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A Research on Knowledge Management of Construction Cost Control

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Abstract: In order to raise the level of management in building construction cost, knowledge management approach is proposed in this paper.An XML(Extensible Markup Language)-based paradigm matrix is established to represent construction cost control knowledge. In the matrix, the row elements are made up of feature attributes, and construction working procedures are the components of the column. Furthermore, based on theHamming weighted proximity, the closeness between new construction projects and target case is calculated such that thesimilarity is obtained, by this method the knowledge matching is achieved.These methods remedy non-standardized description of the construction cost control knowledge and inefficient retrieval of the construction cost control cases, which offers a basis for knowledge management in construction cost control.

Introduction

Due to the complexityand variability of the construction cost, construction cost control knowledgeinvolves a wide range of factors. It is very complex to study. With the advent of the knowledge economy, more and more scholars realized that the knowledge management concept can be applied to the construction field, in order to improve the construction project management. Han-Hsiang Wang et al., applying the ontology method which is one of the knowledge management methods in the context of the construction information expression, analyzed and established the framework of construction riskknowledge[1].GulsahFidan et al. pointed out that the risk management knowledgeof the international engineering projects cost overrunswas not normative. Thenthey introduced the ontology method to establish the cost overruns knowledge base[2].Zhang Jing made a thorough study in the knowledge management of the construction project cost management and proposed appropriate measures for knowledge management[3].The studies provide a good idea for the applications to the construction cost control knowledge management. However, there are few specific measures in standardized description of the knowledge representation and convenient knowledge matching.So this paper established an XML-based paradigm matrix to construction cost control knowledge representation and established a knowledge base. Then using the Hamming weighted proximitymatch the paradigm matrix, achieving case retrieval. Ultimately the most similar case is found and as a sample for reference to the new project. The specific knowledge representation and knowledge retrieval process is shown in Fig. 1.

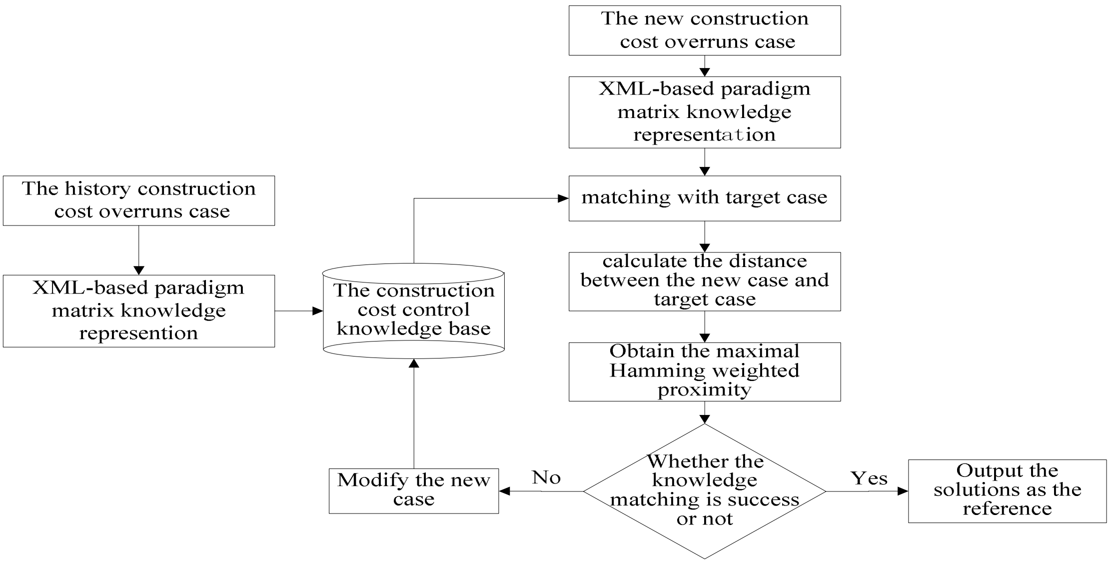

Fig. 1 The flow chart of the construction cost control knowledge representation and knowledge retrieval process

XML-Based Paradigm Matrix for ConstructionCost Control

In the XML-based paradigm matrix,the row elements are made up of characteristics attributes which is based on XML.

XML is extensible markup language. It has two advantages. One is that it can describe complex unstructured problems and the other is that it can realize the sharing of data[4]. Since the final output is the measures for construction cost control and it involves a wide range of factors, the knowledge representation based on XML is used to represent the construction cost control knowledge.

One history successful construction cost control should be seen as a paradigm and its correspondingcontrol measures as a case of output solutions.Based on different environment and conditions, each construction project has a variety of status information, and each have a plurality of characterizing attributes, as well as each attribute has a different characteristic corresponding to the value of the attribute.For this hierarchical structure, the XML-based paradigm for construction cost control measures knowledge representation can be shown in Fig. 2.

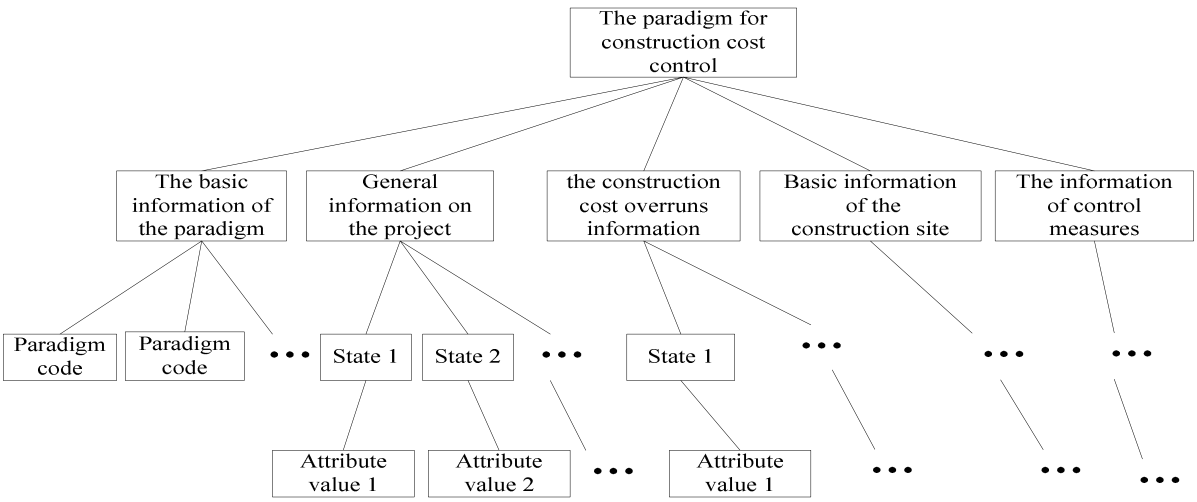

Fig. 2 The figure of the XML-based paradigm for construction cost control measures knowledge representation

Paradigm will be stored in the construction cost control in the knowledge base, paradigm database can be expressed as follows:

$$CaseBase = \{C_1, C_2, \cdots, C_n\},$$

Where $C_i = \{F_i, Q_i\}$is the$i$-th paradigm of the database, F_i is the set of feature attributeof the paradigmC_i,Q_i is the set of measures of theparadigmC_i.

$$F_i = (f_{i1}, f_{i2}, \cdots, f_{in})$$

$$Q_i = \{q_{i1}, q_{i2}, \cdots, q_{in}\}$$

Wheref_{in} is the$n$-th feature attribute of the paradigmC_i, $q_{in}$is the$n$-th construction cost control measures of the paradigmC_i.

Depending on the degree of importance of each feature attribute, carried the weight division.In this article, by means of the knowledge and experience of experts to carry out the construction cost control attributeweights, gettingeach feature attributeof the new construction cost overrun caseand let them build up the matrix as row vector, denoted as R,

$$R = (\varepsilon_1, \varepsilon_2, \cdots, \varepsilon_n),$$

Where ε_n is the$n$-th weight of the feature attribute.

Knowledge retrieval is feature attributesimilarity matching, so thefeature attribute make up the row vector.When the new paradigm finds the most similar case, and then selects the construction cost control measures of the historical case in the paradigm.

In the XML-based paradigm matrix,the column elements are made up of the construction working procedures.

It decomposes the construction process in WBS and selects the leaf nodes of the process to make up the set of the working procedures. The working procedures set can be denoted as D.

$$D = \{D_1, D_2, \cdots, D_m\}$$

Where D_m is then-th weight of the feature attribute.

Each working procedure for the influence degree of the construction cost is not the same, so the weight of the process in construction cost control is also different.Regardthe ratio of the planned cost of the process asthe weight of the construction cost control influence degree in each process and then combine together the weights to form the weight vector, denoted as W.

$$W = (w_1, w_2, K, w_m)^T$$

Where $w_i = \frac{c_i}{\sum_{i=1}^{n} c_i}$, c_i is theplanned cost of the i-th construction process.

Based on the above analysis, the correspondence between feature attributes and working proceduresin construction cost control is shown in Table 1.

Table 1 The representation between construction cost control processes and attributes

Construction cost Procedures	Engineering situation F_1	The degree of deviation F_2	The construction cost overruns F_3	…	The $\boldsymbol{n}$-thfeature attribute F_n
Procedure$\boldsymbol{D_1}$	x_{11}	x_{12}	x_{13}	…	x_{1n}
Procedure$\boldsymbol{D_2}$	x_{21}	x_{22}	x_{23}	…	x_{2n}
…	…	…	…	…	…
Procedure$\boldsymbol{D_m}$	x_{m1}	x_{m2}	x_{m3}	…	F_{mn}

Established the construction cost control matrix M, the row elements are the set offeature attribute F_i, and the column elements are the working procedures set D.The matrix is denoted as:

$$M=\begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix}$$

The Construction Cost control Knowledge Matching Based on the Hamming Weighted Proximity

The intuitive sense of closeness degree is level of two fuzzy sets close to each other[5].As a result of the Hamming approach degreeis effectiveand convenient. It is applied to the construction cost control knowledge retrieval to improve the efficiency and accuracy of knowledge matching.

TheHamming weighted proximity of fuzzy sets $\underset{\sim}{A}$ and $\underset{\sim}{B}$ isdelimited as $t_{HW}(\underset{\sim}{A},\underset{\sim}{B})$.

$$t_{HW}(\underset{\sim}{A},\underset{\sim}{B})=1-d_{HW}(\underset{\sim}{A},\underset{\sim}{B})\ d_{HW}(\underset{\sim}{A},\underset{\sim}{B})=\frac{1}{n}\sum_{i=1}^{n}\omega_i\left|a_i-b_i\right|$$

Where $d_{HW}(\underset{\sim}{A},\underset{\sim}{B})$ is theweighted Hamming distance of fuzzy sets $\underset{\sim}{A}$ and $\underset{\sim}{B}$, there in $\omega_i\geq 0$, and $\frac{1}{n}\sum_{i=1}^{n}\omega_i=1$. By above knowable, the value of the Hamming weighted proximity less than or equal to 0.And the greater of the value be, the more similar of the two sets will be.

The calculation steps of thefeature attributematrixin construction cost control are shown as follow:

(1) According to the feature attribute matrix knowledge representation method establish theconstruction cost control feature attribute matrix of thenew engineering project, denoted as H .

$$H=\begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{bmatrix}$$

(2) The row vector of construction cost control feature attributes inthe new case, denoted asF_{hi}.

$$F_{hi}=\left(a_{i1},a_{i2},\cdots,a_{in}\right)$$

The row vector of construction cost control feature attributes inthe history case, denoted asF_{mi}.

$$F_{mi}=\left(x_{i1},x_{i2},\cdots,x_{in}\right)$$

The construction cost control attributes weight vector R_i, $R_i=\left(\varepsilon_1,\varepsilon_2,\cdots,\varepsilon_n\right)$

The construction cost control process influence weight vector W , $W=\left(w_1,w_2,\cdots,w_m\right)^T$

(3) CalculatetheHamming weighted proximity of fuzzy setsF_{hi}andF_{mi}, denoted as t_i

$$t_i(\underset{\sim}{H},\underset{\sim}{M})=1-d_i(\underset{\sim}{H},\underset{\sim}{M})=1-\frac{1}{n}\sum_{j=1}^{n}\varepsilon_i\left|a_{ij}-x_{ij}\right|$$

(4) Sequentially to calculate, t_i, then combine together them to form the vector of Hamming weighted proximity, denoted as T , $T=\left(t_1,t_2,\cdots,t_m\right)$.

(5)The construction cost control process influence weight vector W multiplied by the vector of Hamming weighted proximity T .Get the final closeness degree t_{mh} .

$$t_{mh}=WT=(w_1,w_2,\cdots,w_m)^T(t_1,t_2,\cdots,t_m)$$

(6)Sequentially to calculate thecloseness degreebetweenthe new case to the history case and identify the maximum Hammingweightedproximity which is the most similar case.

(7)Apply the set of measures Q_i from the most similar case paradigm and provide the feasibility recommendations for the managers.

Conclusion

This paper uses XML to build a knowledge representation paradigm of construction cost control measures, and so build knowledge measure the sample libraries.This method provides an effective and standard approach to the construction cost control knowledge representation.

This article creatively appliedHammingweighted proximity to calculate the closeness degree and find the most similar case.This method makes the knowledge matching process more simple and effective.

In addition,due to the mass of factors and processes involved in the construction process and feature attribute for the construction cost control,this article does not consider the knowledge reduction. It is the lack of research in this paper.

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