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Research on the multi scheme fuzzy optimization model and the algorithm of knowledge management system for intelligent design

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Abstract

Knowledge management system is an important embodiment of the developmental level of enterprise information technology. How to improve the development of enterprise knowledge management system and develop quality knowledge management system oriented at the development demands of enterprises is a complex system engineering, which is restricted by various factors. Therefore, this paper conducts research on the multi scheme optimization of enterprise knowledge management system with multi-attribute characteristics and gives a type of multi scheme fuzzy optimization model and the algorithm of knowledge management system for intelligent design. This paper firstly discusses the selection principles needed to be followed in the multi scheme optimization of enterprise knowledge management system and then selects the indexes for the multi scheme optimization of enterprise knowledge management system. On this basis, this paper establishes the index system for the multi scheme optimization of enterprise knowledge management system and discusses the multi scheme fuzzy optimization model of enterprise knowledge management system from the aspects of the determination of optimization index set and scheme set, establishment of triangular fuzzy number evaluation matrix, acquisition of optimization index weight and implementation of triangular fuzzy number evaluation model.

Keywords: knowledge management system; intelligent design; multi scheme optimization; triangular fuzzy number; index system; model and the algorithm

1.INTRODUCTION

Knowledge management is an important ingredient of enterprise management and thus knowledge management system is an important component of enterprise information management system. Especially in the 21st century, when science and technology are developing at an astounding rate, knowledge is the most competitive core resource of enterprise development. Therefore, it is of great significance to blend various types of knowledge, information and data into the development of knowledge management system (Li and Yao, 2010; Wang, 2012; Maryam and Dorothy, 2001). Some scholars have studied the key technology in the development of knowledge management system based on ontology technology and discussed the implementation of knowledge management system (Wang et al., 2013; Liao et al., 2009; Yu et al., 2011). Some scholars have analyzed the development framework and model of knowledge management system from the perspective of service network and cloud computing (Zhang et al., 2011; Ye et al., 2016; Ren et al., 2014; Liu and Liu, 2013). In addition, some scholars have conducted research on the construction strategy and modeling of knowledge management system (Hou and Zhao, 2012; Zhou and Huang, 2009; Li et al., 2014, Wu et al., 2009). However, the development process of knowledge system is restricted by various factors, which makes the knowledge management system satisfying enterprise demand may possess diversified forms. Therefore, to obtain the optimal
development model of knowledge management system, we need to conduct the multi scheme optimization analysis of knowledge management system (Luo and Ni, 2008; Yu 2010; Li et al., 2010; Liu et al., 2013; Liu et al., 2016). On the basis of existing paper researches, this paper studies the multi scheme fuzzy optimization model and the algorithm of knowledge management system for intelligent design based on the analysis of multi scheme optimization process of knowledge management system and triangular fuzzy number (Chi-Tsuen, 2008; Gisella and Roberto, 2004; Zhao et al., 2014; Roszkowska and Kacprzak, 2016) in expectation of providing support for the development of enterprise knowledge management system.

2. CONSTRUCTION OF MULTI SCHEME OPTIMIZATION INDEX SYSTEM OF ENTERPRISE KNOWLEDGE MANAGEMENT SYSTEM

2.1 Selection principles of multi scheme optimization index

The multi scheme optimization of enterprise knowledge management system is a complicated system engineering with multiple factors, multiple perspectives and multiple layers, so the optimization results are restricted by multiple attributes. Therefore, to make the multi scheme optimization results of enterprise knowledge management system more accurate, reliable and credible, certain principles need to be followed in the selection of optimization indexes.

(1) scientific principle

The selection of optimization indexes should conform to objective laws of the development of enterprise knowledge management system. The selection should be based on reasonable and scientific methods and practical value judgment of enterprise knowledge management system to reflect the essence of enterprise knowledge management system optimization.

(2) systematic principle

Various optimization indexes should make up an organic whole. Certain logical relationship exists among optimization indexes. That is to say, the optimization indexes have individual independence as well as logical relevance, which can reflect key characteristics of different optimization sides and the internal relations between each optimization side.

(3) measurability principle

The multi scheme optimization indexes of enterprise knowledge management system should be simple and clear and have strong microcosm, which can facilitate collection, arrangement and classification can unify the measurement method and metric of various optimization indexes. The operability and quantization of optimization indexes are guaranteed, thus facilitating the mathematical calculation and analysis of the multi scheme optimization of enterprise knowledge management system.

(4) objective principle

The multi scheme optimization indexes of enterprise knowledge management system should be based on objective facts. The selection should be conducted based on optimization criteria. No personal factor or subjective assumption should be mixed in to the formulation process of optimization indexes or else it may lead to the incredibility and unreliability of optimization results.
The multi scheme optimization index system of enterprise knowledge management system should be equipped with hierarchical structure, from top to bottom, possessing primary and secondary, macroscopic and microscopic. An organism system where each layer is associated and the importance grows by layer should be formed. Meanwhile, hierarchical index system also facilitates the implementation and operation of optimization indexes.

The multi scheme optimization indexes of enterprise knowledge management system are both quantitative and qualitative and these two types of indexes complement each other. Detailed original data should be obtained through statistical analysis method as far as possible to achieve the description of quantitative indexes. Fuzzy language is adopted to describe relevant data with fuzzy information and fuzzy description is gradually transformed into quantitative expression.

Typical principle should be followed for the multi scheme optimization indexes of enterprise knowledge management system, which can accurately reflect the essence of enterprise knowledge management system optimization. Under the condition of decreasing number of optimization indexes, the reliability and accuracy of optimization results will not be influenced.

The multi scheme optimization indexes of enterprise knowledge management system should comprehensively consider various factors in the enterprise knowledge management system. The comprehensive analysis of multi scheme optimization from the perspective of integrity can enhance the credibility of optimization results.

### 2.2 Multi Scheme Optimization Index System

Under the guidance of above-mentioned selection principle optimization indexes and through other comprehensive analysis methods like consult experts, referring to data, data statistical analysis and questionnaire, the criterion layer of enterprise knowledge management system optimization are divided into system functionality, system operability, system performance, system environment and system implementation efficiency. The contents examined in each criterion layer are shown in Table 1-5, which is the multi scheme optimization index system of enterprise knowledge management system.

<table>
<thead>
<tr>
<th>System layer</th>
<th>Criterion layer</th>
<th>Index layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi scheme optimization index system of enterprise knowledge management system</td>
<td>System operability</td>
<td>System operating reliability</td>
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<tr>
<td></td>
<td></td>
<td>Interaction and of friendliness of system interface</td>
</tr>
<tr>
<td></td>
<td></td>
<td>System visualization</td>
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<td></td>
<td></td>
<td>System simplicity and usability</td>
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<td></td>
<td>System individuation and intellectualization</td>
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</tbody>
</table>
Table 2 Multi Scheme Optimization Index System of Enterprise Knowledge Management System

<table>
<thead>
<tr>
<th>System layer</th>
<th>Criterion layer</th>
<th>Index layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi scheme optimization index system of enterprise knowledge management system</td>
<td>System functionality</td>
<td>System retrieval capacity</td>
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<td>System sharing capacity</td>
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<td></td>
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<td>System processing performance of heterogeneous data</td>
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<td></td>
<td></td>
<td>System storage capacity</td>
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<td></td>
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<td>System revivability capacity</td>
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<tr>
<td></td>
<td></td>
<td>System processing performance of distributed data</td>
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<td></td>
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<td>System reusability</td>
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<tr>
<td></td>
<td></td>
<td>System data backup and recovery capacity</td>
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<td></td>
<td></td>
<td>System coordinated working performance</td>
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<td></td>
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<td>System project management performance</td>
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<td></td>
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<td>System security and authority management capacity</td>
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</tbody>
</table>

Table 3 Multi Scheme Optimization Index System of Enterprise Knowledge Management System

<table>
<thead>
<tr>
<th>System layer</th>
<th>Criterion layer</th>
<th>Index layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi scheme optimization index system of enterprise knowledge management system</td>
<td>System performance</td>
<td>System security</td>
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<td></td>
<td></td>
<td>System portability</td>
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<td></td>
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<td>System reconfigurability</td>
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<td>System maintainability</td>
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<td>System efficiency</td>
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<td>System completeness</td>
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<td>System upgradeable capacity</td>
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</tbody>
</table>

Table 4 Multi Scheme Optimization Index System of Enterprise Knowledge Management System

<table>
<thead>
<tr>
<th>System layer</th>
<th>Criterion layer</th>
<th>Index layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi scheme optimization index system of enterprise knowledge management system</td>
<td>System implementation efficiency</td>
<td>System competitiveness</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Enterprise economic benefit</td>
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<tr>
<td></td>
<td></td>
<td>Improvement of enterprise information processing capability</td>
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<td></td>
<td></td>
<td>Improvement of enterprise management capacity</td>
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<tr>
<td></td>
<td></td>
<td>Customer satisfaction</td>
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<tr>
<td></td>
<td></td>
<td>Improvement of enterprise working efficiency</td>
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<td></td>
<td></td>
<td>Performance realizability</td>
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<td></td>
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<td>Cost of system development</td>
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<td>Cost of system operation</td>
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</table>

Table 5 Multi Scheme Optimization Index System of Enterprise Knowledge Management System

<table>
<thead>
<tr>
<th>System layer</th>
<th>Criterion layer</th>
<th>Index layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi scheme optimization index system of enterprise knowledge management system</td>
<td>System environment</td>
<td>System platform openness</td>
</tr>
<tr>
<td></td>
<td></td>
<td>System module independence</td>
</tr>
<tr>
<td></td>
<td></td>
<td>System integration</td>
</tr>
</tbody>
</table>
knowledge management system | System interface
---|---
Development of system management tool
System multi-version capacity
Advancement of system development technology

3. IMPLEMENTATION OF THE MULTI SCHEME OPTIMIZATION MODEL AND THE ALGORITHM OF KNOWLEDGE MANAGEMENT SYSTEM

3.1 Basic Concept of Triangular Fuzzy Number

Triangular fuzzy number is a type of effective description of fuzzy information and can objectively represent the extreme value range of fuzzy information and the most possible value point. The general form of triangular fuzzy number $A$ can be expressed as:

$$ A = \left( a^L, a^M, a^R \right) $$

(1)

The general form of membership function $\varphi_A(x)$ of triangular fuzzy number $A$ is:

$$ \varphi_A(x) = \begin{cases} 
\frac{x-a^L}{a^M-a^L} & a^L \leq x \leq a^M \\
0 & x \leq a^L \\
1 & x = a^M \\
0 & x \geq a^R \\
\frac{a^R-x}{a^R-a^M} & a^M \leq x \leq a^R 
\end{cases} $$

(2)

If there exist triangular fuzzy number $A_1 = \left( a_1^L, a_1^M, a_1^R \right)$ and triangular fuzzy number $A_2 = \left( a_2^L, a_2^M, a_2^R \right)$, the multiplication $A_1 \otimes A_2$ between the two can be expressed as:

$$ A_1 \otimes A_2 = \left( a_1^L, a_1^M, a_1^R \right) \otimes \left( a_2^L, a_2^M, a_2^R \right) = \left( a_1^L \times a_2^L, a_1^M \times a_2^M, a_1^R \times a_2^R \right) $$

(3)

The division $A_1 / A_2$ between the two can be expressed as:

$$ A_1 / A_2 = \left( a_1^L, a_1^M, a_1^R \right) / \left( a_2^L, a_2^M, a_2^R \right) = \left( a_1^L / a_2^L, a_1^M / a_2^M, a_1^R / a_2^R \right) $$

(4)

3.2 Determination of optimization index set and optimization scheme set

Corresponding optimization scheme sets are determined based on the number of objects, which are the enterprise knowledge management schemes. Assume the number of enterprise knowledge management schemes satisfying the prescribed conditions is $m$, the corresponding optimization scheme set of the enterprise knowledge management scheme $i$ is recorded as $S_i$. The optimization scheme sets can be expressed as:
Based on the determined optimization scheme sets of enterprise knowledge management system and the basic section principles of optimization indexes, the optimization index sets oriented to optimization scheme sets are determined. Assume the number of optimization indexes satisfying the requirement is \( n \), and then the corresponding identification of optimization index \( j \) is \( r_j \), so the optimization index set \( R \) can be expressed as:

\[
\{r_j | j = 1, 2, \ldots, n\}
\]  

\[ (6) \]

### 3.3 Establishment of the triangular fuzzy number evaluation matrix

Based on the optimization index set \( R \), acquire the value of optimization index for each evaluation scheme in optimization scheme sets \( S \). The value acquisition should integrate various forms of methods, especially for the acquisition of fuzzy information, which include statistical analysis, questionnaire and expert evaluation. Assume the number of decision makers participating in the evaluation is \( K \) and the evaluation value of the \( j \)th optimization index in optimization scheme \( i \) of decision maker \( k \) is \( V_{ij} = (V_{ij}^L, V_{ij}^M, V_{ij}^R) \), so the initial value \( V_{ij} \) of the \( j \)th optimization index in optimization scheme \( i \) can be expressed as:

\[
V_{ij} = \frac{1}{K} \left( V_{ij}^L, V_{ij}^M, V_{ij}^R \right)
\]  

\[ (7) \]

The initial evaluation matrix \( V \) of enterprise knowledge management system optimization can be expressed as:

\[
V = \begin{bmatrix}
V_{11} & \cdots & V_{1j} & \cdots & V_{1n} \\
\vdots & \ddots & \vdots & \ddots & \vdots \\
V_{i1} & \cdots & V_{ij} & \cdots & V_{in} \\
\vdots & \ddots & \vdots & \ddots & \vdots \\
V_{n1} & \cdots & V_{nj} & \cdots & V_{nn}
\end{bmatrix}
\]  

\[ (8) \]

Different optimization indexes may possess different dimensions. To unify the metric of the optimization, we need to adopt the dimensionless method for the processing of optimization indexes.

If optimization index \( j \) is benefit-oriented index, the value \( u_{ij} \) of \( V_{ij} \) after the dimensionless is
\[ u_{ij} = \left( u_{ij}^L, u_{ij}^M, u_{ij}^R \right) = \frac{\left( v_{ij}^L, v_{ij}^M, v_{ij}^R \right)}{\max_{1 \leq i \leq m} (v_{ij}^R)} \]  

(9)

If optimization index \( j \) is cost-oriented index, the value \( u_{ij} \) of \( v_{ij} \) after the dimensionless is

\[ u_{ij} = \left( u_{ij}^L, u_{ij}^M, u_{ij}^R \right) = \frac{\left( \min_{1 \leq i \leq m} (v_{ij}^L), \min_{1 \leq i \leq m} (v_{ij}^M), \min_{1 \leq i \leq m} (v_{ij}^R) \right)}{v_{ij}^R} \]  

(10)

The evaluation matrix \( U \) of enterprise knowledge management system after the dimensionless can be expressed as:

\[
U = \begin{bmatrix}
    u_{11} & \cdots & u_{1j} & \cdots & u_{1n} \\
    \vdots & \ddots & \vdots & \ddots & \vdots \\
    u_{ij} & \cdots & u_{ij} & \cdots & u_{ij} \\
    \vdots & \ddots & \vdots & \ddots & \vdots \\
    u_{mj} & \cdots & u_{mj} & \cdots & u_{mn}
\end{bmatrix} = \begin{bmatrix}
    \left( u_{11}^L, u_{11}^M, u_{11}^R \right) & \cdots & \left( u_{ij}^L, u_{ij}^M, u_{ij}^R \right) & \cdots & \left( u_{in}^L, u_{in}^M, u_{in}^R \right) \\
    \vdots & \ddots & \vdots & \ddots & \vdots \\
    \left( u_{ij}^L, u_{ij}^M, u_{ij}^R \right) & \cdots & \left( u_{ij}^L, u_{ij}^M, u_{ij}^R \right) & \cdots & \left( u_{mn}^L, u_{mn}^M, u_{mn}^R \right) \\
    \vdots & \ddots & \vdots & \ddots & \vdots \\
    \left( u_{mj}^L, u_{mj}^M, u_{mj}^R \right) & \cdots & \left( u_{mj}^L, u_{mj}^M, u_{mj}^R \right) & \cdots & \left( u_{mn}^L, u_{mn}^M, u_{mn}^R \right)
\end{bmatrix}
\]  

(11)

### 3.4 Acquisition of optimization index weight

The importance of different optimization indexes for each optimization scheme set is different, and thus we need to acquire the weight of optimization indexes. Assume the number of decision makers participating in the evaluation is \( P \) and the evaluation value of the \( j \)th optimization index of decision maker \( k \) is \( W_{jk} = (W_{j}^{k-L}, W_{j}^{k-M}, W_{j}^{k-R}) \). In this equation, \( W_{j}^{k-R} \) represents the possible maximum weight of the \( j \)th optimization index; \( W_{j}^{k-M} \) represents the possible minimum weight of the \( j \)th optimization index; \( W_{j}^{k-M} \) represents the most possible weight of the \( j \)th optimization index.

The comprehensive weight of the optimization index is:

\[ w_{j} = \left( w_{j}^{L}, w_{j}^{M}, w_{j}^{R} \right) = \frac{1}{P} \left( \sum_{k=1}^{P} w_{j}^{k-L}, \sum_{k=1}^{P} w_{j}^{k-M}, \sum_{k=1}^{P} w_{j}^{k-R} \right) \]  

(12)
The weight sequence $W$ of the optimization index set is:

$$W = (w_j | j = 1, 2, \cdots n) = (w^L_j, w^M_j, w^R_j) | j = 1, 2, \cdots n$$

(13)

### 3.5 Implementation of triangular fuzzy number evaluation model

Corresponding evolution matrix $U$ of optimization scheme set $S$ and the corresponding weight sequence $W$ of optimization index set $R$ are acquired, so the comprehensive evolution matrix $H$ of enterprise knowledge management system can be expressed as:

$$H = U \otimes W^T$$

$$= \begin{bmatrix} u_{11} & \cdots & u_{1j} & \cdots & u_{1n} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ u_{nj} & \cdots & u_{nj} & \cdots & u_{nn} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ u_{mn} & \cdots & u_{mj} & \cdots & u_{nm} \end{bmatrix} \otimes \begin{bmatrix} w^L_1 \\ \vdots \\ w^L_j \\ \vdots \\ w^L_m \\ \vdots \\ w^R_1 \\ \vdots \\ w^R_j \\ \vdots \\ w^R_m \end{bmatrix}$$

$$= \begin{bmatrix} h^L_1 \\ \vdots \\ h^L_j \\ \vdots \\ h^L_m \\ \vdots \\ h^R_1 \\ \vdots \\ h^R_j \\ \vdots \\ h^R_m \end{bmatrix}$$

$$= \begin{bmatrix} (h^L_1, h^M_1, h^R_1) \\ \vdots \\ (h^L_j, h^M_j, h^R_j) \\ \vdots \\ (h^L_m, h^M_m, h^R_m) \end{bmatrix}$$

(14)

Based on the characteristics of triangular fuzzy number, the single value result $g_i$ of triangular fuzzy number $h_i = (h^L_i, h^M_i, h^R_i)$ can be expressed as:

$$g_i = \frac{h^L_i + 4 * h^M_i + h^R_i}{6}$$

(15)

Therefore, the evaluation result sequence $G$ of optimization scheme set $S$ is:

$$G = \{g_i | i = 1, 2, \cdots, m\}$$

(16)

The optimal enterprise knowledge management system scheme is obtained based on the optimization principle of the evaluation. If it satisfies

$$g_o = \max_{1 \leq i \leq m} G = \max_{1 \leq i \leq m} \{g_i | i = 1, 2, \cdots, m\} = g_j$$

(17)
Then, it indicates that enterprise knowledge management system scheme l is the optimal scheme of optimization scheme set S.

4. CONCLUSION

The optimization of enterprise knowledge management system is a complex system decision-making process restricted by various factors, which calls for comprehensively consideration of the requirements, development and technological environment of enterprise knowledge management system and the various restrictive factors and measurement indexes in the implementation process. Therefore, on the one hand, this paper analyzes the basic principle that needs to be followed in the optimization index selection of enterprise knowledge management system, selects optimization indexes under the guidance of the principle and establishes the optimization index system of enterprise knowledge management system. On the other hand, this paper gives the fuzzy optimization model of enterprise knowledge management system that can comprehensively process various types of influence factors and achieves the quantitative processing of the optimization result of enterprise knowledge management system. The implementation of the index system of enterprise knowledge management system and the fuzzy optimization model of enterprise knowledge management system can provide good support for the selection of enterprise knowledge management system, improve enterprise knowledge management capability, promote enterprise development and enhance enterprise competitiveness.

5. REFERENCES


