

# Evaluating Organization External Knowledge Acquisition

## Based on Scenario

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### Abstract

*Knowledge can be acquired from organization inside and exterior. The knowledge inside organization is limited and the organization external knowledge is important to advance organization competition ability. Knowledge acquisition out of organization plays an extremely important role in organization knowledge management. This study proposed a knowledge acquisition evaluating method based on knowledge scenario. Scenario tree is defined and is used to describe the scenario of origination external knowledge. Scenario tree's dimensions and items are confirmed and their fuzzy weight is afforded. State interval of evaluating method is plot out. Evaluating matrix is proposed for computing the feasibility of organization external knowledge acquisition. The evaluating method is a recursion process among layers. A case is offered to demonstrate the availability of this approach in knowledge acquisition form organization exterior.*

### 1. Instruction

With the arriving of knowledge economy times, knowledge management is becoming more and more important for organization. Knowledge is the source of organizational competitive advantage, and knowledge reserves and new knowledge directly determine the extent of the organization and the ability to change the competitive edge [1-2]. So, knowledge acquisition becomes the key of organization knowledge management. Organizational knowledge acquisitions have two ways [3]. One is internal knowledge accumulation; another is knowledge acquisition from origination external. Internal knowledge accumulation includes knowledge sharing, learning functions, cross-sectored and multi-level study and learning [4]. Organization external knowledge is broad and social, and knowledge acquisition will be restricted by organization self and exterior environment.

At present, the researches on knowledge acquisition focus on such aspects as knowledge acquisition mode [5-7], factors which affect successful knowledge acquisition [8-10], and mechanism [11-12] which are based on Nanaka's SECI model and Szulanski's intercourse model. Many literatures have developed factors affecting knowledge transfer such as knowledge characteristics, the recipient, the context and knowledge itself and so on. Successful knowledge acquisition is associated with several key variables and nine factors are proposed which influencing knowledge acquisition, they are embeddings distance of relational context, organizational, physical, knowledge and norm distance of relational context, project priority and learning culture of recipient context and activity context[13]. Knowledge acquisition mechanisms involve personal move, training, technology transfer, patent, and so on [12].

While knowledge acquisition plays an important role in organization knowledge management, the researches on knowledge acquisition are becoming more and more prevalent. Cohen and Levinthal state knowledge acquisition consists of conveying and absorbing capability [14]. Hamel attributes successful knowledge acquisition to three factors: intent, transparency and receptivity, and further expatiates the determinants of the factors [15]. These researches are analysis about knowledge acquisition method, effecting factors, and knowledge acquisition ability. The performance evaluating of knowledge acquisition is not involved. So this paper proposed an evaluating method for knowledge acquisition from organization external.

The evaluating method used in paper is based on knowledge scenario (*KS*). Outside knowledge constraints is mostly the knowledge scenario. *KS* is the environment and background where knowledge comes into being, and is applied, shared, transferred. *KS* is the basic in knowledge application, share and reuse process. Existed knowledge has knowledge scenario, and the knowledge used in actual case has also knowledge scenario [16].

This paper aims at facilitating the effectiveness of organization exterior knowledge acquisition. It involves two interrelated phases, namely knowledge scenario depicting with scenario tree and feasibility evaluating using evaluating matrix. By applying such an evaluating method, organization knowledge acquisition is more efficient and successful. At last a case is supplied to validate the effective of this method.

## 2. Knowledge scenario description with scenario tree

### 2.1 Scenario tree

**Define1 Scenario tree (ST)** is tree structure which is used to describe knowledge scenario. *ST* includes one root node (*RT*) which denotes whole scenario, multi-middle nodes for scenario dimensionality and multi-leaf nodes (*LN*) to give expression to scenario item. Apart from leaf nodes, every node has one or more sub-nodes and every node has a parent node except root node.

**Define2 Scenario dimensionality (SD)** is a sub-tree of scenario tree which expresses knowledge scenario embranchment or certain aspect.

**Define3 Scenario item (SI)** is inseparable scenario dimensionality, and is corresponding with leaf node. *SI* sets out detailed and specific scenario information and knowledge.

In essence, scenario tree is a classification tool. In this paper, scenario tree is used to describe knowledge scenario. Knowledge scenario is decomposed to scenario dimensionality and scenario items. Fig.1 shows the structure of scenario tree and Tab.1 shows the mapping between knowledge scenario and scenario tree.

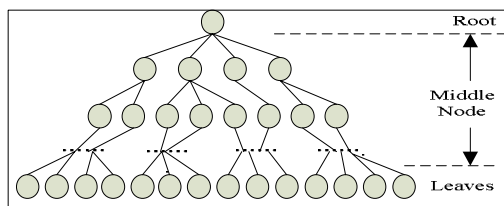


Fig.1 scenario tree

Tab.1 Mapping between scenario and scenario tree

Layer	<i>ST</i>	<i>KS</i>
1	<i>RN</i>	whole scenario
2	middle nodes	<i>SD</i>
3	middle nodes	<i>SD</i>
...	.....	.....

n	<i>LN</i>	<i>SI</i>
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### 2.2 Scenario description for organization external knowledge

In this paper, the evaluating method lies on organizational knowledge and technology. That is to make organizational structure and condition as standard. So, existing organizational extended knowledge scenario includes four dimensionalities: 1) Relation dimensionality, it's the connection between knowledge resource and knowledge recipient; 2) Activity dimensionality, it includes the two sides' activity motivation and motivation strength etc; 3) Technology dimensionality, it includes knowledge and technology difference, knowledge complexity, modular degree and path dependence etc; 4) Environment dimensionality, environment factor in knowledge resource and knowledge recipient, knowledge value cycle and life cycle etc [17]. Scenario description for external knowledge is shown as Fig.2.

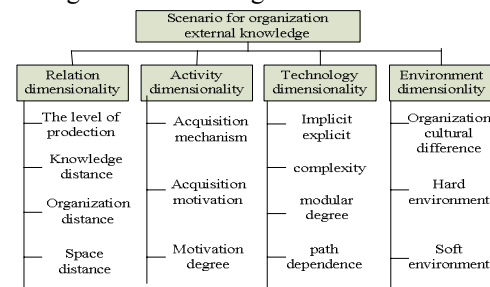


Fig.2 Scenario tree of external knowledge

## 3. The scenario analysis of knowledge acquisition from organizational external

This paper makes three-tier scenario tree as an example to analyze and evaluate knowledge acquisition feasibility from organizational external.

### 3.1 State interval and fuzzy weight

#### 3.1.1 State interval

The feasibility of knowledge acquisition is fuzzy conception. Fuzzy and rough sets theory is used to division the state interval of knowledge acquisition feasibility. The state interval includes five intervals as follow: Very-high feasible, High-feasible, Middle-feasible, Low-feasible and Very-low-feasible. They can be expression by set  $V = \{V_1, V_2, V_3, V_4, V_5\}$ .  $V_1$ = Very-high feasible,  $V_2$ = High-feasible,  $V_3$ = Middle-feasible,

$V_4$ = Low-feasible and  $V_5$ = Very-low-feasible [18].

### 3.1.2 Accounting the fuzzy weight of scenario dimensionality and scenario item

Let  $W = (W_1, W_2, \dots, W_n)$  be the set of scenario dimensionalities' weight. In this set,  $W_i$  is the weight of dimensionality  $D_i$ , where  $i = 1, 2, \dots, n$ . Scenario dimensionality  $D_i$  includes scenario item  $SI_{ij}$ , and the weight of  $SI_{ij}$  is as follows:

$$W_1 = (\omega_{11}, \omega_{12}, \dots, \omega_{1j})$$

$$W_2 = (\omega_{21}, \omega_{22}, \dots, \omega_{2j})$$

$$W_n = (\omega_{n1}, \omega_{n2}, \omega_{n3}, \dots, \omega_{nj})$$

Where,  $\omega_{ij}$  is the weight of scenario item  $SI_{ij}$ .

In dimensionality  $D_i$ , the important of scenario item  $SI_{ij}$  is defined by  $I_{ij} \in (0, 1)$ . When the value of  $I_{ij}$  is bigger, the scenario item  $SI_{ij}$  is more important. Now, the number of expert is  $n$ , and expert  $K$  reckons that the value of  $I_{ij}$  is  $I_{ij-k}$ . Then, the values of  $I_{ij-k}$  is show as Tab.2.

Tab.2 the value of  $I_{ij}$  (expert  $K$ )

S-item	$SI_{i1}$	$SI_{i2}$	.....	$SI_{ij}$
$I_{ij-k}$	$I_{i1-k}$	$I_{i2-k}$	.....	$I_{ij-k}$

Then Eq. (1) can define the relation of importance degree among difference scenario items.

$$\eta_{ipq-k} = \begin{cases} 1, \rightarrow \text{If } \frac{I_{ip-k}}{I_{iq-k}} > 1 \\ 0, \rightarrow \text{If } \frac{I_{ip-k}}{I_{iq-k}} \leq 1 \end{cases} \quad p, q = 1, 2, 3, \dots, j \quad (1)$$

Where,  $\eta_{ipq-k}$  is the relation of importance degree between  $SI_{ip}$  and  $SI_{iq}$ , if  $\eta_{ipq-k} = 1$ ,  $SI_{ip}$  is more important than  $SI_{iq}$ .

$\eta_{ipq} = \sum_{k=1}^n \eta_{ipq-k}$  is the total of  $\eta_{ipq-k}$  by experts.

So Tab.3 shows the value of  $\eta_{ipq}$  for scenario item  $SI_{ij}$  in scenario dimensionality  $D_i$ .

Tab.3 the value of  $\eta_{ipq}$  for scenario item

Scenario item	$SI_{i1}$	$SI_{i2}$	$SI_{i3}$	....	$SI_{ij}$
$SI_{i1}$	$\eta_{i11}$	$\eta_{i12}$	$\eta_{i13}$	....	$\eta_{i1j}$
$SI_{i2}$	$\eta_{i21}$	$\eta_{i22}$	$\eta_{i23}$	....	$\eta_{i2j}$
....	....	....	....	....	....
$SI_{ij}$	$\eta_{ij1}$	$\eta_{ij2}$	$\eta_{ij3}$	....	$\eta_{ijj}$

Then,  $\eta_{ip} = \sum_{q=1}^j \eta_{ipq}$ ,  $q = 1, 2, 3, \dots, j$  shows the

importance of scenario item  $SI_{ip}$  from Tab.3, and

$$\begin{aligned} \text{Max} - \eta_{ij} &= \max \{ \eta_{i1}, \eta_{i2}, \eta_{i3}, \dots, \eta_{ij} \} \\ \text{Min} - \eta_{ij} &= \min \{ \eta_{i1}, \eta_{i2}, \eta_{i3}, \dots, \eta_{ij} \} \end{aligned}$$

Now, the weight of scenario item can be supplied:  $\omega_{ij} = \frac{\eta_{ip}}{\sum \eta_{ij}}$ , and all items' weight in

dimensionality is  $D_i$  as Eq.(2):

$$W_i = \left( \frac{\eta_{i1}}{\sum \eta_{ij}}, \frac{\eta_{i2}}{\sum \eta_{ij}}, \frac{\eta_{i3}}{\sum \eta_{ij}}, \dots, \frac{\eta_{ij}}{\sum \eta_{ij}} \right) \quad (2)$$

The weight of scenario dimensionality  $D_i$  can also be computed as the same to above  $W = (W_1, W_2, W_3, \dots, W_i)$ .

## 3.2 Matrix and knowledge acquisition

### 3.2.1 Ascertain evaluating matrix

For scenario item  $SI_{ip}$  in dimensionality, the number of expert is  $M_{ip\mu}$ , who think the state interval of scenario item is  $V_\mu$ . Then Eq.(3) expresses the probability of scenario item in state  $V_\mu$ .

$$P_{ip\mu} = \frac{M_{ip\mu}}{n}, \quad (\mu = 1, 2, 3, 4, 5) \quad (3)$$

Where  $n$  is the number of expert

And the evaluating matrix of scenario item  $SI_{ip}$  includes probability of all state intervals, which is expressed as Eq.(3).

$$PR_{ip} = (P_{ip1}, P_{ip2}, P_{ip3}, P_{ip4}, P_{ip5}) = \left( \frac{M_{ip1}}{n}, \frac{M_{ip2}}{n}, \frac{M_{ip3}}{n}, \frac{M_{ip4}}{n}, \frac{M_{ip5}}{n} \right)$$

Then, evaluating matrix  $R_i$  of all scenario items in scenario dimensionality  $D_i$  can be supplied as Eq. (4):

$$R_i = \begin{bmatrix} PR_{i1} \\ PR_{i2} \\ PR_{i3} \\ \dots \\ PR_{ij} \end{bmatrix} = \begin{bmatrix} P_{i11} & P_{i12} & P_{i13} & P_{i14} & P_{i15} \\ P_{i21} & P_{i22} & P_{i23} & P_{i24} & P_{i25} \\ P_{i31} & P_{i32} & P_{i33} & P_{i34} & P_{i35} \\ \dots & \dots & \dots & \dots & \dots \\ P_{ij1} & P_{ij2} & P_{ij3} & P_{ij4} & P_{ij5} \end{bmatrix} \quad (4)$$

Where,  $i$  is the number of scenario dimensionality,  $j$  is the number of scenario item in dimensionality.

The evaluating matrix of whole scenario can also be supplied by the same way.

### 3.2.2 Knowledge acquisition evaluating

In this paper, knowledge acquisition in scenario dimensionality  $D_i$  can be evaluated by fuzzy mathematical model Eq. (5).

$$W_i \bullet R_i = R_{Di} \quad (5)$$

Then, Eq.(6) is derivable from Eq.(2) and Eq.(4).

$$(\omega_1, \omega_2, \dots, \omega_j) \begin{bmatrix} P_{i11} & P_{i12} & \dots & P_{i15} \\ P_{i21} & P_{i22} & \dots & P_{i25} \\ \dots & \dots & \dots & \dots \\ P_{ij1} & P_{ij2} & \dots & P_{ij5} \end{bmatrix} = [D_{i1}, D_{i2}, D_{i3}, D_{i4}, D_{i5}] \quad (6)$$

Fuzzy set  $R_{D_i} = (D_{i1}, D_{i2}, D_{i3}, D_{i4}, D_{i5})$  is the state interval of scenario dimensionality  $D_i$  in knowledge acquisition.

Now, the evaluating matrix  $R$  of the whole scenario can be supplied from scenario dimensionality  $D_i$  as Eq. (7).

$$R = \begin{bmatrix} R_{D_1} \\ R_{D_2} \\ \dots \\ R_{D_i} \end{bmatrix} = \begin{bmatrix} D_{11} & D_{12} & \dots & D_{15} \\ D_{21} & D_{22} & \dots & D_{25} \\ \dots & \dots & \dots & \dots \\ D_{i1} & D_{i2} & \dots & D_{i5} \end{bmatrix} \quad (7)$$

On the other hand, the weight of dimensionality  $D_i$  in whole scenario is  $W = (W_1, W_2, W_3, \dots, W_i)$ . So, Eq. (8) defines the evaluating model for whole scenario in knowledge acquisition, and Eq. (9) is derivable from Eq. (7).

$$W \bullet R = R_s \quad (8)$$

$$(W_1, W_2, \dots, W_i) \begin{bmatrix} A_{11} & A_{12} & \dots & A_{15} \\ A_{21} & A_{22} & \dots & A_{25} \\ \dots & \dots & \dots & \dots \\ A_{i1} & A_{i2} & \dots & A_{i5} \end{bmatrix} = (R_{s1}, R_{s2}, R_{s3}, R_{s4}, R_{s5}) \quad (9)$$

Matrix  $R_s = (R_{s1}, R_{s2}, R_{s3}, R_{s4}, R_{s5})$  is the evaluating result of whole scenario in organization knowledge acquisition. Based on the maximum membership grade principle,  $Max - R_{s\lambda}$ , ( $\lambda = 1, 2, 3, 4, 5$ ) is the pivotal item in  $R_s$ . Interval  $V_\lambda$  is mapping with  $R_{s\lambda}$  and  $V_\lambda$  is the state interval of organization knowledge acquisition based on knowledge scenario [19].

#### 4. Application example

The method in this paper is used by an automobile enterprise to acquire engine fault knowledge from vehicle Maintenance Company. Tab.4 shows some engine fault of a car and Fig.3 is the scenario tree of engine fault.

Tab.4 engine fault

Fault component	Common fault
Crankshaft link	Piston ring fracture, Bearing off, The main bearing oil rejection, Inverted gas, Broken crankshaft, connecting rod bending, valve spring break, Aspiratory doors closed lax, channeling oil
Gasoline Injection	The electronic fuel injector failure, increased fuel consumption, to throttle off, tempering blasters, engine speed up bad, not rated power, fuel injection
Fuel System	The fuel shortage, accelerating pump piston cup fault, idling too high, not aspiratory carburetor, by blocking filter
Lubrication, cooling	The water temperature suddenly escalate, pumps leaking water tanks swing, oil pressure suddenly dropped, oil-foot channeling oil, do not apply Valve
Ignition System	Ignition operations, covered by the electrical breakdown, ignition coil electrical leakage, generators belt too loose, sub-cylinder line interpolation wrong, when the ignition unrighteousness

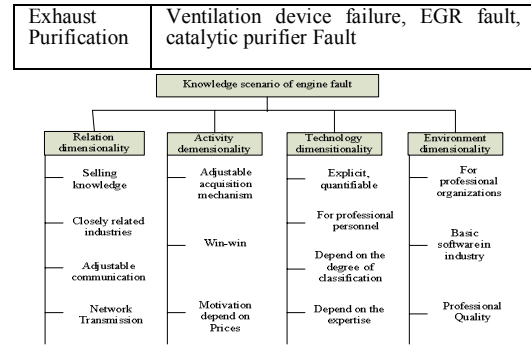


Fig.3 Knowledge scenario of engine fault

Pursuant to **Session 2**, the value of  $\eta_{pq}$  can be computed in dimensionality  $D_i$ . And Tab.5 is the value of  $\eta_{pq}$  in dimensionality  $D_1$  and  $D_2$ .

Tab.5 (a) the value of  $\eta_{pq}$  in  $D_1$

Scenario item	$SI_{11}$	$SI_{12}$	$SI_{13}$	$SI_{14}$	$\eta_{ip}$
$SI_{11}$	0	3	5	5	13
$SI_{12}$	7	0	8	8	23
$SI_{13}$	5	2	0	6	13
$SI_{14}$	5	2	4	0	11

Tab.5 (b) the value of  $\eta_{pq}$  in  $D_2$

Scenario item	$SI_{21}$	$SI_{22}$	$SI_{23}$	$\eta_{ip}$
$SI_{21}$	0	4	4	8
$SI_{22}$	6	0	5	11
$SI_{23}$	6	5	0	11

So, the weights of scenario items in  $D_1$  and  $D_2$  can be calculated by Eq. (2).

$$W_1 = (0.22, 0.37, 0.22, 0.19)$$

$$W_2 = (0.27, 0.365, 0.365)$$

By the same way, the weights of scenario items in  $D_3$  and  $D_4$  can also be computed as follow:

$$W_3 = (0.18, 0.26, 0.34, 0.22)$$

$$W_4 = (0.33, 0.29, 0.38)$$

Then, the weight of  $D_i$  in whole scenario is as follows:

$$W = (W_1, W_2, W_3, W_4) = (0.28, 0.24, 0.31, 0.17)$$

Through Eq. (4) in **Session 2.2**, evaluating matrix of dimensionality is shown as follow:

$$R_1 = \begin{bmatrix} 0.2 & 0.1 & 0.2 & 0.4 & 0.1 \\ 0.1 & 0.3 & 0.1 & 0.3 & 0.2 \\ 0.3 & 0.1 & 0.2 & 0.3 & 0.1 \\ 0.1 & 0.1 & 0.1 & 0.4 & 0.3 \end{bmatrix}$$

$$R_2 = \begin{bmatrix} 0.1 & 0.1 & 0.4 & 0.3 & 0.1 \\ 0.3 & 0.1 & 0.3 & 0.2 & 0.1 \\ 0.1 & 0.3 & 0.3 & 0.2 & 0.1 \end{bmatrix}$$

Now,  $R_{D1}$  and  $R_{D2}$  of  $D_1$  and  $D_2$  can also be supplied.

$$R_{D1} = (0.166, 0.174, 0.144, 0.341, 0.175)$$

$$R_{D2} = (0.173, 0.173, 0.327, 0.227, 0.100)$$

By the same way,

$$R_{D3} = (0.182, 0.225, 0.286, 0.201, 0.106)$$

$$R_{D4} = (0.170, 0.204, 0.316, 0.187, 0.123)$$

Then, the evaluating matrix of whole scenario includes  $R_{D1}$ ,  $R_{D2}$ ,  $R_{D3}$  and  $R_{D4}$ .

$$R = \begin{bmatrix} R_{D1} \\ R_{D2} \\ R_{D3} \\ R_{D4} \end{bmatrix} = \begin{bmatrix} 0.166 & 0.174 & 0.144 & 0.341 & 0.175 \\ 0.173 & 0.173 & 0.327 & 0.227 & 0.100 \\ 0.182 & 0.225 & 0.286 & 0.201 & 0.106 \\ 0.170 & 0.204 & 0.316 & 0.187 & 0.123 \end{bmatrix}$$

Finally, the value of  $Rs$  is counted by Eq. (8):

$Rs = (0.1733, 0.1947, 0.2612, 0.2240, 0.1268)$   
 0.2612 is the largest number in  $Rs$  and 0.2240 is the second largest number in  $Rs$ . The state interval is High-feasible or Middle-feasible. So, the knowledge acquisition based on scenario is efficient and successful.

## 5. Conclusion

This paper proposes an evaluating method for knowledge acquisition from organizational external. Through this method, organization can gain the state interval of knowledge acquisition. By this way, organization knowledge acquisition from external is more efficient and successful.

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