Research on the cost estimation of transmission line project with case-based reasoning

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Abstract

Investment estimation phase of power transmission line project is an important stage of project cost control, the traditional unit investment forecasting methods, however, cannot meet the need of engineering rapid estimation. The research objective of this paper is to forecast the unit investment of the Transmission Line Project applying the case-based reasoning system. Based on the factor analysis tools of multivariate statistical software SPSS, the correlation coefficient matrix of characteristics factors are identified, and weight coefficient of characteristics factors is calculated. Based on the formula of European weighted distance, the similarity is calculated and case similarity is retrieved. Finally, the model is constructed to predict the unit investment of Transmission Line project, and the correctness and usefulness of the model is verified. It is shown that this case-based reasoning system of unit investment can achieve real-time updating of cost index database. The primary contribution of this research is the combination of the cost forecast and Case-based reasoning system of artificial intelligence. It is expected that this work will provide a reference and guidance for transmission line project investment decision in estimating phase.

Keywords: case-based reasoning, transmission line projects, forecasting

1 Introduction

Setting up the prediction model in line with the actuality, accurately and rapidly estimating the construction cost has dramatic theoretical significance and practical value. The accuracy of the transmission lines project cost prediction has a close relationship with the selection of prediction methods. The common predicting method can be divided into three categories:

The first is the approximate deduction method. According to the characteristics of all kinds of engineering projects, some uncertain factors are classified and made hypothesis. Then based on the mechanism of deductive reasoning, project cost prediction model is established. Such as artificial neural network, unit cost factor is the key to construct artificial neural network structure model. Only the various influence factors and influence mechanism are found, the artificial neural network model can be constructed, including the influence of the engineering geologic and topographic conditions, the influence of the transformer substation type, the influence of conductor cross section size of the transmission line, the influence of the cable laying mode, etc.

The second is statistical induction. Based on the finished engineering cost information, the engineering cost and index database is established. Through mathematical means, looking for the change rule of all kinds of construction project cost, project cost prediction model is established [1]. Such as engineering analogy method and fuzzy mathematics method, the difficulty of this method lies in the selection of fuzzy analogy estimate model category. Fuzzy system lacks self-study ability, the membership functions and fuzzy rule of which are chosen by experts subjectively, potentially skewing results.

The third kind is the time series method [2]. Such as moving average, exponential smoothing, autoregressive moving average method, the constant ratio regression method and Markov prediction method, regression analysis and grey prediction method. Using month as the unit to gather the cost information, and to generate a variety of cost index data sequence, fitting model is established on the basis of corresponding theory. Moving average method and exponential smoothing method usually lag and it is difficult to determine the weight coefficient. Autoregressive Moving Average (ARMA) model only adapts to the stationary time series. Constant ratio regression method requires regression analysis, however, missing individual data and uneven distribution will lead to the accuracy reduction or even failure of analysis result. Owing to the poor extrapolation, the model has the feature of high-precision and fitting unless the detailed scale and scope of the project are described in the selected completed project. It is difficult to decide the state transferring probability matrix which is the core. A function curve is hard to be established to describe the change trend of engineering cost, which brings limitations to the application of trend extrapolation.

Considering the shortage of the existing unit investment estimate method, this paper puts forward on estimating construction cost of transmission lines project which on the basis of case-based reasoning technology, and analyzes the necessity and feasibility of forecasting system based on the Case-Based Reasoning. The performance of this model is verified by an illustration.

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2 The establishment of the case-based reasoning system

2.1 THE PRINCIPLE OF CASE-BASED REASONING SYSTEM

The Case-Based Reasoning is a new strategy to demonstrate knowledge and its primary feature is to use previous similar experiences to solve current problems [3]. In CBR, to solve the problem or situation is known as the target case, and the memorized or completed case is called the source case. Case-Based Reasoning is a strategy which obtains the most similar source case in memory by the hints of the target case and finds the answers by the instruction of the source case. The artificial intelligence technology is often used in project cost system design [4], project cost risk control [5], real estate marketing [6], and project cost quickly estimation [7], etc.

2.2 ANALYSIS OF THE APPLICABILITY OF THE CASE-BASED REASONING SYSTEM

Compared to the existing measures, Case-based reasoning system shows more suitable for forecasting the unit investment of transmission lines. First of all, the knowledge of case-based reasoning system is organized in the form of case structure. Moreover, it is difficult to use the function model to describe the engineering cost of transmission lines and the multi-factors of complex misalignment relations characteristic. However, the form of case can provide more abundant information than that of a set of rules.

Second, fuzzy reasoning is a kind of incremental learning method, and neural network method has similar advantages. With the increase of cases, the coverage of the case (the range of solving the problem) and predictive accuracy are improved. Both fuzzy system and neural network are dynamic system. Neural network is suitable for processing unstructured information, while the fuzzy system deals with the structured knowledge more effecttively. Case-based reasoning shows better expandability, for the reason that it is a reference case experience, and requires little field knowledge, which avoids the integrity and consistency of the knowledge base with the increase of knowledge.

2.3 DESIGN OF THE CASE-BASED REASONING SYSTEM OF COMPLETED PROJECT

Based on the analysis of characteristics of transmission lines construction project, and combined with the working process of the case-based reasoning, a case-based reasonning unit investment forecasting system of transmission lines is built as follow.

The first step is acquiring knowledge from completed projects in the database, and extracting the representative attributes of engineering projects. The second step is establishing a completed project database, namely, to establish an extensible engineering database which saves project overview, the main technical and economic indices and unit investment and other attributes. The third step is confirming the target weigh coefficient, that is to say, factor analysis of SPSS is adopted and each attribute is assigned corresponding weights. The forth step is case retrieval. Based on the previous steps, the similarity between two cases is measured by the distance formula. Case retrieval includes two steps: firstly, searching the projects in the case base as similar as possible, secondly, matching up to the most similar item from the similar projects. The fifth step is case revision. Case revision aims at adapting to the problem to be solved, and on the basis of the predicting result it can set a certain minimum threshold to confirm the corresponding adjustment strategy. The sixth step is case study and maintenance. The existing case base can be complemented along with adding or removing case, adjusting the structure of the case, and resetting the indexes to meet the demand of continuous change and expending requirement of cost management.

3 The implementation of case-based reasoning system

3.1 CASE REPRESENTATION AND ORGANIZATION

Case representation is the premise and basis of case-based reasoning, and belongs to a kind of knowledge representation, which turns out to be “cases transition from our experience”. Problem to be solved are structured, and attributes are extracted. Case representation is a description of the current prediction problem, and the corresponding eigenvalue solutions needs to be obtained through reasoning system. On the one hand, it is the descriptive method of the case, on the other hand it is content contained in the case description. According to the basic data approved by a province in China in 2012 at feasibility research stage, the main factors influencing the unit investment of transmission lines engineering have two aspects. One is the project summary information, including voltage grade, overhead line type, topography, ice, and the path length of the overhead line, etc. The other is main economic indexes such as the proportion of corner, tower, ground wire, iron tower, steel, foundation pit concrete, earth rock and number of insulator string index, etc. Unit kilometer cost is needed to be predicted.

The common methods of case representation currently contain causality graph, object-oriented knowledge representation, logic representation, semantic network, frame representation, full-text representation. The framework representation uses a structure or organization to store the past experience, cases of which are structured in the form of “node-slot-value” of semantic network. So the general structure of framework is a semantic network, by the framework and a set of framework is used to describe various aspects of specific attributes of the slot. Framework is a general structure of semantic network, consists of a framework and a set of slots used to describe all aspects of the specific properties. Each slot can be further equipped with "side" to be specified [8]. In the transmission line projects, slots are described formally as follow:

Item number:
Framework name: <Transmission lines project summary>
Slot 1. Project overview
Side 1. Completion date
Side 2. Construction site
Side 3. Construction type
Side 4. Voltage grade
Side 5. Overhead line types(normal, compact, shrunk, long-span)
Side 6. Altitude

Slot 2. Project properties
Side 1. Line length
Side 2. Tower type
Side 3. Tower base quantity
Side 4. Tower material quantity
Side 5. Wire type
Side 6. Conductors bundled number
Side 7. Cover ice
Side 8. Wind speed
Side 9. Terrain proportion
Side 10. Geological proportion
Side 11. Design of the joint and one standardization

Framework name: <Cost information>
Slot 1. (Property Value Inheritance) project profile inherited

Slot 2. Cost indicators
Side 1. Total cost
Side 2. Ontology construction cost
Side 3. Auxiliary construction cost
Side 4. Other expenses

Slot 3. Major material and labor consumption
Side 1. Artificial man-days
Side 2. Concrete
Side 3. Steel
Side 4. Wire
Side 5. Cement

Slot 4. Bill of civil part quantities
Side 1. Earthwork and rockwork
Side 2. Basic engineering

Slot 5. Bill of installation quantities
Side 1. Tower engineering
Side 2. Wiring project
Side 3. Attachment engineering

Slot 6. Result sets
Side 1. Cost of per kilometer
Side 2. Number of per kilometer tower base
Side 3. Wire consumption of per kilometre

Slot 7. Related instructions
Side 1. Analysis of representative case

The case number is the unique identification of engineering cases, represented by a string. Engineering properties are briefly introduced, including the profile information referred construction time, site, time schedule. Engineering metrics includes major staff and technology arrangement technical index, which corresponds case retrieving information. The result sets show better fidelity to the solutions, which includes engineering unit investment and major staff and technology consumption. Relevant specification is the analysis of the typical engineering cases, the relevant cost information of which will be explained or extended. The referred cost information reflected by the cases will be explained and extended.

In order to express case more methodically, cases are organized and arranged to form corresponding completed project database according to the characteristics of the case and retrieval need. Case organization directly affects the efficiency of case retrieval, whose key is the selection of key indicators of transmission line project. Key indicators are determined by the problem to be solved and the characteristics of certain cases.

3.2 CASE RETRIEVAL

3.2.1 Case index

Case indexing method has three types: nearest neighbor, inductive reasoning and knowledge-guided approach. According to the case representation and organization form, case retrieval is conducted by means of the combination of nearest neighbor approach and knowledge-guided approach in the engineering cost estimation system based on case-based reasoning.

Knowledge-guided strategy selects the optimum cases through searching the target case and completed cases in the database, whose attributes, including voltage grade, overhead line type, topography and other indicators, are determined by domain knowledge. Case sets in line with the features of pending cases domain can be output as the candidate sets to be selected in the nearest neighbor approach.

Nearest neighbor approach is a kind of strategy that target case to be resolved and completed cases in the case base are retrieved and traversed, respectively obtaining the similarity between cases of each index field. According to the established weighted vector, the similarity among cases and the problem to be solved are calculated. In addition, users can also get the cases whose similarity exceed the threshold, then modify and retrieve them.

The engineering unit investment factors of transmission lines will be divided into two categories: control attributes and comparison attributes. Among them, control attributes refers to the project profile and basic information of attributes, such as voltage grade and overhead line type, which is essential for judging the similarity of transmission lines projects. Primary retrieval is kind of searching the feasible candidate sets by matching exactly the target case and the case base by the attribute index. Then, by applying the results of paired comparison, an index structure is established. When control properties of transmission line engineering match completely, comparing attributes can be retrieved through advanced searching. On the premise of same control properties, main characteristics of comparing attributes and cases of largest number of matched features are taken into first consideration.

In order to realize the initial matching of the control properties between the cases to be solved and the case base, c++.net is applied to set primary retrieval rules. Combined with representation and organization characteristics of engineering case, the primary search selects the voltage level for the first retrieval conditions, altitude for the second retrieval conditions, overhead line type for the third retrieval conditions, which finally form the candidate sets based on the nearest neighbor algorithm.

The main code of primary retrieval is as follows:

```
int JuniorSearch()
 {
 int count = 0;
 juniorData[count] = targetData[0];
count++;
 for (int index = 1;index<totalCount;index++)
 {
array<String^>^ rowData = tableData[index];
// Matching the first condition?
                if(Convert::ToInt32(rowData[1])!=Convert::ToInt32(
tarValue[1]))
                {
                continue;
}// Matching the second condition?
if((Convert::ToInt32(rowData[2])>Convert::ToInt32(tarValue[2])
)||(Convert::ToInt32(rowData[3])<Convert::ToInt32(tarValue[3]))
)
{
continue;
}// Matching the third conditions?
if(TransformType(rowData[4])!=LINE_TYPE(int(tarValue[4])))
{
continue;
}//Meeting all the three conditions?
juniorData[count] = rowData;
count++;
}
 return count;
 }
```

3.2.2 Similarity retrieval

Through primary index we can find candidate set of cases in the completed project as little as possible, which has reference significance to the target problem to be resolved. Then the similarity of comparing attributes are retrieved and evaluated, in order to find the relative matching case to forecasting unit investment. Due to the incompleteness of information, only the cases whose characterizing attribute are similar can be matched and retrieved, difficult to matching completely. So this section will use SPSS statistical analysis software[9], according to the correlation analysis between each variable, the main factors that influence the engineering cost are determined, furthermore the weight of each comparing attributes influencing the case similarity was defined.

Similarity is basis of the case-based reasoning, the measure method and standard of which determine success or failure of case-based reasoning and the accuracy of the prediction to a great extent. The similarity metrics between cases is represented by S. The closer the control attributes and comparing attributes of x and x' in two cases are, the higher the value of $S(x,x')$ will be. The further the control attributes and comparing attributes of x and x' in two cases are, the lower the value of $S(x,x')$ will be. Generally the similarity between cases is measured by the distance in feature space. The distance metrics which are frequently used include Euclidean distance, City Block, Minkowski distance, Chebyshev distance weighted variance distance and Markov distance.

The similarity of the prediction model in this paper is measured by Euclidean distance[10]. A case is represented with a data vector x. In this article $x_i = \{x_{i1}, x_{i2}, \cdots x_{in}\}$ represents case, where n is the dimension of vector, m is the case numbers in the space X. The calculation steps are as follow:

1) Standardization of data: $x_{mn} = \dfrac{x_{mn} - \min\limits_m x_{mn}}{\max\limits_m x_{mn} - \min\limits_m x_{mn}}$.

2) Determination of the weight: each influence of the comparison properties to transmission line project varies greatly. Some of attributes, including tower index, wire index, foundation pit concrete index, are crucial, while others, such as the number of the insulator string, have little effect. Similarity is sensitive to the change of the weight, so reasonably setting the weight ensures that the results of prediction accuracy. Many methods could be used to calculate the weight, such as expert discussion method, analytic hierarchy process, however, the strong subjectivity of which can lead to similarity deviation if the weight is allocated unreasonably. Factor analysis tools in SPSS software is used to assign the value of relevant weight, which greatly reduces the subjective influence on the prediction result. The article extracts 13 factors from 139 cases according to the engineering characteristics of transmission line projects of a province in 2012.

Based on the selected case database, cases of different voltage levels are selected, in order to examine the selected variable distribution. The unit investment varies greatly among different voltage levels, including 220kV, 110kV, 35kV. In order to identify the important deviation value of the distribution of the variable based on the transmission line projects of different voltage levels, box plot in the software SPSS is used to remove the outlier spots. The result is shown below in Figure 1.

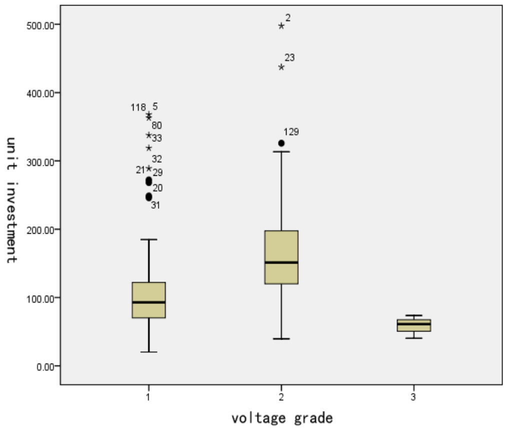


FIGURE 1 Box of voltage grade and unit investment

Based on the factor analysis tools of software SPSS, correlation matrix table is obtained after inputting the data of 13 factors for correlation. Unit investment is the factor to predict, the correlation between other attributes and the target attributes shall be strong, while the correlation between other factors shall be as weak as possible in order to minimize collinearity between them. After inspection, the correlation coefficient between tower index and the material of iron tower is 0.849 which means strong liner correlation and they are merged into tower index. Cast-in-situ foundation and other foundation pit concrete index, bored concrete pile foundation index, are merged as foundation pit concrete index. After calculation, the correlation coefficient between the foundation pit concrete index and foundation pit earthwork index is 0.793, which means strong correlation, and foundation pit concrete index is reserved. The correlation coefficients between unit investment conductor insulator composite index, conductor insulator index without composite are inferior to 0.4, which means weak correlation, and two indexes are deleted. After using factor analysis, the final correlation coefficient matrix is shown in the following Table 1.

TABLE 1 Correlation matrix

		Angle proportion	**Tower index**	**Wire index**	**Grounding line index**	**Foundation pit concrete index**	**Foundation steel index**	**Unit investment**
correlation	Angle proportion	1	-0.03	0.424	-0.136	-0.316	0.358	0.322
	Tower index	-0.03	1	0.234	0.196	0.027	0.276	0.416
	Wire index	0.424	0.234	1	-0.183	-0.282	0.725	0.434
	Grounding line index	-0.136	0.196	-0.183	1	-0.034	-0.168	-0.261
	Foundation pit concrete index	-0.316	0.027	-0.282	-0.034	1	-0.199	-0.202
	Foundation steel index	0.358	0.276	0.725	-0.168	-0.199	1	0.57
	Unit investment	0.322	0.416	0.434	-0.261	-0.202	0.57	1
Sig. (one-sided)	Angle proportion		0.434	0.006	0.221	0.034	0.019	0.032
	Tower index	0.434		0.091	0.133	0.441	0.057	0.007
	Wire index	0.006	0.091		0.15	0.053	0	0.005
	Grounding line index	0.221	0.133	0.15		0.425	0.172	0.068
	Foundation pit concrete index	0.034	0.441	0.053	0.425		0.129	0.125
	Foundation steel index	0.019	0.057	0	0.172	0.129		0
	Unit investment	0.032	0.007	0.005	0.068	0.125	0	

As shown in the Table 1, twelve attributes are extracted from the database, six of which are comparing indexes, including angle proportion, tower index, wire index, ground wire index, foundation pit concrete index, and foundation steel index. As the unit investment index is the target prediction index, the larger the correlation coefficient between comparing attributes and unit investment index is, the strong similarity between the target case and case set is. Based on the correlation coefficient between 6 comparing attributes and unit investment respectively in the correlation matrix table of SPSS factor analysis, the similarity weight of the cases are calculated [11], which is shown in Table 2.

TABLE 2 The weight of Case similarity impacted by characteristics factors

Engineering characteristics	The correlation coefficient to unit investment	The weight
Angle proportion	0.322	0.16
Tower index	0.416	0.19
Wire index	0.434	0.20
Ground wire index	0.216	0.10
Foundation pit concrete index	0.202	0.09
Foundation steel index	0.570	0.26
	2.16	1.00

3) Similarity calculation: to calculate the similarity, the users should input new cases, the attributes of which mainly include angle proportion, tower index, wire index, ground wire index, foundation pit concrete index, and foundation steel index. $d(x_i, y_j)$ represents the distance between the new case x_i and a certain case y_j from the database. The distance is defined by weighted Euclidean distance method [12].

$$d(x_i, y_j) = \left[\sum_{k=1}^{p} w_k (v_{ik} - v_{jk})^2 \right]^{\frac{1}{2}},$$

where p represents the total number of attributes. v_{ik} represents the value of k-th attributes of case i-th. w_k represents the weight of k-th attribute.

The target case and the candidate case base are traversed to retrieve with the maximum value d_{max}, and three cases with the closest distance which is represented as d_1, d_2, d_3 respectively.

The similarity between new case and the case from the database is defined as $sim(x_i, y_j)$. The similarity calculation formula is as followed [13]:

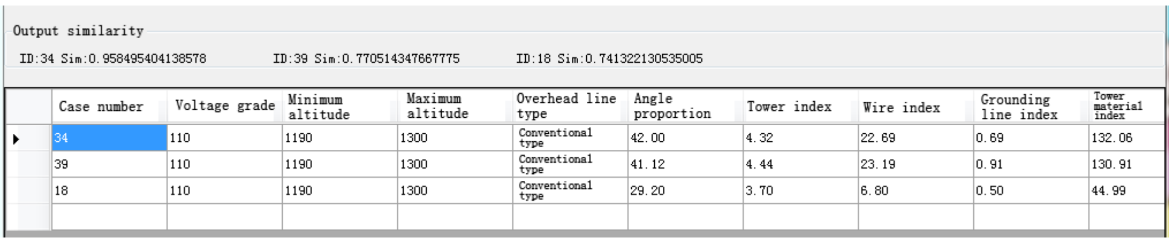
$$sim(x_i, y_j) = 1 - \frac{d_i}{d_{\max}} (i = 1, 2, 3).$$

The output of similarity value should between 0 and 1. The closer the sim value is to 1, the greater the similarity is.

4) Case similarity retrieval: firstly, Similarity is calculated as the followed program code:

```
double CalSim (int P, array <double> ^W,array
<double>^Vi,array<double>^Vk)
{
 double sumUp = 0;
for (int index=0;index<P;index++)
{
double w = W[index];
double vi = Vi[index];
double vk = Vk[index];
 //sum the squares of numerator
 sumUp += w * (vi - vk) * (vi - vk);
 }
 return (System::Math::Sqrt(sumUp));
 }
Advance search is conducted, and the program code is as follow,
int HighSearch()
 {
 if(juniorCount <= 1)
 {
 return 0;
 }
 int count = 0;
 highData[count] = juniorData[0];
 count++;
 int colTotal = juniorData[0]->Length;
 array<double>^ temp = gcnew array <double> (colTotal);
array<double>^ retList = gcnew array <double> (juniorCount -
1);
array<int>^ retIndex = gcnew array<int>(juniorCount - 1);
for (int index = 1;index<juniorCount;index++)
 {
 // The original data
 array<String^>^ rowData = juniorData[index];
 // Convert to processing dataTransformData (rowData,temp);
 // Calculate the similarity
 double sim = CalSim(colTotal,tarW,tarValue,temp);
 // Save the result?
 retList[index-1] = sim;
retIndex[index-1] = Convert::ToInt32(rowData[0]);
 }
 // sort
Array::Sort(retList,retIndex);
//Select the maximum data Y
 int length = retList->Length;
 Dmax = retList[length - 1 ];
 for (int index = 0;index < length && index < 3 ;index ++)
 {
 int id = retIndex[index];
highData[count] = tableData[id];
count++;
 }
 // show result?
showResult(retList,retIndex);
 return count;
}
```

The case No.34, No.39, No.18 are selected with similar value of 98.85%, 77.05%, 74.13% respectively, which are the top three cases with the largest similarity. The result is shown in the following Figure 2:



Output similarity

ID:34 Sim:0.958495404138578 ID:39 Sim:0.770514347667775 ID:18 Sim:0.741322130535005

Case number	Voltage grade	Minimum altitude	Maximum altitude	Overhead line type	Angle proportion	Tower index	Wire index	Grounding line index	Tower material index
34	110	1190	1300	Conventional type	42.00	4.32	22.69	0.69	132.06
39	110	1190	1300	Conventional type	41.12	4.44	23.19	0.91	130.91
18	110	1190	1300	Conventional type	29.20	3.70	6.80	0.50	44.99

FIGURE 2 Prediction system based on case-based reasoning

3.3 CASE REVISION

Based on similarity calculation, the similarity between the target case and the candidate case in the case base is obtained. An appropriate minimum threshold is set according to the influence of similarity to the target case. Cases whose similarity are greater than or equal to the lower threshold are selected as the matching case of the target case, which provides decision support for new projects. If the similarity of the model doesn't reach the threshold, case will be amended according to the voltage level, overhead line type and other attributes in the case base.

If the similarity threshold is set to 0.9 in the above case-based reasoning system, the similarity between case 24 and the target case is 95.85%, above the threshold, which needs no adjustment. Case 39 and case 18 need appropriate amendments according to the expert experience and human-computer interaction, because the similarity of which are below the threshold. After case revision the similarity is above the threshold, which guarantees the precision of the prediction.

Comparison between main engineering characteristics of target case and similar case is shown in Table 3.

TABLE 3 The main engineering characteristics of target case and similar cases

Case No.	Angle ratio	Tower index	Wire index	Ground wire index	Iron tower material index	Basic steel index	Foundation pit concrete index	Unit investment
Target case	39.00	4.50	24.92	0.70	133.24	25.36	269.71	
34	42.00	4.32	22.69	0.69	132.06	28.00	99.78	279.63
39	41.12	4.44	23.19	0.91	130.91	24.94	270.99	153.16
18	29.20	3.70	6.80	0.50	44.99	17.68	161.28	178.84

As for case revision, the inconsistent between target case and senior retrieved case needs considering mainly, in order to find out the optimal solution. For example, the perception of angle steel tower, steel towers and steel rods needs to be considered in similar cases, for the iron tower indices differ greatly. The influence of different factors including wire type and wire section needs to be considered in order to correct the wire indicator. Casting type of basis needs to be considered to rectified foundation pit concrete index. After the above factors are considered comprehensively, the cases whose similarity are below the threshold are modified, and unit investment is derived from appropriate forecasting model.

Based on the comparison of the cost index and the actual situation of the project, the prices of case No.39 and No.18 increase 35%, namely, 206.766 and 236.07 ten thousand yuan/km, respectively. The prediction of unit investment is 2408200 using arithmetic average, which is 3.92% lower than actual estimate. The predicted results are accurate and convincing.

3.4 CASE LEARNING AND MAINTENANCE

Case learning takes a new round of case decision by adding the newly completed project to the corresponding decision-making environment through the case description and index. The case learning process can update the case base, so as to provide a rich case database for case reasoning. With the quantity of the case increasing, however, the efficient of the program may fall, emerging redundancy, repetition and obsolete. When the cost of retrieving similar case is greater than the benefit it offers, index mechanism of the case database should be adjusted and the case data should be maintained, including improving obsolete case and deleting the invalid case. The forecasting system's capacity to solving problems is gradually strengthened and improved through the case study and maintenance.

4 Conclusions

Based on artificial intelligence methods, case-based reasoning forecasting system of unit investment is analyzed, which provides a quick and effective approach for unit investment rapid estimation at estimate stage. Firstly, completed engineering data is organized, stored and managed using ACCESS. Secondly, the software SPSS is used to data denoising, and the cost index weight coefficient is built by factor analysis tools. Then, the programming algorithm of dynamic case reasoning system component is designed by C++/CLI language. The program dynamically associates the activities of the execution program with the completed engineering database, which realizes the primary search, advanced search and similar case output. Based on the completed transmission line projects in 2012, the essay accomplishes the rapid search of similar cases and optimizes the output of the program after adjustment.

At present, the case-based reasoning system prediction for transmission line projects is still at its initial stage. The uncertainty of the index weight setting still exists because of the strong dependence of historical database. Similarity distance formula is the key to the precision of prediction which directly affects the accuracy of the prediction results. The modification of the similar case is the difficulty of the research due to the objective of expert evaluation.

The combination of the unit transmission line project with the artificial intelligence greatly improves the speed of the unit investment fast calculation. The system provides reference for the foundation of the building cost index database, which also provides reference for the data accumulation of the owners' projects.

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