

# A Field Theory Based Model for Identifying the Effect of Organizational Structure on the Formation of Organizational Culture in Construction Projects

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Received March 18, 2015/Revised November 25, 2015/Accepted January 19, 2016/Published Online March 15, 2016

## Abstract

A carefully selected organizational structure paves the way for the success of a construction project by fostering a strong and enduring organizational culture. However, very little research has been conducted regarding the effect of organizational structure on the formation of organizational culture. This research employs the field theory to demonstrate organizational culture development and thereafter proposes a novel model for identifying the effect of organizational structure on the formation of organizational culture in a construction project. An empirical analysis based on the Chinese construction industry is performed to verify the proposed model. The primary contribution of this research is twofold. First, it presents a new perspective of examining organizational culture development from organizational structure by using the cultural field theory. Second, it reveals the important effect of organizational structure on the formation of organizational culture and offers project owners a new approach for identifying the effect which could also be a reference for further selecting an appropriate organizational structure.

Keywords: *Organizational culture, organizational structure, cultural field theory, organizational performance, project organization*

## 1. Introduction

A carefully selected organizational structure paves the way for the success of a construction project. As highlighted by Dobbs *et al.* (2013), a well-designed project organization is conducive to the integration of stakeholders and can lead to an 11-12% capital expense reduction. Organizational structure is the anatomy of project governance that groups essential elements, determines the size of major units, and specifies the means of collaboration, coordination, and decision-making within an organization (Mintzberg 1979). Basically, project organizational structure shapes the relationships between stakeholders, and interweaves people and their works involved (Shirazi *et al.*, 1996). Along with the further research, there has been a recognition of organizational culture which is an intervening variable between organizational structure and the individual attitudes or behaviours of members (Lazar *et al.*, 1974). An effective organizational structure motivates organizational members, who might have different cultural backgrounds, to achieve a common goal. However, project owners are often confronted with a challenge to determine such an organizational structure which is favorable

to organizational culture development. This challenge stems from the lack of an effective approach to identify the effect of organizational structure on the formation of organizational culture (Brunetto *et al.*, 2014).

Organizational culture was defined by Schein (1984) as “*the pattern of basic assumptions that a given group has invented, discovered, or developed in learning to cope with its problems of external adaption and internal integration, and that have worked well enough to be considered valid, and therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems.*” A strong and enduring organizational culture provides persistent guidance for project operation, improves communication efficiency, and lays a solid foundation for project management (Maloney and Federle, 1991; Mohamed, 2003; Brunetto *et al.*, 2014). Recent studies have revealed that organizational culture is an important factor in determining organizational structure (Brunetto *et al.*, 2014; Shelton *et al.*, 2011). However, modelling organizational culture and in return considering it as a reference in selecting organizational structures in the construction context still remain ambiguous.

This study therefore aims to provide project owners with a

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novel method for identifying the effect of organizational structure on the formation of organizational culture which could also be a reference for further determining an appropriate organizational structure for construction project. The remainder of this paper is organized as follows. Next section reviews relevant studies with the intention of identifying the limitations in the current practice. The field theory was then employed to investigate culture development in organizations, resulting in the conceptualization of an organizational culture field. Based on this concept, a model was proposed for contrasting the effect of organizational structure on the formation of organizational culture. After that, a questionnaire survey was conducted to demonstrate the effectiveness of the proposed model in China's construction industry. Finally, the research findings, limitations, and conclusions are presented.

## 2. Literature Review

### 2.1 Organizational Structure

A number of studies have been undertaken to investigate organizational structure in the construction industry. They are mainly concerned with critical factors of organizational governance, and guidance to design and select organizational structures for a construction project. For example, Tatum and Fawcett (1986) compared the advantages and disadvantages of five organizational structures and developed a matrix of organizational criteria. Through a questionnaire survey, Poirot (1991) formulated the metrics of organization effectiveness. Basing on 18 case studies, Shirazi *et al.* (1996) acknowledged the impacts of the environment of a construction project and technological sophistication on project organizations. Hu *et al.* (2014) revealed that the approach for owners to manage mega-projects in the construction industry is multidimensional and complicated. With the aim of designing and implementing more efficient project organizations, Jalal and Koosha (2015) analyzed the variables that have important relations with project management characteristics in the construction industry.

James and Jones (1976) found that organizational structure may have a conceptual relationships with individual attitude and behaviour. However, through examining 216 employees, Kanten *et al.* (2015) found that organizational structure has no direct effect on individual adaptive performance. On the contrary, it is believed that organizational structure affects organizational culture, and individuals' attitude and behaviour must be affected also (Naoum, 2001; Egan *et al.*, 2004; Tseng, 2010).

### 2.2 Organization Culture

In the construction industry, organizational culture has been drawing much attention over the past decades. A majority of studies spell out organizational culture profiles in a construction project. Maloney and Federle (1990) provided a model to measure organizational culture within a construction organization. Cameron and Quinn (1999) developed an organizational culture assessment instrument based on a theoretical model (i.e., Competing Values Framework) to assess the organizational culture profile. This

instrument has been found effective by Liu *et al.* (2006), Oney-Yazici *et al.* (2007) and Jaeger and Adair (2013) in examining the cultural profiles of construction organizations in China, Turkey, and Gulf Cooperation Council countries respectively. Commonly, they found a positive and significant correlation between organizational culture and perceived organizational support.

In addition, Cheung *et al.* (2011) developed a structural framework of organizational culture to address the artefacts of organizational culture in construction. Gajendran *et al.* (2012) proposed a culture analysis framework for studying construction project organizations based on a synthesis of three cultural philosophical positions: integration-technical, differentiation-practical, and fragmentation-emancipation. Brunetto *et al.* (2014) established a path model and used the survey method to investigate the organizational culture within asset management organizations in Australia. Furthermore, a couple of studies placed emphasis of organizational culture on organization performance in the construction industry (Coffey, 2010), leadership in the construction sector (Giritli *et al.*, 2013), bidding (Low *et al.*, 2014), and interaction of major stakeholders (Ankrah and Langford, 2005).

Comprehending the formation of organizational culture properly is fundamental to exploring the manner in which an organization operates and finding a way to improve organizational performance (Schein, 1984; Ankrah and Langford, 2005). Nevertheless, the formation of organizational culture has not been elaborated clearly in the area of construction management and economics.

## 3. Main Theory

### 3.1 The Field Theory

The concept "field" was first established by Michael Faraday and James Clerk Maxwell in the electromagnetic field to describe non-touch interaction between particles (Gulak, 1971). Basically, a material named after an electric field or a magnetic field exists around electrified bodies, magnetic bodies, or electric streams as a result of electromagnetism. This material exists wherever, like the other, as a media of electric and magnetic effect. Therefore, a "field" is recognized as a basic form of physical presence transferring the interaction among substances.

The quantum field theory proposed by Physicists Werner Heisenberg and Wolfgang Ernst Pauli uncover an interaction field of each particle (Li, 2012). After decades of evolution, the field theory has been broadly applied from the disciplines of physics, chemistry, and mathematics (Vecchio, 2000; Suhendro, 2008; Lazar, 2013) to social science (Robbins, 1991; Lewin, 2007). Lewin, K. firstly established the topological psychology by introducing field theory into the field of Psychology. He argued that Psychologists are concerned with a particular kind of field which he called the "life space" of individuals or groups and the behaviour  $b$  of a person is a function of the situation  $S$  which is meant to include both the person and his psychological environment (Taylor, 1968). De Greene (1978, 1989, 1990)

implied that a field theory could make complex sociotechnical systems phenomena more accessible to explanation and prediction.

### 3.2 Organizational Culture Field

Organizational culture is embodied with organizational behaviours, which in turn affect organizational performance (Schein, 1984). Similar to the acts of electrons and attractions that are transmitted by the electrical and force fields, respectively, the effect from organizational culture likewise can be unfolded in an organizational cultural field. Organizational cultural field is a vehicle of organizational culture's affection to the organization performance. Organizational members behave in their own ways, but they are exposed to the organizational cultural field. Their behaviours tend to be homogeneous and gradually conform to the organizational culture. To this end, all members' behaviours must align with coincident objectives and adapt to the culture. Then, an organizational culture will form finally. Consequently, the cooperative effect of organizational members is maximized to accelerate the achievement of organizational goals.

To analyze the organizational cultural field, the field intensity and field potential energy of organizational culture are introduced to present the attributes of the organizational cultural field. As discussed above, organizational members in an organizational cultural field are exposed to the effects of organizational culture, namely  $\vec{F}$ . Using  $Q$  for the individual cultural attribute per organizational member, including achievement and characteristics, the organizational cultural field intensity  $\vec{E}$  is expressed as  $\vec{E} = \vec{F}/Q$ .

Given an organizational cultural field, the status of an individual's behaviour can correspond to a culture status in the field space, which represents a certain amount of energy and is called potential energy  $U$ . Subject to cultural field actions or other external actions, the status of corresponding culture of individual's behaviour can sustain changing, which is similar to the change of individual potential energy due to "work of force". Suppose all individuals' behaviours in an organization have been changed to meet coincident culture, the organizational culture will be formed finally and the potential energy of the entire organizational cultural field will be  $\Sigma U$ .

## 4. Model Development

Basically, a construction project organization is composed of a number of units with different participants and different cultures. Definitely, a construction project organization has its own culture, but the formation of the culture accumulates on any sub-cultures, which are usually attached to other units. In a construction project organization, the units interact with each other through the organizational cultural field. The cultural field imposes its influence on the organization units by means of the superposition of field intensity.

Some studies shed lights on the impacts of organizational culture on organizational units by drawing an analogy with the behaviors of particles in a field (Zheng *et al.*, 2010). Therefore,

an organizational cultural field model is proposed here with reference to the formulas and parameters of field in physics. According to the *inverse square law*, two organizational units  $A$  and  $B$  are assumed, both being related to each other, then the field intensity acting on an individual in  $B$  from  $A$  (i.e.  $\vec{E}_{AB}$ ) and the square of relation distance between  $A$  and  $B$  (i.e.  $r^2$ ) is in an inverse relation:

$$\vec{E}_{AB} = k \frac{\vec{E}_A}{r^2} \quad (1)$$

Where  $\vec{E}_A$  is the cultural field intensity of unit  $A$ ;  $r$  is the relation distance between  $A$  and  $B$ . For example,  $r$  equals 2 if  $A$  is in direct relation with  $B$ . Each intermediate medium counts 1;  $k$  is the effect coefficient which reflects the closeness between the two units and reaches a higher value for a relation which is more helpful to the transition of organizational culture.

During the formation of organizational culture in construction organizations, an upper level unit imposes certain requirements on a lower level unit while units at the same level coordinate with each other. The units at a lower level are normally subordinates of the upper level units. Let  $k_1$  represent the effect coefficient of the upper level units on the lower level units,  $k_2$  represents the effect coefficient among the units at the same level, and  $k_3$  is the effect coefficient of the lower level units on the upper level units. Thus,  $k_1 > k_2 > k_3$ .

Furthermore, due to the relatively small effect of the lower level units on the upper level units in construction organizations, the effect of the lower level units on the upper level units is ignored in the model, i.e.  $k_3 = 0$ .

Thus, individuals in  $B$  are subject to a field intensity of  $\Phi(\vec{E})$ , and  $\Phi(\vec{E}) = \vec{E}_B + \vec{E}_{AB}$ .

When there are other units in relation with  $B$ ,

$$\Phi(\vec{E}) = \vec{E}_B + \sum_i k_i \frac{\vec{E}_i}{r_i^2} \quad (2)$$

As a consequence of the interaction between one cultural field and another within an organization, an individual's status changes and the organizational culture forms gradually. However, it takes a long time to form the organizational culture if only internal effects exist. Furthermore, the autonomically-formed culture may deviate from the target organizational culture. To ensure that an organizational culture facilitates the achievement of the organizational goals, organizational leaders should exert external intervention on the basis of the moral, system, and material cultures, such as promotion, regulation, rewards, and penalties (Fan *et al.*, 2008). The external effect can be expressed by  $\vec{F}_e$ .

Let  $\vec{E}$  and  $U$  represent the cultural field intensity and the potential energy of the formed organizational culture respectively. It can be derived that:

$$\sum_i \Delta U = \sum_i (U - U_i) = \sum_i [\vec{F}_{ei} + \sum_j \Phi(\vec{E}_i) Q_{ij}] \cdot \Delta S_i \quad (3)$$

where  $\Delta U$  is the differential organizational cultural field potential;  $U_i$  is the potential of cultural field of organization unit  $i$ ;  $\vec{F}_{ei}$  is the external force on unit  $i$ ;  $\Phi(\vec{E}_i)$  is the effect on unit  $i$

due to the field intensity, which is a function of the intensity of all related cultural fields;  $Q_{ij}$  is the cultural property of individual  $j$  from unit  $i$ ;  $\Delta\vec{S}_i$  is the displacement of unit  $i$  in the cultural field under the influence of external force and cultural field force (i.e., the change in situation from the culture of unit  $i$  to the formed organizational culture).

Equation 3 explains the formation of organizational culture using the theory of work and energy transform. The culture of the organizational units evolve continuously and finally achieve homogeneity with the organizational culture. The aggregation of all “work of forces” illustrates the increase in the potential energy of the organizational culture.

Furthermore, Eq. (3) can be transformed as follows:

$$\sum \vec{F}_{ei} \cdot \Delta\vec{S}_i = \sum (U - U_i) - \sum_{i,j} \Phi(\vec{E}_i) Q_{ij} \cdot \Delta\vec{S}_i \quad (4)$$

In Eq. (4), let  $W(\vec{F}_e) = \sum \vec{F}_{ei} \cdot \Delta\vec{S}_i$  and  $W(\vec{E}) = \sum_{i,j} \Phi(\vec{E}_i) Q_{ij} \cdot \Delta\vec{S}_i$ , then it can be rewritten as:

$$W(\vec{F}_e) = \sum \Delta U - W(\vec{E}) \quad (5)$$

It can be derived from Eq. (5) that the more the work  $W(\vec{E})$  enforced by the cultural field intensity is, the less the extra workload  $W(\vec{F}_e)$  undertaken by managers would be. Therefore, the spontaneous formation of organizational culture is easier. Moreover, the effect of different organizational structures on the formation of organizational culture can be contrasted based on Eq. (5). Given two organizational structures  $X$  and  $Y$ , the difference between the work  $W_X(\vec{E})$  and  $W_Y(\vec{E})$  enforced by the field intensity of two organizational cultural field can be presented as  $\Delta W(\vec{E})$ :

$$\Delta W(\vec{E}) = W_X(\vec{E}) - W_Y(\vec{E}) = \sum_{i,j} (\Phi_X(\vec{E}_i) - \Phi_Y(\vec{E}_i)) Q_{ij} \cdot \Delta\vec{S}_i \quad (6)$$

Similarly,  $\Delta W(\vec{E}) > 0$  means that the structure  $X$  is superior to structure  $Y$  on the formation of organizational culture. Otherwise, the  $Y$  is more favorable than  $X$ .

### 5. Model Application

As discussed above, the effect of organizational structure on the formation of the organizational culture can be derived if parameters  $\vec{E}$ ,  $Q$ , and  $\Delta\vec{S}$  are quantified. However, it is not an easy task to quantify these parameters correctly. As an alternative, the relative effect values of the cultural fields between the different organizational structures for a specific construction project can be adopted.

To validate the model (Eq. 6), the effect of two kinds of organizational structure on the formation of organizational culture in a hypothesized urban rail transit construction project in China is contrasted in this study. For simplicity, it is assumed that the urban rail transit construction project has  $n$  sub-projects and three functional departments. Researchers have demonstrated that both functional and matrix organizational structures have gained popularity for large-scale construction projects in China (Cheng and Chen, 2009). Hence, the project owner in this case

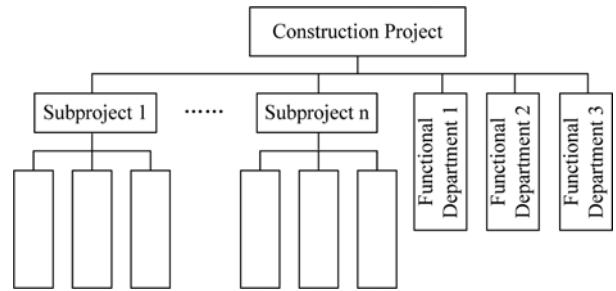


Fig. 1. Functional Structure Organization for an Urban Rail Transit Construction Project

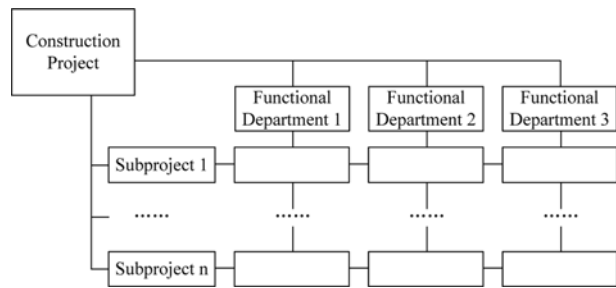


Fig. 2. Matrix Structure Organization for an Urban Rail Transit Construction Project

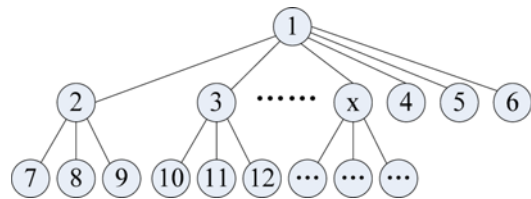


Fig. 3. Calculation Diagram for the Formation of an Organizational Culture in Functional Structure Organization

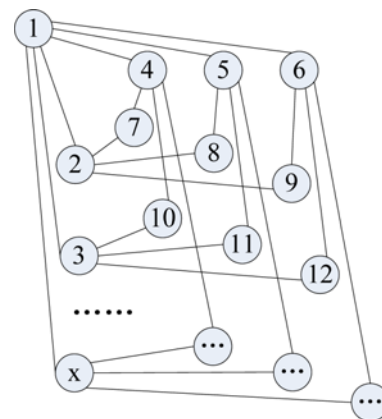


Fig. 4. Calculation Diagram for the Formation of an Organizational Culture in Matrix Structure Organization

study planned to identify a more favorable organizational structure for the formation of organizational culture - functional or matrix.

The two organizational structures are shown in Figs. 1 and 2. The calculation diagrams for the formation of the organizational

culture are shown in Figs. 3 and 4.

According to Eq. (6), the organization structure that is better to the formation of organizational culture by comparing the work  $W(\vec{E})$  enforced by the culture field in functional organizational structure and matrix one.

$$\begin{aligned} \Delta W(\vec{E}) &= W_f(\vec{E}) - W_m(\vec{E}) = \sum_{i,j} (\Phi_i(\vec{E}_i) - \Phi_m(\vec{E}_i)) Q_{ij} \cdot \Delta \vec{S}_i \\ &= (\vec{E}_1 - \vec{E}_1) \cdot (Q_{11} + Q_{12} + \dots) \cdot \Delta \vec{S}_1 + \left[ \left( \vec{E}_2 + \frac{k_1}{4} \vec{E}_1 \right) - \left( \vec{E}_2 + \frac{k_1}{4} \vec{E}_1 \right) \right] \\ &\quad (Q_{21} + Q_{22} + \dots) \cdot \Delta \vec{S}_2 + \dots + \left[ \left( \vec{E}_7 + \frac{k_1}{4} \vec{E}_2 + \frac{k_1}{9} \vec{E}_1 \right) - \right. \\ &\quad \left. \left( \vec{E}_7 + \frac{k_1}{4} \vec{E}_2 + \frac{k_1}{4} \vec{E}_4 + \frac{2k_1}{9} \vec{E}_1 \right) \right] (Q_{71} + Q_{72} + \dots) \cdot \Delta \vec{S}_7 + \dots \end{aligned} \quad (7)$$

In Eq. (7), let  $Q_i$  represent the totality of all the individual properties of unit  $i$  (i.e.,  $Q_i = \sum Q_{ij}$ ).  $\vec{E}_i$  is the cultural field intensity of unit  $i$ .  $\Delta \vec{S}_i$  is the displacement of unit  $i$ .

Since different organizational units have their own attributes, the main purpose of this case study is to identify whether a functional structure or a matrix structure better match the formation of an organizational culture. Thus, the difference between the two structures is considered in the study. Units of this organization, whatever functional or matrix structure, are composed of certain individuals who have their own individual differences. As a result, parameters (e.g.  $\vec{E}$ ,  $Q$  and  $\Delta \vec{S}$ ) for an organizational unit should not have significant effect on the contrast of the two organizational structures in this study. For simplicity, individual differences in organization units are not taken into account. It is assumed mathematically that all the units have the same  $\vec{E}$ ,  $Q$ , and  $\Delta \vec{S}$ , and all of three parameters are positive. Thereby, the different influence on the formation of organizational culture is caused merely by the difference between the organizational structures.

Then, Eq. (7) can be simplified as:

$$\begin{aligned} \Delta W(\vec{E}) &= W_f(\vec{E}) - W_m(\vec{E}) = \sum_{i,j} (\Phi_i(\vec{E}_i) - \Phi_m(\vec{E}_i)) Q_{ij} \cdot \Delta \vec{S}_i \\ &= \left[ (1-1) + \left[ (n+3) \left( 1 + \frac{k_1}{4} \right) - (n+3) \left( 1 + \frac{k_1}{4} \right) \right] + \left[ 3n \left( 1 + \frac{k_1}{4} + \frac{k_1}{9} \right) - \right. \right. \\ &\quad \left. \left. 3n \left( 1 + \frac{k_1}{4} + \frac{k_1}{4} + \frac{2k_1}{9} \right) \right] \right] \vec{E} Q \cdot \Delta \vec{S} = -\frac{13}{2} n k_1 \vec{E} Q \cdot \Delta \vec{S} < 0 \end{aligned} \quad (8)$$

According to Eqs. (6) and (5), it is found that  $W_f(\vec{E}) < W_m(\vec{E})$  and then  $W_f(\vec{E}) > W_m(\vec{E})$ . In other words, the matrix structure requires less extra management than the functional structure, and it is therefore more helpful to the formation of organizational culture. Based on the analysis through the model calculations mentioned above, the matrix organizational structure should be more favorable in this case study to the formation of organizational culture.

## 6. Validation

A questionnaire survey was conducted in the urban rail transit

construction sector in China. The survey result was compared with the model application for validation (Eq. 6). Specifically, the survey was conducted with the intention to investigate the organizational structure of large-scale construction projects and the formation of organizational culture.

### 6.1 Questionnaire Design

This questionnaire was designed with reference to the Organizational Project Management Maturity Model (OPM3) developed by the Project Management Institute (PMI) (PMI, 2003). The questionnaire consisted of three parts. The first part introduced the background and the survey aims. A virtual urban rail transit construction project and the units that comprise the construction organization were given. The respondents were requested to select an organizational structure with which they were most familiar to establish the organization. They were also requested to evaluate the organizational structure which they thought was in line with their professional knowledge and experience based on the prerequisite that the diversity of units be ignored.

The second part of the survey collected basic information about the respondents, including years of work experience, roles in projects, and the selected organizational structure of the construction project. The third part posed questions about the assessment of organizational structures with reference to the questionnaire of OPM3. There were eight items in the questionnaire on the formation of organizational culture. Respondents were asked to rate the level of organizational culture formation in their selected organization. The Likert rating scale was used by the respondents (1/strongly disagree, 2/disagree, 3/medium, 4/agree, 5/strongly agree) (Tan, 2008). Higher ratings indicate the corresponding organizational structure is more helpful to the formation of the organizational culture.

### 6.2 Questionnaire Survey

The survey was conducted in a number of urban rail transit construction projects in major cities of Eastern China, namely Shanghai, Nanjing, Suzhou, and Changzhou. Taking into account the variation in their understanding of organizational culture, the invited participants included various professionals (e.g., owners, contractors, suppliers, supervision engineers, and other consultants) in order to allow for a diversity of respondents' backgrounds. The project respondents of the survey were scattered in different cities, so the questionnaire were mainly hand-delivered by paper to local project sites and electronically by e-mail to the respondents in other cities. A total of 537 questionnaires were distributed, of which 197 were completed and found to be valid, a 36.68% effective rate of return.

The working years of all the respondents followed a normal distribution, and the percentage of respondents who had over six working years was nearly 80%, which shows that most of the respondents had adequate professional experience and had ample knowledge of urban rail transit construction projects and organizations.

Table 1. Independent Samples Test for the Evaluations on the Formation of an Organizational Culture

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	.226	.635	-5.426	195	.000	-2.283	.421	-3.112	-1.453
Equal variances not assumed			-5.431	192.330	.000	-2.283	.420	-3.112	-1.454

### 6.3 Reliability Analysis

Reliability refers to the consistency or stability of the survey results and is an important index which reflects the stability and reliability of the questionnaire. Cronbach's alpha values were used to analyse the reliability of the questionnaire. The alpha value normally ranges between 0 and 1; an alpha value greater than 0.9 indicates very good reliability while a value greater than 0.8 means the reliability is acceptable (Tan, 2008).

Cronbach's alpha values of the data were calculated by using the Statistical Packages for the Social Sciences (SPSS) 19.0. The alpha value of the questionnaire was 0.872, indicating that the internal reliability of the questionnaire was acceptable.

### 6.4 Results

SPSS 19.0 was used to record and analyse the data from the valid questionnaires. The data analysis results show that the percentages of those who selected the functional structure and the matrix structure were 46.70% and 53.30%, respectively. This result aligns with the known practice of large-scale construction projects in China (Cheng and Chen, 2009). Furthermore, it supports the feasibility of analysing the formation of organizational cultures affected by different organizational structures. The evaluation results from respondents were analysed by two sample t-test (Table 1).

From the result of Levene's test in Table 1, the two group variances were equal at the significant level 0.05 (sig = 0.635 > 0.05). According to the line of Equal variances assumed, it can be seen that the deviation between the quantitative evaluations on the formation of organizational culture by the members of two different organizational structures is significant (Sig.= 0.000 < 0.001).

As shown in Table 2, the total points given by the respondents from matrix structure organizations were obviously higher than those from the functional structure organizations. The means of points are 29.076 and 26.794, respectively, suggesting that the matrix structure organization is more helpful to the formation of organizational culture. This result is consistent with the results of the model deduction discussed above.

Table 2. Group Statistics for the Evaluations on the Formation of an Organizational Culture

Structure of Organization	N	Mean	Std. Deviation	Std. Error Mean
Functional	92	26.794	2.922	.305
Matrix	105	29.076	2.967	.290

## 7. Findings and Discussions

### 7.1 Applicability of the Model

It was found that the model developed in this paper is useful to calculate the work resulted from culture field intensity for the formation of organizational culture in a construction organization. In addition, the model can be used to analyse whether or not the organizational structure would be beneficial to the formation of organizational culture. The results of the questionnaire survey echoed the results of the model calculation, namely, that the matrix structural organization is more favorable than the functional structure to the formation of an organizational culture given that an urban rail transit construction project has a number of units. Furthermore, according to Eq. (8), the larger is the scale of the construction project (i.e., greater  $n$ ), the greater is the work resulted from by culture field intensity in a matrix structure organization than in a functional structure. That is to say, the advantage of the matrix structural organization for the formation of an organizational culture is more obvious. This finding agrees with construction practice, which proves the applicability of the organizational culture formation model as well.

Compared with previous studies (e.g., Maloney and Federle, 1990; Cameron and Quinn, 1999; Brunetto *et al.*, 2014), the model developed in this paper not only provides a basis for future research on the formation of organizational culture but also presented a new theory for the measurement of organizational culture. The model could be a better theoretical basis and practical approach for project owners as a reference to select organizational structures other than those in the research of Tatum and Fawcett (1986), Poirot (1991), Shirazi *et al.* (1996), and Hu *et al.* (2014).

### 7.2 Organizational Culture Field

The field theory was suggested to examine the formation of an organizational culture and thereby to support the selection of a construction project organization structure. The applicability of the model proposed in this paper to urban rail transit construction projects in China indicates a new perspective for the investigation of organizational structure from the organizational culture.

It is also found that cultural field not only assists in the comparison between different organizational structures, but also explains the formation of an organization. It can be seen from Eqs. (3) and (4) that the work in organizational culturefield is  $W(\vec{E}) = \sum \Phi(\vec{E}_i) Q_{ij} \cdot \Delta \vec{S}_i$ , the culture field intensity  $\vec{E}$  of the organization units and the individual cultural attribute  $Q$  in the

model were both positively correlated with the formation of an organizational culture. To accomplish the formation of an organizational culture, it is implied that project participants should have a more matured and positive culture to enhance the training of employees and improve the quality of the individual culture.

Furthermore, Eq. (3) shows that the shorter the displacement between the culture of the units and the whole organizational culture is (i.e., the less  $\Delta\tilde{S}$  is), the fewer the efforts needed to unify and form an organizational culture are. Since an organizational culture is characterized by an organization's values, assumptions, and expectations (Udompanich, 2011), project participants who have similar value goals to the construction organization should be involved as much as possible to fortify the organization. At the same time, it is vitally important that the construction project's objectives are formulated to account for the various interests of the project stakeholders.

### 7.3 Formation of Organizational Culture for Urban Rail Transit Construction Projects in China

The case study findings showed that the method of contrasting the effect of organizational structure on the formation of organizational culture proposed in this study is feasible. Similarly, results showed that matrix structure is better than functional structure of urban rail transit construction projects in China in terms of developing a proper organizational culture. This is in line with findings of previous studies (e.g. Cheng and Chen, 2009). However, there is lack of in-depth investigation of inherent mechanism. This study revealed that advanced communication is one of most critical drivers that matrix structure is superior to functional structure on the formation of organizational culture in urban rail transit construction projects. In the model proposed of this study (Eqs. (1), (2) and (3)), the parameter  $k$  represents the effect coefficient between organizational units. Both the effect of culture field intensity among organizational units and the spontaneous development of organizational culture are positively correlated with the value of parameter  $k$ . Therefore, efforts are required to enhance the contract administration and project governance (e.g. institutions and regulations) in order to promote the communication between organizational units. Alternatively, integrated teams could be formed with an aim to foster an environment of communication between units. As a result, the value of parameter  $k$  will increase so that the adaptation level of the organization to the urban rail transit construction projects will be improved.

## 8. Conclusions

The cultural field is a covert phenomenon in construction project organizations. The effect of organizational structure on the formation of organizational culture exists, varying from one cultural field to another. By examining organizational culture formation, the type of organizational structure that better matches the formation of organizational culture can be determined to achieve higher operating efficiency in construction project organizations. The formation of organizational culture in urban

rail transit construction projects was modelled in this paper in light of the cultural field theory. Using a case study in China, the proposed model was demonstrated useful to explain why the matrix organizational structure gains much popularity in implementing urban rail transit construction projects in China.

It is found that the cultural field theory can be employed to examine the structure of construction organizations. The model of organizational culture formation developed in this paper can be used as a reference to select and design a construction organizational structure. While the findings extend previous studies by offering a new perspective for debates, some limitations are appreciated. The model introducing the *inverse square law* to define the relationship between the cultural field intensity and distance deserves much more validation in further research. In addition, for simplicity, the individual differences among organization units that exist in practice but has not well considered. Moreover, only a specific type of large-scale construction project (i.e. urban rail transit construction project) was taken as a case study to validate the model in this paper and the parameter of construction project type was not reflected in the model. Therefore, future studies are recommended to refine the model parameters and improve the model with more case studies.

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