Research on randomcity of conflict events in construction engineering projects

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Abstract. The conflict events that occurred in construction engineering projects (CEP) often bring about many adverse effects on project implementation and show a character of randomcity. To find out the occurring rule of conflict events, all sorts and occurring frequencies of conflict events in CEP are analyzed based on the investigation. The representing rule of conflict events in every stage has been revealed in a new concept referred to as the representation degree by the method of quantitative analysis combined with qualitative analysis. Then, according to the basic principle of the analytic hierarchy process, every stage's judgment matrixes of conflict events are set up. Latent roots of these matrixes have revealed the influence order of cumulative results of conflict events at each stage. The harvest has obvious theoretical and practical value for forecasting conflict events, mastering the whole project situation, avoiding and reducing conflict events, and improving project management ability.

1 Introduction

The conflict events in construction engineering projects show different forms in different stages [1-2], these conflict events seem randomcity and contingency on their surface, but this randomcity might have some inherent rules. At present, an authoritative viewpoint in conflict events management is Harold Kerzner's research harvest based on the universal application of project management. The research shows seven factors that result in conflict in the project, which are project priority, management program, technical view, resource of manpower, cost, schedule, and personality[3]. For this, the most important view in the research is that the seven factors appear at the same time in different stages of the project, although have different occurring frequencies. However, this view might not fit construction project management, and their countermeasures to solve conflicts could not be effective in construction conflict management. Therefore, it is necessary to learn and master the random rule of conflict events in CEP to manage and control conflicts in large-scale construction projects..

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2 Investigation and statistics of conflict events

In order to understand the conflict events in large-scale construction projects, and reveal the objective situation and distribution rule of conflict events, an extensive investigation has been carried at the support of China national social science fund project and ninety-six large-scale construction enterprises in twenty-seven provinces. After researchers completed the questionnaire edition on the bases of determining survey parameters such as survey object, survey content, survey methods, and survey sample demands[4], 438 questionnaires were issued. Finally, 376 questionnaires were recovered. Through the identification, 325 valid questionnaires were obtained, and the questionnaire recovery rate was 85.84%. Based on the actual recovered sample, the response rate of the questionnaire was 86.43%.

In this survey, in order to find the occurring characteristics of conflicts in different project stage, the occurring frequency degree of conflicts is set up in advance, that is, little, less, normal, much and more. Thus, according to the analysis of 325 valid samples, the investigators reported 726 items of conflict events. Through the consolidation analysis of 726 conflict events, it is known that there are 76 representative conflict events in 19 categories in large construction projects, the category and occurring frequency degree of conflict events in each stage and their cumulative reflection number in the survey are shown in Table 1.

Table 1. Statistic of conflict events in each stage.

Stage	Category of conflict	Frequency					Number
		Little	Less	Normal	Much	More	
Decision-making	Project scheme decision-making				●		15
	Project feasible study			●			24
	Project investment estimation		●				19
	Report submission and approval				●		13
Preparation	Engineering survey and design					●	59
	Project bidding				●		39
	Land expropriation and migration			●			26
	Construction procedures transaction			●			31
Construction	Safety management		●				64
	Contract disputes		●				28
	Engineering quality			●			46
	Environmental problem			●			48
	Construction schedule				●		53
	Personnel coordination				●		45
	Resource allocation					●	67
	Technical problems		●				50
Ending	Expense settlement			●			34
	Residual problem handling					●	45
	Project confirmation and handover				●		20

3 The occurring rule of conflict events in every stage

It can be seen from Table 1 that there are different numbers of conflict categories in different stages, which have also different occurring frequencies. In order to reveal the occurring rule of conflict events in every stage, a new concept referred to as the representation degree φ that quantitatively expresses the occurring intensity of conflict

events is introduced here. It means that these conflicts in very high frequency would have obvious occurrence. If using representation degree to describe the intensity of obvious occurrence, then, the greater the degree of representation is, the more attention is needed in construction management. Based on the ideal, let $\varphi_i = \varpi_i \times n_i$, where, n_i is the i th cumulative value of response number to each conflict event from informants, ϖ_i is its corresponding weight value based on qualitative frequency in table 1. For quantitative analysis, the qualitative frequency is divided into five kinds, which are 1, 2, 3, 4, 5, and respectively mapping with little, less, normal, much, and more in the investigation. After dealing with unitary theory[5], all corresponding weight value and their representation degree of conflict events can be obtained in table 2.

Table 2. The representation degree of conflict events.

stage	Category of conflict		n_i	ϖ_i	φ_i	Order of degree
Decision-making	D1	Project scheme decision-making	15	0.81	12.1	D2>D3>D1>D4
	D2	Project feasible study	24	0.76	18.2	
	D3	Project investment estimation	19	0.75	14.3	
	D4	Report submission and approval	13	0.81	10.5	
Preparation	P1	Engineering survey and design	59	0.75	44.5	P1>P2>P4>P3
	P2	Project bidding	39	0.73	28.3	
	P3	Land expropriation and resident migration	26	0.77	20.0	
	P4	Construction procedures transaction	31	0.76	23.7	
Construction	C1	Safety management	64	0.77	49.2	C7>C1>C5>C8 >C4>C3>C6>C2
	C2	Contract disputes	28	0.76	21.4	
	C3	Engineering quality	46	0.74	34.0	
	C4	Environmental problem	48	0.72	34.4	
	C5	Construction schedule	53	0.72	38.3	
	C6	Personnel coordination	45	0.72	32.5	
	C7	Resource allocation	67	0.75	50.1	
	C8	Technical problems	50	0.74	37.0	
Ending	E1	Expense settlement	34	0.75	25.5	E2>E1>E3
	E2	Residual problem handling	45	0.76	34.2	
	E3	Project confirmation and handover	20	0.75	15.0	

4 Conflict event's latent roots and their consistency test

Construction engineering project is made of four stages and cumulative results of conflict events in every stage must bring about different effects on construction. If every stage is regarded as a subsystem, then, the effect of the subsystem on whole could be made sure by a judgment matrix set up by elements in the subsystem[6]. According to the analytic hierarchy process (AHP), the matrix's latent root would comprehensively reflect this subsystem characteristic[7]. So, cumulative results of conflict events in one stage can also be analyzed in the judgment matrix set up by conflict events of the subsystem.

For instance, take the construction stage as an example, using the calculation procedure of AHP theory, the judgment matrix M_c of conflict events in the construction stage can be set up based on the comparative result between any two representation degrees of conflict event, and the matrix maximum latent root can be obtained as follows. Because of the universality of the analytic hierarchy process, the calculation procedure of AHP and the meaning of symbols don't introduce again.

$$M_C = \begin{vmatrix} 1.000 & 0.435 & 0.691 & 0.699 & 0.778 & 0.661 & 1.018 & 0.752 \\ 2.299 & 1.000 & 1.589 & 1.607 & 1.790 & 1.519 & 2.341 & 1.729 \\ 1.447 & 0.629 & 1.000 & 1.012 & 1.126 & 0.956 & 1.474 & 1.088 \\ 1.430 & 0.622 & 0.988 & 1.000 & 1.113 & 0.945 & 1.456 & 1.076 \\ 1.285 & 0.559 & 0.888 & 0.898 & 1.000 & 0.849 & 1.308 & 0.966 \\ 1.514 & 0.658 & 1.046 & 1.058 & 1.178 & 1.000 & 1.542 & 1.138 \\ 0.982 & 0.427 & 0.679 & 0.687 & 0.764 & 0.649 & 1.000 & 0.739 \\ 1.330 & 0.578 & 0.919 & 0.930 & 1.035 & 0.878 & 1.354 & 1.000 \end{vmatrix} \quad \omega = \begin{vmatrix} 0.089 \\ 0.204 \\ 0.128 \\ 0.127 \\ 0.114 \\ 0.134 \\ 0.087 \\ 0.118 \end{vmatrix}$$

$$M_C \times \omega = \begin{vmatrix} 1.000 & 0.435 & 0.691 & 0.699 & 0.778 & 0.661 & 1.018 & 0.752 \\ 2.299 & 1.000 & 1.589 & 1.607 & 1.790 & 1.519 & 2.341 & 1.729 \\ 1.447 & 0.629 & 1.000 & 1.012 & 1.126 & 0.956 & 1.474 & 1.088 \\ 1.430 & 0.622 & 0.988 & 1.000 & 1.113 & 0.945 & 1.456 & 1.076 \\ 1.285 & 0.559 & 0.888 & 0.898 & 1.000 & 0.849 & 1.308 & 0.966 \\ 1.514 & 0.658 & 1.046 & 1.058 & 1.178 & 1.000 & 1.542 & 1.138 \\ 0.982 & 0.427 & 0.679 & 0.687 & 0.764 & 0.649 & 1.000 & 0.739 \\ 1.330 & 0.578 & 0.919 & 0.930 & 1.035 & 0.878 & 1.354 & 1.000 \end{vmatrix} \begin{vmatrix} 0.089 \\ 0.204 \\ 0.128 \\ 0.127 \\ 0.114 \\ 0.134 \\ 0.087 \\ 0.118 \end{vmatrix} = \begin{vmatrix} 0.709 \\ 1.630 \\ 1.026 \\ 1.014 \\ 0.911 \\ 1.073 \\ 0.696 \\ 0.943 \end{vmatrix}$$

Based on this, the matrix maximum latent root $\lambda_{C\max}$ can be calculated furtherly, that is 8.126, this matrix's index CI of consistency test is 0.018. When the rank number of the matrix is 8, the standard index RI of the consistency test is 1.41 by relative table[8], then, the ratio of 0.018 and 1.41 is 0.0127. Because the ratio is much less than the specified value of 0.1, so, according to multivariate statistics[9], the result fits the rule.

In the same way, another three stages of matrixes and maximum latent roots can be obtained too, and every maximum latent root is also satisfactory in the consistency test. Where, the matrix maximum latent root of decision-making, preparation, and ending stage are as follows respectively.

$$\lambda_{D\max} = 5.021 \quad \lambda_{P\max} = 7.722 \quad \lambda_{E\max} = 4.130$$

5 Conclusions and suggestions

According to the analysis results in Table 2, the conflict events in each stage of large construction projects have the following characteristics and occurring rules.

(1) In the decision-making stage, the main conflict events focus on the disputes of project feasibility study among participators, and the lowest one is the such problem as the report submission and approval. The order of representation degree from D1 to D4 shows in table 2.

(2) In the preparation stage, the problems of the conflict events are mainly concentrated in the conflicts and contradictions among participators in the drawing review and technical explanation due to the poor engineering survey and design, the secondary problems are mainly such conflict events as project bidding, construction procedures transaction and land expropriation and resident migration. Thus, the order of representation degree from P1 to P4 can be made.

(3) In the construction stage, the main occurring conflicts from the top to low are respectively resource allocation, safety, construction schedule, technology, environment, quality, personnel management, and contract disputes. It can be seen that the prominent conflict event in the project construction stage is the project resources and interest allocation closely related to all participants.

(4) In the completion stage, the conflict events mainly turn to the residual problem handling and the cost settlement, which has a high degree of consistency with the actual problems appearing in the construction project. The order of representation degree from E1 to E3 can be shown in table 2.

Meanwhile, seeing from the whole project view, according to the latent root of every stage, the influence order on the whole construction project can be obtained as follow.

$$\lambda_{C\max} > \lambda_{P\max} > \lambda_{D\max} > \lambda_{E\max}$$

This means that a great number of conflict events would appear in the construction stage, and lots of resources would be consumed. If these conflict events in this stage could not be resolved effectively, the construction project might be affected seriously. Therefore, it is necessary to strengthen conflict management in the construction stage. At the same time, due to the smaller difference of latent root between the preparation stage and construction stage, the effect of preparation stages is not ignored either. The smaller difference tells construction managers that whether the project would be developed smoothly in the construction stage is connected tightly with the state of each work in the preparation stage. So, making every task perfect by all means in advance is a necessary condition for avoiding and cutting down conflict events in the later stage.

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