

# Research on civil engineering project team management under adverse conditions

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**Abstract.** Under the background of COVID-19 global spread, engineering project management is facing new difficulties and challenges. Because of the urgency and temporary uncertainty of civil engineering projects, it is more likely to be affected by environmental stimulation, which will affect the cost, quality and progress of the engineering project. How to maintain the stability of the project management team and improve the project performance under the adverse conditions is a new topic in the research of engineering management. Based on the Conservation of resources theory, the theoretical model of team learning in engineering projects under the background of epidemic situation is explored and verified, which can influence project performance by enhancing team resilience, and the moderating effect of collectivism orientation is found. Finally, the management suggestions of the project team are put forward under the adverse situation such as the impact of epidemic situation.

## 1. Introduction

At present, the haze of COVID-19 is lingering. Due to its uncertainty, urgency and temporary characteristics, engineering projects are easy to be shut down and resumed due to environmental stimulation, which will affect the cost, quality and progress of the project. Therefore, how to ensure the stability of the project team and improve the project performance under adverse circumstances has become an important issue for the current project managers.

In view of the problem of how organizations recover and develop continuously in adversity, some scholars put forward the concept of resilience. In the context of engineering projects, team resilience is defined as the ability of a team to deal with problems, overcome obstacles or resist the pressure caused by adverse situations without collapse<sup>[1]</sup>. Morgan and others believe that the learning team can continuously improve the team ability through continuous learning, mastering methods, and return to the right track faster when encountering setbacks<sup>[2]</sup>. As the embodiment of team ability, whether team learning can affect the development and enhancement of project team resilience during the epidemic remains to be explored. Considering that different team members have different interpretations of the same information, we can not ignore the impact of individual cultural values on members' attitude, cognition and behavior. As an important individual cultural value variable, collectivism orientation may affect team members' learning attitude, and then affect the effectiveness of information transmission in team learning. Therefore, this paper will also examine the moderating effect of collectivism orientation on the relationship between team learning and team resilience.



## 2. Theory and hypotheses

### 2.1. Team learning and project performance

Team learning refers to the process that team members continuously acquire, integrate and share knowledge through interaction, and on this basis, improve behavior, optimize team system, and enhance organizational adaptability to achieve organizational goals [3]. Team members acquire and share knowledge through team learning. The empirical research results of Navimipour et al. [4] Based on engineering project team show that the process of knowledge sharing, application and integration of project team members plays a significant role in accelerating progress, reducing cost and improving work efficiency. In the environment of high team learning, team members are more motivated to improve project performance. Therefore, we predict:

**Hypothesis 1.** team learning has a positive impact on project performance.

### 2.2. The mediating role of team resilience

During the epidemic period, in challenging conditions, in order to make the project team resilient, team members must make use of their available resources, including tool resources, cognitive resources, social resources and emotional resources. Team learning is a process of resource reserve. According to the conservation of resources theory, people with more abundant resources are more able to solve the inherent problems in the stress environment and reduce the negative impact of resource loss [5]. Team members can obtain more other resources by using and investing the resources they have through team learning [5]. The more resources the team has, the stronger its ability to cope with and deal with pressure in work. The team can also help the team optimize the allocation of resources by providing internal and external resource support, and form a cooperative atmosphere to cope with the crisis through good learning interaction among members [6], and the team will be more able to solve problems or reduce team losses, So as to recover and grow under the influence of the epidemic. Therefore, we predict:

**Hypothesis 2.** Team learning has a positive impact on team resilience

Karlsen believes that team resilience is the ability to help the team recover and grow in the face of setbacks, failures or in an environment that may endanger team performance [7]. Compared with teams with poor resilience, teams with high resilience may be more flexible and adaptable to adversity, and they tend to regard setbacks as challenges or opportunities [8], which helps to stimulate team members' intrinsic motivation and positive emotions, seek development in the epidemic crisis, and then improve project performance. Therefore, we predict:

**Hypothesis 3.** Team resilience has a positive impact on team performance.

Under the influence of the epidemic, the project team is facing various crises. In order to achieve a higher level of team performance, we must have the ability to overcome difficulties and flexibly deal with all kinds of problems, that is, to have a higher level of team resilience. Team learning is one of the important ways to improve team resilience. To sum up, team learning can affect team performance by influencing team resilience. Therefore, we predict:

**Hypothesis 4.** Team resilience plays a mediating role between team learning and team performance.

### 2.3. The moderating effect of collectivism orientation

As an individual cultural value, collectivism orientation mainly shows that individuals pay more attention to collective needs, interpersonal relationships and team goals in the collective [9]. Team members have different degrees of collectivism, and their attitude, cognition and behavior may be different in the same team learning process. Under the influence of the epidemic, even if the team members work in the state of maintaining social distance, the members with high collectivism orientation will be more willing to interact with the team members in order to achieve the project objectives, which will strengthen the cooperation, learning and communication of team members, promote information sharing, and obtain harmonious interpersonal relationship, help and cooperation through good learning interaction, This will help them to reduce stress in adversity, maintain positive emotions, face difficulties and adjust state actively, and then improve team resilience [10, 11]. On the

contrary, members with low collectivism pay more attention to personal interests, tend to pursue personal interests and goals<sup>[12]</sup>, and have a negative attitude in the process of team learning, which reduces the effectiveness of team information acquisition and sharing, and further affects the team's ability to deal with problems. Therefore, we predict:

**Hypothesis 5.** Collectivism orientation moderates the relationship between team learning and team resilience, that is, the higher collectivism, the stronger the positive effect of team learning on team resilience.

### 3. Method

#### 3.1. Sample and procedure

Using a questionnaire survey method to collect the relevant data of the project and project team with the background of a project that is currently participating or most impressed during the epidemic period. Finally, a total of 246 questionnaires were sent out and 233 questionnaires were returned. After eliminating the questionnaires that were not carefully filled in, with abnormal values, missing items and missing items, 210 valid questionnaires were obtained, with an effective recovery rate of 85.4%.

The survey objects are mainly from the construction industry; 71% were male and 29% were female; In terms of educational background, 78% of them have bachelor degree or above, 17% have junior college degree, and 5% have junior college degree or below; In terms of working years, 1-3 years accounted for 41%, 4-6 years accounted for 39%, 7-10 years accounted for 11%, and more than 11 years accounted for 9%; In terms of job categories, project managers and leading group members accounted for 12%, middle-level project managers such as department or professional leaders accounted for 45%, and grassroots project staff accounted for 43%.

#### 3.2. Measures

The measurement indexes of the variables involved in this study were all from the mature scales published in authoritative journals at home and abroad, and were modified according to the epidemic background. Likert 5-point scale was used to score, from 1 to 5, totally disagreed to very agreed.

Team learning is mainly based on the team learning scale developed by Guo jienan<sup>[13]</sup>, a domestic scholar, and team resilience is based on the Organizational Resilience Scale developed by Wang linzhao<sup>[14]</sup> in the cross organizational context based on ambulkar et al. And the single dimension eight item scale for measuring the Organizational Resilience of Engineering projects is formed by combining the scale development framework of Churchill. The five item scale developed by Liu and cross was used to evaluate the project performance. Collectivism orientation adopts the maturity scale of collectivism orientation compiled by domestic scholars Zhao Jinjin and Liu Bo<sup>[15]</sup> with reference to Edwin et al.

### 4. Results

#### 4.1. Reliability and validity

Amos21.0 and Spss22.0 were used for reliability and validity analysis. Table 1 presents the factor loadings, AVE, CR and Cronbach's  $\alpha$ . Table 2 displays the correlations with other variables for the study variables. In terms of reliability, the load coefficient of each variable measurement index factor is greater than 0.7, and the AVE of each variable is greater than 0.5, the combined reliability (CR) is greater than 0.6, the coefficient of Cronbach's  $\alpha$  is greater than 0.8, Which indicate that the variables have good measurement reliability. Each variable's correlation with other variables is less than the square root of its AVE, indicating that each variable has good discriminant validity.

Table 1. Test of reliability and validity

Variables	Items	Factor loading	AVE	CR	Cronbach's $\alpha$	Variables	Items	Factor loading	AVE	CR	Cronbach's $\alpha$
TL	TL1	0.840	0.643	0.878	0.876	CO	CO1	0.792	0.667	0.889	0.887
	TL2	0.758					CO2	0.811			
	TL3	0.786					CO3	0.786			
	TL4	0.820					CO4	0.875			
TR	TR1	0.752	0.542	0.904	0.900	TP	TP1	0.728	0.602	0.883	0.880
	TR2	0.722					TP2	0.732			
	TR3	0.701					TP3	0.753			
	TR4	0.718					TP4	0.765			
	TR5	0.760				TP5	0.890				
	TR6	0.711									
	TR7	0.704									
	TR8	0.813									

Table 2. Correlations with other variables

	M	SD	1	2	3	4
1.TL	3.764	0.975	<b>0.802</b>			
2.TR	3.715	0.985	0.576**	<b>0.736</b>		
3.TP	3.848	0.680	0.689**	0.637**	<b>0.776</b>	
4.CO	3.818	0.685	-0.067	0.674**	0.245**	<b>0.817</b>

Note: \*\*\* $p < 0.001$ , \*\* $p < 0.01$ , \* $p < 0.05$ . The bold number is the square root of the variable's AVE.

#### 4.2. Hypothesis test

##### 4.2.1. Main effect

The reliability and validity test results show that the measurement model of this study has a good measurement structure and can be used for structural model test. We tested our hypotheses with hierarchical regression, and the results are shown in Table 3.

The first model includes the control variables of this study: education background, position and team size; Model 2 shows that team learning has a significant positive impact on project performance ( $\beta = 687$ ,  $P < 0.001$ ), hypothesis 1 passed the test; Model 6 shows that team learning has a significant positive impact on team resilience ( $\beta = 576$ ,  $P < 0.001$ ), hypothesis 2 passed the test. Model 3 shows that team resilience has a significant positive impact on project performance ( $\beta = 638$ ,  $P < 0.001$ ), hypothesis 3 passed the test.

##### 4.2.2. Mediating effect

Model 4 in Table 3 shows the analysis results when independent variables and intermediate variables enter the regression equation at the same time. When team learning and team resilience are both independent variables, the regression coefficient of team learning is still significant, but the coefficient decreases from 0.687 to 0.476, which indicates that team resilience plays a partial mediating role in team learning and project performance. Hypothesis 4 is supported.

Table 3. Results of hierarchical regression

Variables	TP				TR			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Qualification	-0.121	0.001	-0.044	0.008	-0.121	-0.018	-0.010	-0.009
Rank	0.028	0.035	0.019	0.028	0.014	0.021	0.037	0.025
Team size	-0.019	-0.027	-0.085	-0.062	0.103	0.097	0.030	0.035
TL		0.687***		0.476***		0.576***	0.622***	0.609***
TR			0.638***	0.366***				
CO							0.713***	0.696***
TR×CO								0.072*
R <sup>2</sup>	0.018	0.477	0.417	0.565	0.019	0.341	0.843	0.848
F	1.276	46.665***	36.692***	53.000***	1.338	26.536***	219.762***	188.757***

Note: \*\*\* $p < 0.001$ , \*\* $p < 0.01$ , \* $p < 0.05$ .

#### 4.2.3. Regulatory effect

The data of model 8 in Table 3 shows that the interaction between team learning and collectivism orientation has a significant positive impact on team resilience, indicating that collectivism orientation can strengthen the positive impact of team learning on team resilience, that is, the higher the collectivism orientation of team members, the stronger the positive impact of team learning on team resilience.

According to the analysis results, the moderating effect of collectivism orientation on team learning and team resilience is drawn, as shown in Figure 1. The solid line shows the impact of team learning on team resilience when team members are highly collectivist oriented; The dotted line indicates the impact of team learning on team resilience when team members have low collectivism orientation. It can be seen from the figure that the slope under the guidance of high collectivism is greater than that under the guidance of low collectivism. That is, the higher the collectivism orientation, the stronger the positive effect of team learning on team resilience. Hypothesis 5 passed the test.

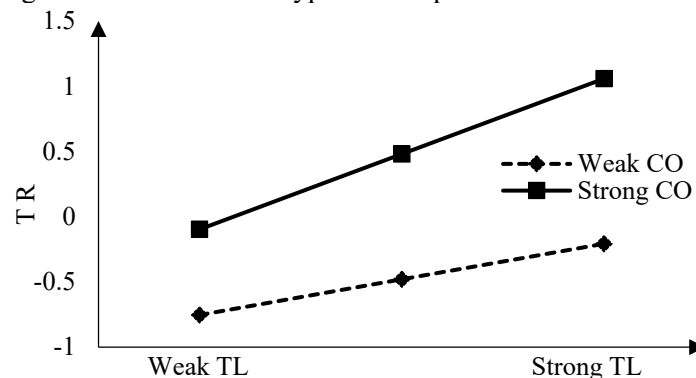


Figure 1. Moderating role of the collectivism orientation

## 5. Conclusions

First, in the context of epidemic situation, effective team learning can help the project team to collect information, improve team ability to adjust status, adapt to changes and make changes, on the other hand, promote cooperation among members through team learning process, enhance team cohesion and ensure the project team to achieve higher project performance.

Second, team resilience plays a mediating role between team learning and project performance. Firstly, high team learning atmosphere can promote team members to show more positive emotions, and then improve team resilience. Secondly, teams with high resilience regard adversity and setbacks as opportunities for learning and development. Under the effect of high team learning, teams with high resilience are more willing to learn from adversity and thus develop, further improving team resilience

and forming a virtuous circle with team learning. Affected by the epidemic, the team's ability to deal with problems, overcome obstacles and adapt to changes directly affects the project performance, so the role of team resilience is particularly important. Therefore, in the context of epidemic situation, team learning can affect project performance by influencing team resilience.

Third, the higher the collectivism orientation, the stronger the positive effect of team learning on team resilience. The results show that under the influence of the epidemic, the team members with higher collectivism orientation are more willing to participate in team learning for the benefit of the team, so as to improve the effectiveness of information transmission in team learning, strengthen the cooperative relationship among team members, and further improve the resilience level of the project team.

The findings of this paper also have important implications for the management practice of improving team resilience and team performance of project teams.

First, In the face of the normalization of epidemic situation, the project team should pay attention to team learning, encourage and support team members to learn and share knowledge together, and provide support and reward for employees' learning behavior, such as open communication, discussion of project tasks and problems encountered, establishment of team learning cycle mechanism and organization of learning training, and timely summary of experience and lessons learned, In order to improve the ability of team members to find and solve problems.

Managers should pay attention to and cultivate the collectivism of team members. On the one hand, through training, rewards and other ways, they can improve the dependence of team members on the team, promote the establishment of a deep connection between team members' personal goals and team goals, and promote team members to focus on collective interests, adjust personal goals with team goals, and take team honor as personal honor.

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