl and Cshell script.

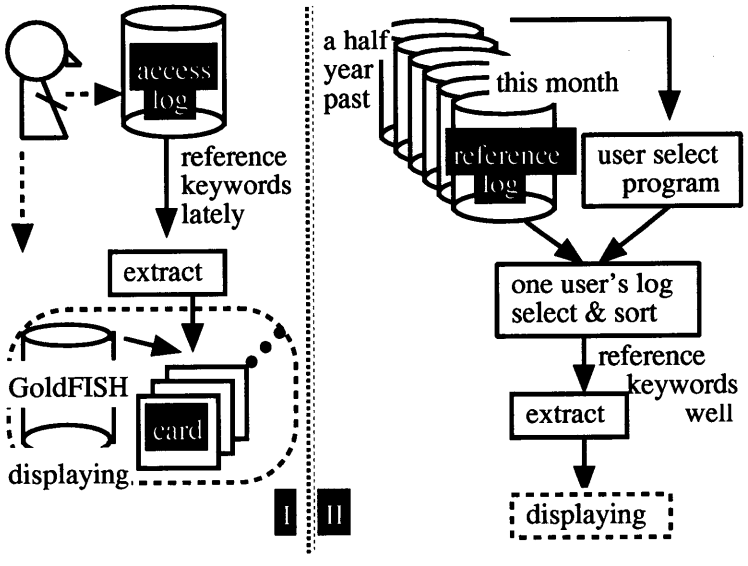

Figure 5: Capturing Algorithm for I and II

Each function is shown by automatically extracted from access and referential logs, which contain the log of the previous day(Figure 5,Figure 6).

Users can access to *GGG* from both of WWW browser and command line. Four functions are shown in the following.

I : Showing 10 cards, which the user saw the latest. This support assists a user who expresses the behavior type A, in order that the user can refer the target knowledge quickly.

II : Showing 5 cards, which have often been used by other person during a half year, in order to give a chance of knowledge awareness. This person's identity will not be disclosed.

III : Showing 5 popularity cards, which are the best referred in a group at this month, in order to notice the knowledge sharing activity.

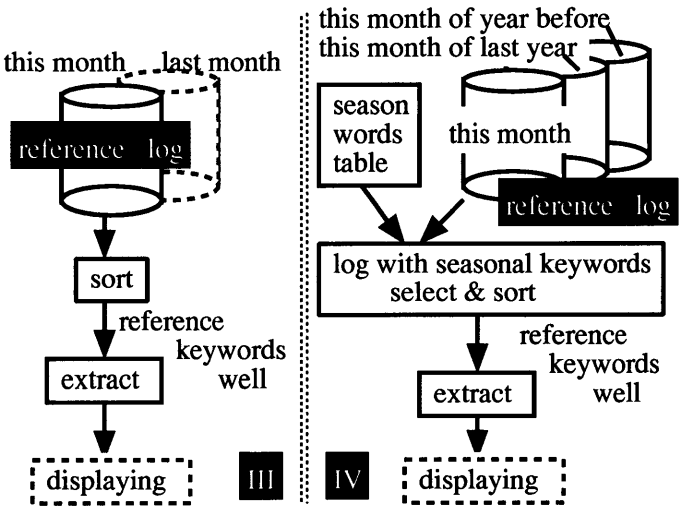

Figure 6: Capturing Algorithm for III and IV

IV : Showing 5 reasonable cards, which are selected based on the season word table. The season word table is constructed by a questionnaire replied by users, in order to stimulate the latent knowledge awareness.

A basic function I will be shown at any time. Showing an accompanying function is chosen from among II, III, IV functions which take turns every day, and is displayed with function I. There are two reasons for the accompanying showing as follows. (1) If naming every function respectively, it causes confusion to the user. (2) It aims to reinforce or notice factors gradually and naturally by the accompanying display with indicating basic function whose frequency in use is high.

5 Related Work

The 7 stage model is well-known as the user model in HCI [6]. This model showed the key of user interface design in the view point of a mental process at working. The "Hurdle Jumping Model" stands on the same point to treat the user behavior as the 7 stage model. However, this model is different in the way user's behavior can be grasped.

- The main point of this issue.
  The 7 stage model focuses on usefulness at user interface. The "Hurdle Jumping Model" focuses on the process to start the use of the service.

- The scope of this model.
  The scope of the 7 stage model is the interaction of a user and a computer at a short period of time. The scope of the "Hurdle Jumping Model" is not only an individual but also the environment of the user at a long period of time. After all, the last goal of our study is to achieve cooperative work in a group by knowledge sharing.

6 Discussion

Two months have passed since we introduced support functions to a group. Because knowledge sharing process is carried out at a slow speed, there are not many logs for evaluate our support functions. However, as for qualitative evaluation, we observed some effectiveness of the "Hurdle Jumping Model" as follows.

- adaptation of a model
  In this paper, the objects of the analysis are retrieval and reference acts. We have proposed three factors of the user behavior, *purpose of the use* , *expectation to the service* and *clue of the use* based on this case study. These factors have a close relation with group actions. Therefore, when we consider a viewpoint of cooperation , these factors can also be applied to other kinds of behaviors.

- knowledge sharing with a ripple effect
  Promotion of self-disclosure is related to increasing open information as a ripple effect in consideration of "Johari window" [11]. In this study, we proposed a method of promoting knowledge sharing with a ripple effect. For instance, knowing what the others do, is effective to maintain cooperation in a group. In other words, showing the other's behavior logs, is a kind of non-verbal communication. Then, we focused on one's behavior log for data of noticing. For example, a passive user who does not use the service, turns into a consumer by stimulating latent knowledge awareness, and a consumer who is a free rider

on knowledge, turns into a producer by noticing of the activity of knowledge sharing in a group.

7 Conclusions

In this study, we analyzed a case study of retrieval and reference acts in knowledge sharing process. We proposed "Hurdle Jumping Model" from the results of the analysis, and also designed some supports based on this model. The factors of "Hurdle Jumping Model" are *purpose of the use*, *expectation to the service* and *clue of the use*. These factors are caused by cooperation in a group. They can be supported by reinforcing or noticing. That is to say, supports are (1) to give a chance of knowledge awareness, (2) to promote a noticing of the activity of knowledge sharing and (3) to stimulate latent acquisition requirement of knowledge. We showed an implementation of such supports. As one of our further works, we plan to analyze logs of our support functions to confirm the effectiveness.

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