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No-Blame Culture and the Effectiveness of Project-Based Design Teams in the Construction Industry: The Mediating Role of Teamwork

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Abstract: This study investigates how a no-blame culture affects the effectiveness of project-based design teams across different project delivery methods in the construction industry. Ninety-two team members of 34 project-based design teams assessed the no-blame culture, level of teamwork, and team effectiveness in teams that were procured through different routes. A multilevel analysis shows that the relation between integrated project delivery methods, such as design–build and strategic partnering, and team effectiveness varies across levels of no-blame culture. A mediated regression analysis found that the effect of no-blame culture on team effectiveness is mediated by teamwork. Managers of project-based design teams in the construction industry should, therefore, invest both time and effort in creating a no-blame culture and the level of teamwork in parallel. This will enhance the level of team effectiveness in integrated project delivery methods. **DOI: 10.1061/(ASCE)ME.1943-5479.0000796.** © *2020 American Society of Civil Engineers.*

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Introduction

Over the last several decades, construction clients have increasingly searched for more collaborative and integrated ways of working in the supply chain to accomplish construction projects (Chini et al. 2018; Koolwijk et al. 2018; Suprapto et al. 2015; Walker and Lloyd-Walker 2015). Integrated working arrangements, such as design–build (DB) and strategic partnering (SP), intend to bring together key participants of the supply chain, such as designers and constructors, early in the project (Baiden and Price 2011; Eriksson 2015). However, bringing people with various backgrounds together does not ensure they will effectively collaborate and make appropriate decisions based on their joint knowledge (Baiden and Price 2011).

For example, in construction industry projects, team members from various organizations need to collaborate. That is, experts with different backgrounds—such as electrical engineering, sustainable design, and architecture—have to closely collaborate and coordinate their actions across disciplinary and organizational boundaries to accomplish shared goals (Fong and Lung 2007). Together, project team members have to manage complex problems, solve difficult design issues, and deal with last-minute design changes (Hamzeh et al. 2018; Savelsbergh et al. 2015). Before a team can take effective actions, its members need to reach a common understanding of the issue at hand and how it can be solved (Barron 2000). To develop a joint understanding, team members must openly discuss their ideas, challenge others' assumptions, share information, and integrate their diverse knowledge and viewpoints (Allen et al. 2005; Edmondson and Lei 2014; Manata et al. 2018).

The way project team members collaborate and share knowledge is influenced by a team's environment (Edmondson and Lei 2014; Li et al. 2019; Uhl-Bien et al. 2007). An environment in which people feel safe to speak their minds, ask one another questions, learn from their own and others' mistakes, and openly share information is crucial to unleash the knowledge that resides within team members (Edmondson and Lei 2014; Lloyd-walker et al. 2014). In the context of construction project organizations, such an environment is often characterized as an environment with a no-blame culture (e.g., Baiden et al. 2006; Lloyd-walker et al. 2014). A no-blame culture is defined by Lloyd-walker et al. (2014, p. 233) as "one in which individuals do not fear repercussion from risk-taking or problem identification, where employees feel free to contribute to discussions and raise issues."

A no-blame culture is believed to be a critical success factor for integrated working arrangements in the construction industry (Yeung et al. 2007; Lahdenperä 2012). However, there is a lack of studies that investigate how a no-blame culture relates to team effectiveness in integrated working arrangements in the construction industry. Most studies on the role of a no-blame culture are based on case studies done on specific project delivery methods, such as project alliancing (e.g., Lloyd-walker et al. 2014). Other fields found evidence that a no-blame culture influences team effectiveness (Edmondson and Lei 2014; Mathieu et al. 2008). However, supply chains in the construction industry are different from many other supply chains, because of the industry's fragmented nature (Eriksson 2015).

Also, research that uses project delivery methods as a proxy for collaboration has reported inconsistent results regarding project

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performance (e.g., Chen et al. 2016; Hale et al. 2009; Tran et al. 2016). Integrated project delivery methods, such as project alliancing, often set policies and procedures that are thought to support a no-blame culture (e.g., Lloyd-walker et al. 2014). However, project team members often encounter situations where the adoption of relational arrangements has an opposite effect (Chan et al. 2012; Rose and Manley 2010). Therefore, emphasizing the type of project delivery method while ignoring the actual level of collaboration might explain the inconsistent results (Koolwijk et al. 2018). Indeed, other "less relational" integrated working arrangements (Jobidon et al. 2019), such as design–build, may also benefit from a no-blame culture. Therefore, irrespective of the integrated project delivery method used, integrated project teams may require an environment of a no-blame culture to become effective. This raises the question whether the relation between integrated project delivery methods and the effectiveness of project teams varies across levels of no-blame culture.

A no-blame culture is promoted as an important condition for teamwork that in turn will lead to higher project team effectiveness (Lloyd-walker et al. 2014). This would mean that the level of team effectiveness is indirectly, via teamwork, positively influenced by the no-blame culture. To date, there is a lack of studies investigating this mediational pathway for project teams in the construction industry. Therefore, the researchers developed and tested the hypothesis that teamwork acts as a mediator between a no-blame culture and the effectiveness of project teams in the construction industry. Understanding the mechanisms underlying team effectiveness can help managers enhance effectiveness.

The paper is structured as follows. First, the main concepts will be presented and a set of hypotheses will be developed. Then, the research approach is described, followed by the results and conclusions. Finally, the limitations and managerial implications will be discussed.

Theory and Hypotheses

A no-blame culture can be described as an emergent state that stems or emerges from collaboration in a team. It influences the effectiveness of a team. A no-blame culture is an important condition for cross-functional design teams to become effective in integrative project delivery methods used in the construction industry (Fig. 1).

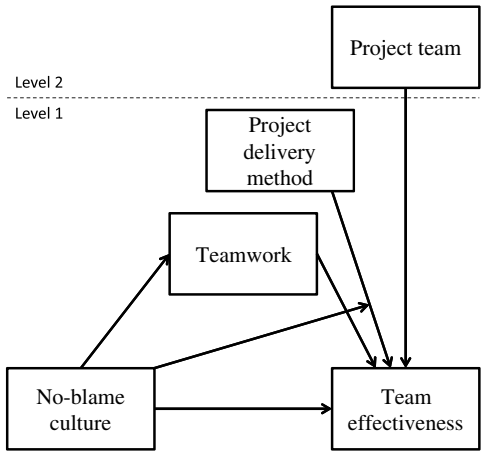

Fig. 1. Teamwork as a mediator between no-blame culture and team effectiveness and no-blame culture is an important condition for teams to become effective in integrated project delivery methods.

Project-Based Cross-Functional Design Teams

In the construction industry, teams are typically project-based cross-functional design teams (PBCFDT). A PBCFDT is made up of highly specialized professionals from different functional areas, such as architecture and structural engineering, who are brought together to design, for example, a museum or petrochemical installation. The team members are often employed by various organizations, such as design, engineering, or contracting firms, and collaborate for the duration of the project (Briscoe and Dainty 2005; Salas et al. 2000). Each member brings a different type of expertise to the team, enabling the timely integration of their information into the design (Ancona and Caldwell 1992; Edmondson and Nembhard 2009). The level of reciprocal interdependence between the team members is high, which means that to get the work done, team members need to closely collaborate to accomplish the task (Buvik and Rolfsen 2015; Tesluk et al. 1997). To work closely together implies that team members need to cooperate, coordinate their actions, and continuously exchange information to end up with a design that integrates the knowledge of all involved disciplines (Shen et al. 2018). Team collaboration, however, is not an easy task for a PBCFDT because members need to deal with diversity and engage in cross-boundary working (Shen et al. 2018).

Cross-Functional Design Teams in Various Project Delivery Methods

Projects can be delivered through various project delivery methods, such as design–bid–build (DBB) and strategic partnering (Koolwijk et al. 2018). Each delivery method establishes different relationships among the members of the PBCFDT (Laurent and Leicht 2019).

The traditional DBB method is known for its phased approach, where the owner has individual contracts with involved architectural/engineering (A/E) firms providing the design services. The team members of the different A/E firms deliver full plans and specifications for the construction project. These documents are subsequently used by the owner as a basis for a separate contract with a constructor. In this approach, the contractor and subcontractors are not involved in the design phase. Because the participants in the DBB method have separate contracts, they are believed to focus mainly on their organization's interests (Pesek et al. 2019). Therefore, when a problem arises, parties would not look for a solution, but try to put the blame on one another (Baiden et al. 2006). This would foster a transactional mentality among the team members and act as a barrier, thus hindering close collaboration and impeding the development of trust and integration of activities (Baiden and Price 2011).

In both the design–build and engineer–procure–construct (EPC) approaches, the owner signs a contract with one entity (Shen et al. 2018), a design builder, often according to functional specifications and a basic design provided earlier by an A/E firm (Molenaar et al. 1999). The design builder brings together the design and construction specialists from different firms in a joint cross-functional design team. This team's members need to closely collaborate and align their activities (Jobidon et al. 2019). DB is not considered a relational contract because the formal arrangement between the client and the design builder is not aimed at the alignment of project objectives and business goals and is not directed at creating a more collaborative atmosphere (Harper and Molenaar 2014; Jobidon et al. 2019). Instead, this formal arrangement only structures the relationship between the owner and the design builder. Within the DB project organization, team members need to closely collaborate to develop the design. It may well be that the effectiveness of this DB team is affected by the level of no-blame culture. DB can be

extended with maintenance (DBM). In this case, maintenance specialists are brought into the design team to add their knowledge about maintenance to the design. In this article, DB, EPC, and DBM are combined into one category DB(M).

Building team (BT) is a Dutch approach in which the owner, contractor, A/E firms, and often key subcontractors together develop the basic design into a final design (Chao-Duivis et al. 2013). The owner selects the firms and signs separate traditional contracts with them. In addition, an overarching project partnering agreement is signed by all members of the building team. This agreement states mutual obligations, such as how to collaborate, task division, and joint decision making (Chao-Duivis et al. 2013). The project partnering agreement embeds core partnering principles of equity, respect, and no-blame culture into the agreement, and therefore pushes a transactional relationship toward a more relational relationship (Bennett and Jayes 1998).

Strategic partnering is a delivery method in which the owner enters into a long-term multipartner agreement with a contractor, key subcontractors, and one or more A/E firms (Koolwijk et al. 2018). The partners collaborate from the early design phase onward. What makes this a *strategic* partnership is that partners are awarded a follow-up project when they deliver the project according to prespecified targets. The partners form a joint project board and joint project team. The latter is responsible for the daily management of the design and construction activities. Other collaborative characteristics of SP include inclusive decision making, open-book accounting, risk–reward sharing, open communication, and joint team-building activities (Koolwijk et al. 2018). These characteristics should drive a no-blame culture, which in turn should foster teamwork and innovation (Walker and Lloyd-Walker 2015).

No-Blame Culture

Culture is the social context in an organization, and is embedded in the "values, beliefs, and assumptions held by organizational members" (Denison 1996, p. 624). A culture is deeply rooted in the systems of an organization, and is relatively stable and difficult to manipulate once established (Ostroff et al. 2013). Climate is what people "see" happening to them when they are working in an organization. It is the employees' perception of what is going on between people, and often referred to as the "atmosphere" on the work floor (Mathieu et al. 2008). Culture and climate are related, in that one cannot create a climate in which people feel safe to speak up, if the culture does not approve people showing vulnerability (Quelhas et al. 2019). Therefore, deeper layers of no-blame culture can be viewed through the eyes of employees who have to work in an organizational climate (Ostroff et al. 2013). Importantly, at the team level, climate is known to affect behaviors (Mathieu et al. 2008).

However, climate is not stable (Ostroff et al. 2013). It is a shared cognition that is shaped through interaction and can be manipulated by actors (Denison 1996). It is therefore called an emergent phenomenon; i.e., "[a] phenomenon is emergent when it originates in the cognition, affect behaviors, or other characteristics of individuals, is amplified by their interactions, and manifests as a higher-level collective phenomenon" (Kozlowski and Klein 2000, p. 55).

Because the definition of *no-blame culture* emphasizes how organizational members perceive the social environment and how this environment impacts their feelings and behavior (Lloyd-walker et al. 2014), a no-blame culture should be understood as a construct that defines a specific dimension of the climate within a project organization or team.

Team Effectiveness and No-Blame Culture

Team effectiveness can be conceptualized in many different ways (Mathieu et al. 2008). Here, we consider team effectiveness as a blended concept that consists of team members' behaviors needed to achieve a desired result, the quality and timeliness of their intermediate outputs, and team members' satisfaction with the general performance of the team (Hackman et al. 2000; Mathieu et al. 2008; Salas et al. 2004; Van den Bossche et al. 2006). Furthermore, to measure the effectiveness of a team, the measures should be linked to the teams' context (Andersson et al. 2017). To understand what relevant behaviors and outputs of PBCFDT are, these behaviors are briefly described.

PBCFDT members are interdependent (Bankvall et al. 2010). To timely achieve the project goals, team members need to plan and deliver their mutual commitments within the time permitted. Furthermore, team members need to deliver high-quality design products, such as drawings and calculations, and rely on one another's work. Construction projects are characterized by high levels of complexity (Bosch-Rekveldt 2011). Team members often encounter many different problems and changes, which they have to effectively handle to finalize the project at large (Hamzeh et al. 2018).

Ideally, when there is a no-blame culture, team members do not try to put the blame on one another, and instead analyze the underlying problem to find a solution (Walker and Lloyd-Walker 2014, 2015). A no-blame culture enables teams to learn, and therefore a team becomes more effective (Huang et al. 2008; Lacerenza et al. 2018). Therefore, a no-blame culture is here considered an important condition for team effectiveness. The following hypothesis describes the relation between a no-blame culture within a team and the team's effectiveness.

H1: A no-blame culture has a positive influence on team effectiveness.

Teamwork and No-Blame Culture

Teamwork is a multidimensional construct that explains how team inputs are transformed into outcomes (Mathieu et al. 2008). Teamwork consists of behaviors, cognitions, and feelings of team members who interact with one another to achieve desired mutual goals (Salas et al. 2004). After Mathieu and Salas, we here define teamwork as (1) a set of behaviors that consist of collaboration, communication, joint decision making, and mutual support; (2) the shared cognition among team members about how to coordinate the efforts of the team; and (3) the feelings team members have about one another and one another's work, which consists of the level of trust team members have in the work of other team members and the level of respect they have for the other team members. The constructs are further defined as follows:

- *Collaboration* is the overarching notion of teamwork capturing how well team members work together toward a common goal (Daugherty et al. 2006).
- *Communication* is the extent to which team members effectively and timely inform one another (Baiden et al. 2006; Hoegl and Gemuenden 2001; Salas et al. 2015; Suprapto et al. 2015).
- *Mutual support* describes to what extent team members assist one another in performing their tasks. Through assistance, team members provide resources and task-related effort to one another; for example, when there is an uneven distribution of workload in their team (Hoegl and Gemuenden 2001; Salas et al. 2005).
- *Joint decision making* gives team members equal opportunities to contribute to a project (Baiden et al. 2006). Teams where

every team member can contribute their ideas are found to be more effective (Dreu 2002).

- *Coordination* refers to the shared understanding of team members about who is responsible for performing particular tasks (Lim and Klein 2006; Salas et al. 2015). This shared understanding is necessary to synchronize and align the activities within the team to reach the team's goals (Hackman 1990; Hoegl and Gemuenden 2001).
- *Trust* is the "belief in the others' ability, dependability, or competence to perform a task" (Pinto et al. 2009, p. 640). Trust is fundamental to cross-functional teams where team members are highly interdependent because no single member has the expertise to effectively deal with all design and project challenges (Chiocchio et al. 2011).
- *Respect* describes how well a team member feels appreciated by the other team members (Carmeli et al. 2015). When team members feels respected, they can be honest with other team members without getting a negative or strong emotional response.

A no-blame culture is found to facilitate communication between team members (Lloyd-walker et al. 2014). If there is a climate in which team members do not have to fear the repercussions of speaking up, they will be more willing to contribute their ideas and provide suggestions for improvements (Edmondson and Lei 2014). Then, team members will also be more likely to collaborate (Lloyd-Walker et al. 2014).

The following hypothesis describes the relation between a no-blame culture and the level of teamwork.

H2: A no-blame culture has a positive influence on teamwork.

Teamwork and Team Effectiveness

The relation between teamwork and team effectiveness is evidenced in many studies (Lepine et al. 2008; Mathieu et al. 2008). The following hypothesis addresses the relation between the level of teamwork and the level of team effectiveness.

H3: Teamwork has a positive influence on team effectiveness.

Mediating Role of Teamwork

On the basis of the relations described in the previous section, it can be stated that there is an indirect connection between a no-blame culture and team effectiveness where teamwork plays a mediating role. Therefore, the following section focuses on the mediating role of teamwork between a no-blame culture and team effectiveness.

H4: Teamwork mediates the positive effect of a no-blame culture on team effectiveness.

Moderating Role of No-Blame Culture between Project Delivery Methods and Team Effectiveness

One of the aims of integrated project delivery methods, such as DB, PT, and SP, is to join the knowledge and skills of various firms from the early design phases onward. This should enable the mutual use of skills and knowledge, resulting in a higher project performance (Baiden and Price 2011). However, bringing together people with various backgrounds does not ensure they will effectively collaborate and make appropriate decisions based on their joint knowledge (Baiden and Price 2011). Team members must feel safe to share their information and knowledge before the project organization is able to use this resource (Edmondson and Lei 2014). This will be true irrespective of the used integrated project delivery method. Hence, the relation between a project delivery method and the effectiveness of project teams might vary across levels of no-blame culture.

H5: The relation between project delivery method and team effectiveness varies across levels of no-blame culture.

Control Variables

To avoid any spurious relationships between the independent variable (no-blame culture) the mediator (team work), and dependent variable (team effectiveness), this study includes the following control variables.

Team Competences

The competences of project team members refer to knowledge and skills of all members required to successfully deliver the project (Rahman and Kumaraswamy 2008; Suprapto et al. 2015). Individual team members need to have enough task-related knowledge and skills to effectively perform their tasks (Mathieu et al. 2008). Furthermore, as a whole, the team needs to have enough knowledge and skills to perform all relevant tasks (Chiocchio et al. 2011). The following hypothesis specifies the relationship between team competences and team effectiveness.

H6: Team competences have a positive influence on team effectiveness.

Goal Clarity

A team goal specifies the outcome a team is aiming for (van der Hoek et al. 2018). A clear goal directs a team (Hackman et al. 2000) and will help a team to become effective (Bosch-Rekveldt 2011). Clear, challenging, but reachable goals are critical to energize a team and make it work harder (Hackman et al. 2000; Locke and Latham 2002; Toor 2009). Therefore, the following hypotheses describes the relation between goal clarity and team effectiveness.

H7: Goal clarity has a positive influence on team effectiveness.

Relationship Duration

The construction industry is often characterized by the discontinuous nature of its projects, which makes it difficult to build long-term relationships (e.g., Bygballe et al. 2010). On a project team level, this discontinuous nature can affect the composition of teams across projects. Changes in team composition affect team learning, such as speaking up, because team members will only show these behaviors when they trust one another and feel safe (Edmondson and Lei 2014). Therefore, the duration of the relationship between core team members affects team learning and subsequent team effectiveness (Edmondson and Lei 2014). Relationship duration is further expressed in the expected future length of the relationship. This "shadow of the future" would foster collaboration and trust, because team members expect to interact with one another in the future (Eriksson 2015).

The following hypothesis specifies the relation between relationship duration and the level of team effectiveness.

H8: Relationship duration has a positive influence on team effectiveness.

By testing the eight hypotheses, this study aims to examine how a no-blame culture affects the effectiveness of project-based design teams with different project delivery methods in the construction industry. The first main question is whether teamwork mediates the relationship between no-blame culture and team effectiveness (H4). The second main question aims to investigate whether the relationship between project delivery methods and team effectiveness is dependent on the existence of a strong no-blame culture. Thus, the second main question is whether the relation between project delivery method and team effectiveness varies across levels of no-blame culture (H5).

Method

Sample and Data Collection

Respondents varying widely in background and experience, type and size of projects, and project delivery methods were recruited using two approaches. First, through their networks, the researchers invited companies that were active in the construction industry to participate in a survey. This resulted in 83 project team members who then received an invitation to complete an online questionnaire between January 2016 and March 2017. The net response rate was 83.1% ($n = 69$).

Second, 1,099 architectural firms from the contact database of the Royal Institute of Dutch Architects received an email invitation to participate in the survey between October and December 2017. This time, the net response rate was 5.1% ($n = 57$).

Combined, there were 116 respondents who completely or partially filled out the questionnaires. After discarding respondents with more than 50% of missing values, the final database consists of 92 respondents. In this final database, 81 values (3.2%) were missing. Because Little's missing completely at random test (MCAR) test showed that these missing values were missing at random ($\chi 2 = 61.890$ df $= 61$; sig $= 0.444$), any imputation method could be applied to replace them. To replace missing values, the regression imputation method was applied.

The 92 respondents belonged to 34 different project teams designing different kinds of construction projects in the Netherlands. For eight teams, all core team members participated; in two teams, at least 75% of the core team members participated. There were five teams with 50%–75% and eight teams with 25%–50% of the core team members participating. For 11 teams, less than 25% of all core team members participated. On average, a project team consisted of 5.83 core team members, with a standard deviation of 1.764.

Table 1 provides descriptive information on the individual respondents. They work for clients ($n = 6$), construction management firms ($n = 2$), engineering firms ($n = 28$), architectural firms ($n = 33$), contractors ($n = 7$), subcontractors ($n = 13$), or demolition companies ($n = 3$).

Table 2 shows the characteristics of the projects respondents worked on. The majority of the respondents came from housing ($n = 37$) or the oil and gas ($n = 22$) industry (Table 2). The projects were delivered using different project delivery methods, such as design–bid–build ($n = 8$) and strategic partnering ($n = 6$). The construction costs of the projects ranged from 350,000 euros to 45,000,000 euros, with a median of 3,750,000 euros (Table 3).

Data were collected using a single method based on self-reports of perceived team characteristics, such as the level of teamwork and team effectiveness. Self-reports are the most relevant measurement method when it comes to measuring perceptions (Conway and Lance 2010). Self-reports, however, may introduce systemic response bias. To rule out method effects, multiple ad hoc measures were taken. First, the researchers mainly used existing measurement scales that had been developed in literature (Podsakoff et al. 2003). Second, to reduce evaluation apprehension, the respondents' anonymity is protected (Podsakoff et al. 2003). The outcomes of the study are only shared on an aggregated level in which individual- and team-level data cannot be recognized.

To see whether the majority of the variance can be explained by a single factor, the number of factors in the exploratory factor analysis was constrained to 1 in a post hoc analysis. The unrotated solution showed a variance of 30.81%; thus, no general factor is apparent and it is therefore unlikely that a common method variance affects the results (Podsakoff and Organ 1986).

Measures

All measures, with the exception of measures related to respondents' background and project characteristics, such as project

Table 1. Descriptive information on the individual respondents

Measure	Category	n	Percentage (%)
Age ($N = 92$)	20–30	8	8.7
	31–40	30	32.6
	41–50	24	26.1
	51–60	25	27.2
	61–70	5	5.4
Gender ($N = 92$)	Male	80	87.0
	Female	12	13.0
Education ($N = 92$)	Primary	1	1.1
	Lower vocational	1	1.1
	Secondary vocational	11	12.1
	Bachelor's degree	38	41.8
	Master's degree	41	45.1
Employment ($N = 92$)	Client	6	6.5
	Construction management	2	2.2
	Engineering	28	30.4
	Architectural	33	35.9
	Contractor	7	7.6
	Subcontractor	13	14.1
	Demolition/asbestos sanitation	3	3.3

Table 2. Characteristics of the projects and respondents

Characteristic	Projects	Respondents	Percentage of respondents (%)
Project delivery method			
Design–bid–build	8	11	12.0
Building team	9	13	14.1
Design–build(–maintain)/ engineer, procure, and construction management	11	40	43.5
Strategic partnering	6	28	30.4
Function of the buildings			
Housing	9	37	40.2
Office	2	2	2.2
Leisure (theater, cinema)	2	2	2.2
Utility	6	10	10.9
School	6	9	9.8
Care (home for the elderly)	1	1	1.1
Cure (hospital, medical center)	1	6	6.5
Oil and gas	4	22	23.9
Multifunctional	3	3	3.3
Type of construction works			
New building	19	54	58.7
Maintenance/renovation	5	27	29.3
Transformation (change function)	3	3	3.3
Combination (new, maintenance, renovation, and/or transformation)	7	8	8.7

Table 3. Construction costs of the projects in euros

Measure	Median	Mean	SD	Min	Max
Construction costs in euros ($N = 92$)	3,750,000	9,171,199	12,765,628	350,000	45,000,000

delivery method, were collected with a Likert-type 4-point scale ranging from 1 (representing a perfectly positive assessment of the trait; e.g., strongly agree) to 4 (representing a zero of the trait; e.g., disagree). Where possible, constructs were measured using existing measurement scales that had been developed in literature. All scales were part of the graduation project of Gaviria Moreno (2015). In this graduation project, the conceptualization of the measures was supported in interviews with practitioners. Furthermore, the translation and phrasing of the items was piloted in an online survey. The adapted final Questionnaire S1 is available online in the ASCE Library.

Before a mean score was computed for each scale to perform the multilevel analysis, the researchers wanted to be sure that each scale represented only one construct. Therefore, the measurement scales were subjected to exploratory factor analysis (EFA) with varimax and Kaiser normalization rotation to explore the underlying structure of the questions (Table 4). A minimum factor weight of 0.40 was used for inclusion of questions onto a factor, and scree plots and eigenvalues were used to identify distinct variables or dimensions (Field 2009). A value of 0.5 for the Kaiser–Meyer–Olkin (KMO) criterion was used as a threshold for sampling adequacy (Field 2009). Items cross-loading over 0.50 were removed. The determinant of the R-matrix was used to detect multicollinearity. The determinant should be greater than 1.0×10^{-5} (Field 2009). Items with very high correlations ($R > 0.8$) would be removed (Field 2009). Once redundant and cross-loading items were removed, a factor analysis was conducted again without the removed items. This procedure was repeated until a clean factor structure was found. Subsequently, Cronbach's alpha was computed to assess the reliability of the factors identified. When the Cronbach's alpha of a factor was below 0.6, the EFA was repeated (Field 2009). EFA identified the six factors of the theoretical framework that together explained 66.33% of the variance. Table 4 shows the final structure, consisting of the expected six factors with eigenvalues of 1 or higher. From the 30 variables, 7 were dropped because of collinearity, low loading, or cross-loading (see Questionnaire S1 for details) (Osborne et al. 2008). The KMO (0.763) measure verified the sampling adequacy of the analysis, and all KMO values for individual items were above the threshold of 0.5. Bartlett's test of sphericity was significant. The determinant was above the threshold: 3.567×10^{-5}.

The project team's no-blame culture was measured using the team psychological safety climate indicators developed by Edmondson (1999). The no-blame culture was measured with seven items, such as "I feel safe enough to speak what's on my mind" and "It is difficult to ask other team members for help." The seven items were subjected to the EFA described previously. Only one factor presented the no-blame culture. Two items were dropped because of cross-loading. The Cronbach's alpha of the 5-item scale was $\alpha = 0.736$, which can be considered reliable (DeVellis 2016).

The level of teamwork was measured using nine indicators that reflect collaboration, mutual support, joint decision making, communication, coordination, trust, and respect. For example, coordination was measured with two items: "Team members have a joint understanding of how to reach the goals of the project" and "Team members have a joint understanding of who needs to perform which tasks." The solution of the EFA led to the conclusion that there was only one teamwork factor present. Three items were dropped because of cross-loading. Subsequently, the six indicators were combined to form one overall scale of teamwork. The Cronbach alpha of the 6-item scale was $\alpha = 0.796$, which is considered reliable (DeVellis 2016).

Team effectiveness was measured with seven items based on scales adapted from Van den Bossche et al. (2006) and Pearce and Sims (2002). Two items from Van den Bossche et al. (2006) were used to measure the satisfaction of the team with their output, e.g., "How satisfied are you with the performance of the team?" Five items from Pearce and Sims (2002) were used to measure output, quality, and change effectiveness. An example of the last-mentioned item is "The team handles new problems effectively." The EFA showed that there was only one team-effectiveness factor present. One item was dropped because of collinearity. The scale showed good reliability ($\alpha = 0.852$) (DeVellis 2016).

Three control scales were included, namely goal clarity, team competences, and relationship duration, because they may impact the level of team effectiveness. Goal clarity was measured with two items. One item was dropped because of cross-loading. Team competences were measured with three questions about the knowledge and skills of the team as a whole and those of the individual team members. The EFA showed only one team competences factor was present. All items were retained. The scale had a reliability of $\alpha = 0.757$. Relationship duration was measured with two questions: "Have you worked with this team on a previous project?" and "Do you expect to work with this team in the future?" The three items were retained in the EFA. The reliability of this scale was $\alpha = 0.769$.

The project delivery methods used in each project were measured with a nominal scale. The DBB model was used as the reference category in SPSS. The integrated models, such as DB and SP, were combined into one single category and were used as the category of interest.

Data Analyses

To answer the two questions, and to test the eight hypotheses, the mean scores of each scale were computed per individual respondent. Although most variables represent team-level constructs, such as no-blame culture, the mean scores were not aggregated on a team level to prevent artificial inflation of variances, which could affect the outcomes of the analysis. To allow for team effects, a multilevel model was developed with team number as a Level 2 variable, and thus with the individual team members nested within teams. A multilevel model allows for the decomposition of the variance into different levels by specifying a random intercept for team to estimate the variance among teams. A forward stepwise model selection was applied (Seltman 2008). For each step in the multilevel model, a likelihood ratio test was performed to see whether the changes significantly improved the model (Field 2009).

The first step was to develop the null multilevel model, which includes the second-level variable team, which denotes the separate teams, and the dependent variable team effectiveness. This null multilevel model was further extended in steps by adding the explanatory and control variables. The first step was to add no-blame culture (H1). This should demonstrate that no-blame culture is directly related with team effectiveness. In the second step, the mediator teamwork is added to the model (H4). When there is a mediator involved, introducing this mediator should change the direct effect from the independent variable no-blame culture on the dependent variable teamwork (MacKinnon et al. 2002). Then, the control variables were added to the multilevel model to estimate their effects (H6, H7, and H8). When a control variable has a significant effects on the model, interactions between the control variables and main variables were tested to see whether the control variable is a confounding variable. Finally, the contextual effect of project delivery methods was factored in to see whether these have an effect on the level of team effectiveness.

Table 4. Factor loadings after rotation, explained variance, and Cronbach's alpha for each of the six components (no-blame culture, teamwork, team effectiveness, goal clarity, team competences, and relationship duration)

Number	Description	Components and factor loadings[a]					
		No-blame culture	Teamwork	Team effectiveness	Goal clarity	Team competences	Relationship duration
	No-blame culture						
1	In this team, my unique skills and talents are valued and utilized	0.666	—	—	—	—	—
2	In this team, it is easy to discuss difficult issues and problems	—	—	—	—	—	—
3	When someone makes a mistake on this team, it is often held against him or her (*R*)	0.504	—	—	—	—	—
4	On this team, some people are rejected for being different	0.759	—	—	—	—	—
5	No one on this team would deliberately act in a way that undermines my efforts	—	—	—	—	—	—
6	On this team, I feel safe enough to speak what is on my mind	0.605	—	—	—	—	—
7	On this team, it is difficult to ask other team members for help (*R*)	0.696	—	—	—	—	—
	Teamwork						
8	Team members work together well	—	—	—	—	—	—
9	Team members back one another up in carrying out team tasks where possible	—	0.556	—	—	—	—
10	Team members communicate openly with one another	—	—	—	—	—	—
11	Team members value one another as a person	—	—	—	—	—	—
12	Team members trust one another's products, such as drawings, calculations, and documents	—	0.605	—	—	—	—
13	Team members agree on decisions made in the team	—	0.586	—	—	—	—
14	Team members have a joint understanding of how to reach the goals of the project	—	0.810	—	—	—	—
15	Team members have a joint understanding of who needs to perform which tasks	—	—	—	—	—	—
16	Team members have a joint understanding of how and when to communicate with one another	—	0.749	—	—	—	—
	Team effectiveness						
17	How proud are you of the performance of the team?	—	—	—	—	—	—
18	How satisfied are you with the performance of the team?	—	—	0.600	—	—	—
19	The quality of the team's output is very high (think about design documents, calculations, etc.)	—	—	0.660	—	—	—
20	The team delivers its commitments on time	—	—	0.623	—	—	—
21	The team uses the available time effectively	—	—	0.842	—	—	—
22	The team handles new problems effectively	—	—	0.780	—	—	—
23	The team copes with change very well	—	—	—	—	—	—
	Goal clarity and attainability						
24	At the start of the project, the project goals were clear to me	—	—	—	0.856	—	—
25	I feel the project goals were attainable	—	—	—	—	—	—
	Team competences						
26	To accomplish all tasks, my team as a whole has enough knowledge and skills	—	—	—	—	0.454	—
27	I feel that individual team members on my team have enough knowledge about their field	—	—	—	—	0.876	—
28	I feel that individual team members on my team have enough skills to perform their tasks at the required level	—	—	—	—	0.835	—
	Relationship duration						
29	Have you worked with (a part of) this core team on a previous project?	—	—	—	—	—	0.853
30	Do you expect to work with this core team in the future on another project?	—	—	—	—	—	0.862
Explained variance after extraction and varimax rotation		13.03	12.96	14.59	5.92	10.34	9.49
Cronbach's alpha of each factor		0.736	0.796	0.852	N/A	0.757	0.769

[a]<0.40 is suppressed.

Following the theoretical framework, the interaction effect between project delivery methods and no-blame culture was entered to explore if the effect of project delivery method on team effectiveness varies across levels of no-blame culture (H5). The multilevel model was built in SPSS 23.

To further assess the effect of no-blame culture on teamwork (H2), the effect of teamwork on team effectiveness (H3), and indirect effects of no-blame culture on team effectiveness through teamwork, separate statistical mediation analyses were performed using the PROCESS macro for SPSS (Hayes 2017).

Approval by the Human Ethical Research Committee

This study was formally approved by the Human Ethical Research Committee of Delft University of Technology (HERC). Following the ethical guidelines of the HERC, informed consent was obtained from each respondent before he/she started the survey, anonymity was ensured, and respondents were informed that they could withdraw at any time. The data were treated with confidentiality and stored in a secure data server that is accessible only by the researchers.

Results

Descriptive Statistics and Correlations

Correlations and descriptive statistics are presented in Table 5. To support the hypothesis of mediation, there must be significant correlations between the dependent and independent variable, and the mediator and the dependent variable (Kenny 2018). The correlation table shows that study into the mediating role of teamwork is relevant because the three concepts show significant and positive correlations.

There is a significant correlation between the variable no-blame culture and the dependent variable team effectiveness ($r = 0.393$, $p < 0.01$). The mediator teamwork is positively correlated with team effectiveness ($r = 0.545$, $p < 0.01$). Furthermore, a no-blame culture is significantly correlated with teamwork ($r = 0.503$, $p < 0.01$). Hence, the initial requirements for mediation are met. Several control variables showed significant correlations with the variables in the proposed model. First, the team competences are correlated with teamwork ($r = 0.397$, $p < 0.01$), team effectiveness ($r = 0.426$, $p < 0.01$), and no-blame culture ($r = 0.426$, $p < 0.01$). Second, the relationship duration had correlation with teamwork ($r = 0.300$, $p < 0.01$) and weak correlations with team effectiveness ($r = 0.276$, $p < 0.01$) and team competences ($r = 0.276$, $p < 0.01$). Third, the clarity of the goals had a weak correlation with no-blame culture ($r = 0.209$, $p < 0.05$) and team effectiveness ($r = 0.231$, $p < 0.0.05$).

Multilevel Model

Table 6 summarizes the forward steps taken to develop the final multilevel model (Model IX). For each step, the likelihood ratio test was performed to test the sufficiency of a smaller model versus a more complex model. In Steps I to III and in step IX, the chi-square statistic is significant, thus the goodness of fit of the model significantly improved in these steps compared with the preceding model.

In Model III, the control variable team competences had a significant effect on team effectiveness. To address the possibility that team competences act as a confounding variable, interactions between team competences and the main variables were tested (see Models IV and V in Table 6). The interactions were shown to be insignificant, so team competences are not to be considered confounding factors. In Models VI and VII (Table 6), relationship duration and goal clarity respectively were added to Model III as control variables. Both had insignificant effects on team effectiveness and were therefore further discarded and both H7 and H8 were therefore rejected.

The test of fixed effects of Model IX showed that a no-blame culture $F(1, 89.99) = 4.41$, $p < 0.05$; teamwork $F(1, 88.68) = 18.80$, $p < 0.01$; team competences $F(1, 89.182) = 6.89$, $p < 0.01$; and the interaction of no-blame culture and project delivery methods $F(1, 89.99) = 5.90$, $p < 0.05$ significantly predicted the level of team effectiveness in project-based design teams in the construction industry. The project delivery methods alone did not significantly predict the level of team effectiveness $F(1, 89.97) = 3.34$, $p > 0.05$. The hypotheses H1, H3, and H6 were therefore accepted.

In Table 6, Model IX shows that the estimated values of integrated project delivery methods on the level of team effectiveness vary across levels of no-blame culture; estimate $= -0.786$, $p < 0.05$, confidence interval (CI) $(-1.429, -0.143)$. Hypothesis H5, which states that the relation between integrated project delivery method and team effectiveness varies across levels of no-blame culture, was therefore supported. That is, higher levels of no-blame culture in integrated project delivery methods lead to higher team effectiveness.

Table 7 shows the variance explained by each variable that was added to the null multilevel model. Based on Model 0, it can be concluded that 1.7% of the total variance in team effectiveness can be attributed to the difference between teams. It reflects how teams differ in their mean difference in team effectiveness. The variance explained by no-blame culture (Table 7, Model I) is 24% between teams and 15% within teams. The larger reduction in the between-team variance suggests the level of no-blame culture differs from team to team. The lower within-team variance shows that a no-blame culture is indeed a team-level construct (Edmondson 1999). The addition of the variable teamwork (Model II, Table 7) explains an additional 37% of the variance between teams and 17% within teams. Team competences (Model III in Table 7) explain an additional 33% of the variance between teams and 4% within teams. Finally, the interaction between project delivery methods and no-blame culture explains another 2% of the variance between teams and 7% of the variance within teams (Table 7, Model IX). This finding supports the idea that within teams, the no-blame culture moderates the effects of project delivery method on team effectiveness.

In total, 96% of the between-team and 43% of the within-team variance of team effectiveness was explained by multilevel Model IX compared with the null model.

The direct relation of no-blame culture with team effectiveness was significant (Table 6, Model I). This effect was reduced when controlling for the mediating variable teamwork (see Table 6, Model II). Partial mediation was therefore indicated (Kenny 2018; MacKinnon et al. 2002). To further investigate the mediating effect of teamwork between no-blame culture and team effectiveness,

Table 5. Means, standard deviations, and correlations among variables

Variable	Mean	SD	NB	TW	TE	TC	RD	GC
1. No-blame culture	1.38	0.44	1	—	—	—	—	—
2. Teamwork	1.80	0.52	0.503**	1	—	—	—	—
3. Team effectiveness	1.89	0.54	0.393**	0.545**	1	—	—	—
4. Team competences	1.43	0.49	0.426**	0.397**	0.426**	1	—	—
5. Relationship duration	2.64	0.93	0.199	0.300**	0.276**	276**	1	—
6. Goal clarity	2.01	0.78	0.209*	0.191	0.231*	0.103	0.025	1

Note: *$p < 0.05$; **$p < 0.01$; $N = 92$; NB = no-blame culture; TW = teamwork; TE = team effectiveness; TC = team competences; RD = relationship duration; and GC = goal clarity.

Table 6. Estimation of fixed effects on team effectiveness with team number as second-level variable and model fit

Model	Variables	Team effectiveness			95% Confidence interval		Model fit			
		Estimate	SE	p	Lower	Upper	−2LL	χ^2_{change}	Parameters	df_{change}
0	—	1.890	0.059	0.000	1.767	2.013	144.632	—	3	—
I	No-blame culture	0.480	0.118	0.000	0.245	0.714	129.492	15.140**	4	1
II	No-blame culture	0.178	0.123	0.150	−0.066	0.421	108.858	20.634**	5	1
	Teamwork	0.508	0.105	0.000	0.298	0.717	—	—	—	—
III	No-blame culture	0.070	0.126	0.577	−0.179	0.320	102.608	6.250*	6	1
	Teamwork	0.449	0.104	0.000	0.241	0.656	—	—	—	—
	Team competences	0.284	0.111	0.013	0.062	0.505	—	—	—	—
IV	No-blame culture	0.128	0.291	0.661	−0.451	0.708	102.559	0.049^{ns}	7	1
	Teamwork	0.448	0.104	0.000	0.240	0.655	—	—	—	—
	Team competences	0.333	0.250	0.186	−0.163	0.830	—	—	—	—
	No-blame culture*Team competences	−0.031	0.140	0.825	−0.309	0.247	—	—	—	—
V	No-blame culture	0.069	0.129	0.594	−0.188	0.326	102.606	−0.047^{ns}	7	1
	Teamwork	0.441	0.241	0.071	−0.038	0.920	—	—	—	—
	Team competences	0.273	0.327	0.407	−0.378	0.923	—	—	—	—
	Teamwork*Team competences	0.005	0.151	0.971	−0.294	0.305	—	—	—	—
VI	No-blame culture	0.042	0.126	0.741	−0.208	0.291	100.480	2.128^{ns}	7	1
	Teamwork	0.431	0.104	0.000	0.225	0.637	—	—	—	—
	Team competences	0.294	0.110	0.009	0.075	0.513	—	—	—	—
	Goal clarity	0.087	0.060	0.146	−0.031	0.206	—	—	—	—
VII	No-blame culture	0.067	0.125	0.591	−0.181	0.315	101.424	1.184^{ns}	7	1
	Teamwork	0.429	0.105	0.000	0.220	0.638	—	—	—	—
	Team competences	0.265	0.112	0.020	0.043	0.488	—	—	—	—
	Relationship duration	0.056	0.051	0.278	−0.046	0.158	—	—	—	—
VIII	No-blame culture	0.055	0.123	0.655	−0.190	0.300	98.996	3.611^{ns}	7	1
	Teamwork	0.456	0.102	0.000	0.253	0.660	—	—	—	—
	Team competences	0.258	0.110	0.021	0.040	0.477	—	—	—	—
	PDM: Integrated	−0.263	0.137	0.058	−0.536	0.009	—	—	—	—
	PDM: DBB	0	—	—	—	—	—	—	—	—
IX	No-blame culture	0.764	0.316	0.017	0.137	1.391	93.284	9.324**	8	2[a]
	Teamwork	0.432	0.100	0.000	0.234	0.630	—	—	—	—
	Team competences	0.281	0.107	0.010	0.068	0.493	—	—	—	—
	PDM: DBB	0.928	0.508	0.710	−0.081	1.937	—	—	—	—
	PDM: Integrated	0	—	—	—	—	—	—	—	—
	PDM-Integrated*No-blame culture	−0.786	0.324	0.017	−1.429	−0.143	—	—	—	—
	PDM-DBB*No-blame culture	0	—	—	—	—	—	—	—	—

Note: *Significant at $p < 0.05$; **significant at $p < 0.01$; ns = not significant; PDM = project delivery method; −2LL = −2 log-likelihood; χ^2_{change} = change in chi-square statistic; and df_{change} = change in degrees of freedom.
[a]Based on difference between Models III and IX.

a separate mediation analysis was performed using bias-corrected bootstrap confidence intervals (BCB-CI) (Hayes 2017). In this analysis, team competences were modeled as a control variable. The results of the mediation analysis confirmed that the positive effect of no-blame culture on team effectiveness is predominantly mediated by teamwork (Table 8). The indirect effect of no-blame culture on team effectiveness was $\beta = 0.204$, BCB-CI = 0.074–0.383 (Table 8). Hypotheses H2 and H4 were therefore accepted.

Conclusion and Discussion

This study aims to examine how a no-blame culture affects the effectiveness of project-based design teams with different project delivery methods in the construction industry. The first main question is whether teamwork mediates the relationship between no-blame culture and team effectiveness (H4). The second main question aims to investigate whether the relationship between project delivery methods and team effectiveness is dependent on the existence of a strong no-blame culture. Thus, the second main question is whether the relation between project delivery method and team effectiveness varies across levels of no-blame culture (H5).

The main finding is that the relation between integrated project delivery method and team effectiveness varies across levels of no-blame culture. The second main finding is that the effect of no-blame culture on team effectiveness is predominantly mediated by teamwork. This means that if a no-blame culture exists, it does not lead to an effective team unless project team members collaborate as a team; that is, in the presence of teamwork.

The findings add to the body of knowledge about the role of a no-blame culture as an antecedent in promoting team effectiveness in integrated project delivery methods, such as design–build and strategic partnering (Lahdenperä 2012; Lloyd-walker et al. 2014). The study provides further proof for the relations between

Table 7. Covariance parameters and variance explained in comparison to null multilevel model and difference between models

Model	Variables	Variance	Team effectiveness		R (%)	ΔR (%)
			Estimate	SE		
0	—	Between team	0.0051	0.0497	—	—
	—	Within team	0.2871	0.0269	—	—
I	No-blame culture	Between team	0.0038	0.0210	24	—
	—	Within team	0.2431	0.0414	15	—
II	No-blame culture	Between team	0.0020	0.0158	61	37
	Teamwork	Within team	0.1943	0.0327	32	17
III	No-blame culture	Between team	0.0003	0.0140	94	33
	Teamwork	Within team	0.1828	0.0306	36	4
	Team competences	—	—	—	—	—
IX	No-blame culture	Between team	0.0002	0.0116	96	2
	Teamwork	Within team	0.1649	0.0271	43	7
	Team competences	—	—	—	—	—
	PDM	—	—	—	—	—
	PDM*No-blame culture	—	—	—	—	—

Note: PDM = project delivery method.

Table 8. Test of indirect effect of no-blame culture on team effectiveness through teamwork

Variable	Total effect		Direct effect		Indirect effect		95% BCB-CI	
	Coefficient	p	Coefficient	p	Point estimate		Lower	Upper
No-blame culture	0.314	0.01	0.110	0.38	0.204	sig.	0.074	0.386

Note: sig. = significant based on 95% bias-corrected bootstrapping confidence interval of 5,000 subsamples.

no-blame culture, teamwork, and team effectiveness in project-based design teams in construction (Lloyd-walker et al. 2014). Moreover, this study shows the mediating role of teamwork and corroborates the results of Suprapto et al. (2015), who found that teamwork mediates the effects of relational attitudes and collaborative practices on perceived project performance.

This research further identified team competences as a variable that, in addition to no-blame culture and teamwork, has a strong impact on team effectiveness. This finding is consistent with earlier studies that found that teams are only effective if the team members have the appropriate task-related knowledge and skills (Mathieu et al. 2008). Especially in cross-functional design teams where individual team members have different, task-specific competences, and team members are highly interdependent, the competence level of each team member can influence the effectiveness of the whole team (Chiocchio et al. 2011; Salas et al. 2000).

Surprisingly, goal clarity did not influence the level of team effectiveness. This was not expected, because such a direct relation between goal clarity and team effectiveness was found before (Bosch-Rekveldt 2011). However, teams in the construction industry often have to cope with multiple goals at the same time. It may well be that this goal complexity moderates the relationship between goal clarity and team effectiveness (Luo et al. 2017). An alternative explanation may be that projects in the construction industry involve interorganizational collaboration. Individual organizational goals might be contradictory or parties might understand the targeted outcomes differently, with the associated effects on performance (Senescu et al. 2013). This deserves further study.

The lack of an association between relationship duration and team effectiveness was another unexpected outcome. In many studies, long-term relationships are found to strengthen the level of information sharing and alignment of activities between firms and their representatives, because partners know one another and build mutual trust (Eriksson 2015). Furthermore, in many different team-related studies, a lack of team longevity has been found to negatively influence the level of team effectiveness (Edmondson and Nembhard 2009; Yeh et al. 2005). However, other studies suggested that team members who have been working together for a longer period of time tend to communicate less among themselves and individuals outside their team, which reduces the level of information sharing and idea generation (Katz 1982). Isolated teams may suffer from a lack of performance feedback from external sources, which in turn can lower team effectiveness (Katz 1982; Pesämaa et al. 2018). Alternatively, this result might also emphasize the fragmented nature of project teams in the construction industry (Dubois and Gadde 2002; Suprapto et al. 2015).

This study contributes to the growing body of research that examines the dynamics of integrated and multidisciplinary teams in the construction industry (e.g., Manata et al. 2018; Pesämaa et al. 2018). In construction industry projects, project team members are often confronted with unplanned or emergent situations that require joint analysis of the situation, exploration of a wide range of alternatives, and evaluation of the risks of failure (Hamzeh et al. 2018). To solve these situations together, team members often have to improvise and think out of the box and challenge one another's assumptions (Hamzeh et al. 2018; Manata et al. 2018). A no-blame culture is a supportive environment that encourages innovation among team members because it enables them to speak up and share their ideas (Edmondson and Lei 2014). Therefore, a no-blame culture is a "sharing culture," which is an important facilitator of knowledge transfer across construction project cooperation networks (Sun et al. 2019). Finally, this study suggests that if project managers ignore the importance of no-blame culture and collaborative teamwork within a cross-functional design team, the impact of integrated project delivery methods will be severely compromised.

Limitations

This study was based on a sample of respondents with various backgrounds involved in a wide range of Dutch construction projects. The Dutch are known for their consensus-seeking culture and rather direct and open ways of communication. Therefore, further study is required to assess the effects of a no-blame culture in other cultures with lower acceptance of speaking up and admitting mistakes.

Unfortunately, the researchers were not able to get all members of each core team to respond to the survey. There is a possibility that this has affected the level of variance within teams. However, the outcomes of the multilevel model the researchers used were consistent with the outcomes of separate mediation analyses using bias-corrected confidence estimates (Hayes 2017), and this lends support to the robustness of these findings. Finally, the dependent variable used in this study was team effectiveness, measured by self-report. Further investigation of relationships with other relevant dependent variables, such as cost, time, work quality, and outcomes for different stakeholders, is therefore warranted.

Future Research

It is often argued in literature that certain relational project delivery methods, such as project alliancing, foster a no-blame culture (e.g., Kumaraswamy and Rahman 2006; Lahdenperä 2012; Lloyd-walker et al. 2014; Walker and Lloyd-Walker 2015). It is, however, the question what elements of these relational project delivery methods shape the perceptions of team members. Are project team members influenced by formal arrangements and procedures, or do actual processes between people and other practices such as team building play a larger role in developing a joint no-blame culture? Therefore, the researchers aim to further investigate the level of no-blame culture in different integrated project delivery methods and the relative importance of contractual conditions and practices to the level of no-blame culture in project teams. Furthermore, the construction industry is project-based industry where multiple firms work together in a temporary organization. It would be an interesting study to see whether and how different organizational cultures influence the team-level climate of an interorganizational project team. No-blame culture is a psychological state of a team. This state is dynamic (Edmondson and Lei 2014). Construction projects often have long life spans. Hence, a longitudinal study has the strong potential to uncover the dynamics and antecedents of a no-blame culture.

Managerial Implications

The findings show that the development of a no-blame culture does not automatically lead to an effective team in integrated project delivery methods. For a no-blame culture to have effect on the effectiveness of the team, managers should develop the level of teamwork and encourage collaboration within a project team. Managers of project-based design teams in the construction industry should, therefore, invest both time and effort in creating a no-blame culture and the level of teamwork in parallel. Research shows that selected team-building activities can be considered to develop the different elements of teamwork (Lacerenza et al. 2018). However, to get most out of this team training, a no-blame culture is critical, because team members will be more willing to discuss their errors and learn from them (Lacerenza et al. 2018). Furthermore, when the teamwork and a no-blame culture are established, managers should nurture the no-blame atmosphere and teamwork throughout the project.

In addition, team competences were uncovered as having a strong influences on team effectiveness. Managers should therefore bring together team members with sufficient abilities.

Data Availability Statement

Some or all data, models, or code generated or used during the study are proprietary or confidential in nature and may only be provided with restrictions.

Data concerning personal information of the respondents and the projects on which they have worked may not be made public due to restrictions imposed by the Human Ethical Research Committee of Delft University of Technology. The data contains information that could compromise the privacy of the research participants.

Supplemental Data

Questionnaire S1 is available online in the ASCE Library (www.ascelibrary.org).

References

Allen, R. K., B. Becerik, S. N. Pollalis, and B. R. Schwegler. 2005. "Promise and barriers to technology enabled and open project team collaboration." *J. Civ. Eng. Educ.* 131 (4): 301–311. https://doi.org/10.1061/(ASCE)1052-3928(2005)131:4(301).

Ancona, D. G., and D. Caldwell. 1992. "Cross-functional teams: Blessing or curse for new product development." In *Transforming organizations*, edited by T. A. Kochan and M. Useem, 154–168. Oxford, UK: Oxford University Press.

Andersson, D., A. Rankin, and D. Diptee. 2017. "Approaches to team performance assessment: A comparison of self-assessment reports and behavioral observer scales." *Cognition Technol. Work* 19 (2): 517–528. https://doi.org/10.1007/s10111-017-0428-0.

Baiden, B. K., and A. D. Price. 2011. "The effect of integration on project delivery team effectiveness." *Int. J. Project Manage.* 29 (2): 129–136. https://doi.org/10.1016/j.ijproman.2010.01.016.

Baiden, B. K., A. D. Price, and A. R. Dainty. 2006. "The extent of team integration within construction projects." *Int. J. Project Manage.* 24 (1): 13–23. https://doi.org/10.1016/j.ijproman.2005.05.001.

Bankvall, L., L. Bygballe, A. Dubois, and M. Jahre. 2010. "Interdependence in supply chains and projects in construction." *Supply Chain Manage. Int. J.* 15 (5): 385–393. https://doi.org/10.1108/13598541011068314.

Barron, B. 2000. "Achieving coordination in collaborative problem-solving groups." *J. Learn. Sci.* 9 (4): 403–436. https://doi.org/10.1207/S15327809JLS0904_2.

Bennett, J., and S. Jayes. 1998. *The seven pillars of partnering: A guide to second generation partnering*. London: Thomas Telford.

Bosch-Rekveldt, M. G. C. 2011. *Managing project complexity: A study into adapting early project phases to improve project performance in large engineering projects, technology, strategy and entrepreneurship*. Delft, Netherlands: Delft University of Technology.

Briscoe, G., and A. Dainty. 2005. "Construction supply chain integration: An elusive goal?" *Supply Chain Manage. Int. J.* 10 (4): 319–326. https://doi.org/10.1108/13598540510612794.

Buvik, M. P., and M. Rolfsen. 2015. "Prior ties and trust development in project teams—A case study from the construction industry." *Int. J. Project Manage.* 33 (7): 1484–1494. https://doi.org/10.1016/j.ijproman.2015.06.002.

Bygballe, L. E., M. Jahre, and A. Swärd. 2010. "Partnering relationships in construction: A literature review." *J. Purchasing Supply Manage.* 16 (4): 239–253. https://doi.org/10.1016/j.pursup.2010.08.002.

Carmeli, A., J. E. Dutton, and A. E. Hardin. 2015. "Respect as an engine for new ideas: Linking respectful engagement, relational information

processing and creativity among employees and teams." *Hum. Relat.* 68 (6): 1021–1047. https://doi.org/10.1177/0018726714550256.
Chan, P., E. Johansen, and R. Moor. 2012. "Partnering paradoxes: A case of constructing inter-organisational collaborations in infrastructure projects." *Project Perspect.* 34 (1): 28–33.
Chao-Duivis, M., A. Koning, and A. Ubink. 2013. *A practical guide to Dutch building contracts*. Gravenhage, Netherlands: Stichting instituut voor Bouwrecht.
Chen, Q., Z. Jin, B. Xia, P. Wu, and M. Skitmore. 2016. "Time and cost performance of design–build projects." *J. Constr. Eng. Manage.* 142 (2): 04015074. https://doi.org/10.1061/(ASCE)CO.1943-7862.0001056.
Chini, A., L. Ptschelinzew, R. E. Minchin, Y. Zhang, and D. Shah. 2018. "Industry attitudes toward alternative contracting for highway construction in Florida." *J. Manage. Eng.* 34 (2): 04017055. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000586.
Chiocchio, F., D. Forgues, D. Paradis, and I. Iordanova. 2011. "Teamwork in integrated design projects: Understanding the effects of trust, conflict, and collaboration on performance." *Project Manage. J.* 42 (6): 78–91. https://doi.org/10.1002/pmj.20268.
Conway, J. M., and C. E. Lance. 2010. "What reviewers should expect from authors regarding common method bias in organizational research." *J. Bus. Psychol.* 25 (3): 325–334. https://doi.org/10.1007/s10869-010-9181-6.
Daugherty, P. J., R. G. Richey, A. S. Roath, S. Min, H. Chen, A. D. Arndt, and S. E. Genchev. 2006. "Is collaboration paying off for firms?" *Bus. Horiz.* 49 (1): 61–70. https://doi.org/10.1016/j.bushor.2005.06.002.
Denison, D. R. 1996. "What is the difference between organizational culture and organizational climate? A native's point of view on a decade of paradigm wars." *Acad. Manage. Rev.* 21 (3): 619–654. https://doi.org/10.5465/amr.1996.9702100310.
DeVellis, R. F. 2016. *Scale development : Theory and applications, Applied research methods*. 4th ed. Thousand Oaks, CA: Sage Publications.
Dreu, C. K. D. 2002. "Team innovation and team effectiveness: The importance of minority dissent and reflexivity." *Eur. J. Work Organiz. Psychol.* 11 (3): 285–298. https://doi.org/10.1080/13594320244000175.
Dubois, A., and L.-E. Gadde. 2002. "The construction industry as a loosely coupled system: Implications for productivity and innovation." *Constr. Manage. Econ.* 20 (7): 621–631. https://doi.org/10.1080/01446190210163543.
Edmondson, A. C. 1999. "Psychological safety and learning behavior in work teams." *Admin Sci. Q.* 44 (2): 350–383. https://doi.org/10.2307/2666999.
Edmondson, A. C., and Z. Lei. 2014. "Psychological safety: The history, renaissance, and future of an interpersonal construct." *Annu. Rev. Organiz. Psychol. Organiz. Behav.* 1 (1): 23–43. https://doi.org/10.1146/annurev-orgpsych-031413-091305.
Edmondson, A. C., and I. M. Nembhard. 2009. "Product development and learning in project teams: The challenges are the benefits." *J. Prod. Innovation Manage.* 26 (2): 123–138. https://doi.org/10.1111/j.1540-5885.2009.00341.x.
Eriksson, P. E. 2015. "Partnering in engineering projects: Four dimensions of supply chain integration." *J. Purchasing Supply Manage.* 21 (1): 38–50. https://doi.org/10.1016/j.pursup.2014.08.003.
Field, A. 2009. *Discovering statistics using SPSS*. 3rd ed. Thousand Oaks, CA: Sage Publications.
Fong, P. S., and B. W. Lung. 2007. "Interorganizational teamwork in the construction industry." *J. Constr. Eng. Manage.* 133 (2): 157–168. https://doi.org/10.1061/(ASCE)0733-9364(2007)133:2(157).
Gaviria Moreno, J. C. 2015. "Psychology in construction: Measuring the influence of psychological features on project performance in housing association renovation projects." Master thesis, Dept. of Management in the Built Environment, Delft Univ. of Technology.
Hackman, J. R. 1990. *Groups that work (and those that don't)*. San Francisco: Jossey-Bass.
Hackman, J. R., R. Wageman, T. M. Ruddy, and C. R. Ray. 2000. "Team effectiveness in theory and practice." In *Industrial and organizational psychology: Theory and practice*, edited by C. Cooper and E. A. Locke. Oxford, UK: Blackwell.
Hale, D. R., P. P. Shrestha, G. E. Gibson, Jr., and G. C. Migliaccio. 2009. "Empirical comparison of design/build and design/bid/build project delivery methods." *J. Constr. Eng. Manage.* 135 (7): 579–587. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000017.
Hamzeh, F. R., H. Alhussein, and F. Faek. 2018. "Investigating the practice of improvisation in construction." *J. Manage. Eng.* 34 (6): 04018039. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000652.
Harper, C. M., and K. R. Molenaar. 2014. "Association between construction contracts and relational contract theory." In *Proc., Construction Research Congress 2014*, 1329–1338. Atlanta: ASCE Construction Research Congress.
Hayes, A. F. 2017. *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. 2nd ed. New York: Guilford Publications.
Hoegl, M., and H. G. Gemuenden. 2001. "Teamwork quality and the success of innovative projects: A theoretical concept and empirical evidence." *Organiz. Sci.* 12 (4): 435–449. https://doi.org/10.1287/orsc.12.4.435.10635.
Huang, C., C. Chu, and P. Jiang. 2008. "An empirical study of psychological safety and performance in technology R&D teams." In *Proc., 4th IEEE Int. Conf. on Management of Innovation and Technology, 2008: ICMIT 2008*, 1423–1427. New York: IEEE.
Jobidon, G., P. Lemieux, and R. Beauregard. 2019. "Comparison of Quebec's project delivery methods: Relational contract law and differences in contractual language." *Laws* 8 (2): 9–75. https://doi.org/10.3390/laws8020009.
Katz, R. 1982. "The effects of group longevity on project communication and performance." *Admin Sci. Q.* 27 (1): 81–104. https://doi.org/10.2307/2392547.
Kenny, D. A. 2018. "Mediation." Accessed July 15, 2019. http://davidakenny.net/cm/mediate.htm.
Koolwijk, J. S. J., C. J. V. Oel, J. W. F. Wamelink, and R. Vrijhoef. 2018. "Collaboration and integration in project-based supply chains in the construction industry." *J. Manage. Eng.* 34 (3): 04018001. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000592.
Kozlowski, S. W. J., and K. J. Klein. 2000. "A multilevel approach to theory and research in organizations: Contextual, temporal, and emergent processes." In *Multilevel theory, research, and methods in organizations: Foundations, extensions, and new directions*, 3–90. San Francisco: Jossey-Bass.
Kumaraswamy, M., and M. Rahman. 2006. "Applying teamworking models to projects." In *The management of complex projects: A relationship approach*, 164–186. Oxford, UK: Blackwell.
Lacerenza, C. N., S. L. Marlow, S. I. Tannenbaum, and E. Salas. 2018. "Team development interventions: Evidence-based approaches for improving teamwork." *Am. Psychol.* 73 (4): 517. https://doi.org/10.1037/amp0000295.
Lahdenperä, P. 2012. "Making sense of the multi-party contractual arrangements of project partnering, project alliancing and integrated project delivery." *Constr. Manage. Econ.* 30 (1): 57–79. https://doi.org/10.1080/01446193.2011.648947.
Laurent, J., and R. M. Leicht. 2019. "Practices for designing cross-functional teams for integrated project delivery." *J. Constr. Eng. Manage.* 145 (3): 05019001. https://doi.org/10.1061/(ASCE)CO.1943-7862.0001605.
Lepine, J. A., R. F. Piccolo, C. L. Jackson, J. E. Mathieu, and J. R. Saul. 2008. "A meta-analysis of teamwork processes: Tests of a multidimensional model and relationships with team effectiveness criteria." *Personnel Psychol.* 61 (2): 273–307. https://doi.org/10.1111/j.1744-6570.2008.00114.x.
Li, Y., Y. Lu, Q. Cui, and Y. Han. 2019. "Organizational behavior in megaprojects: Integrative review and directions for future research." *J. Manage. Eng.* 35 (4): 04019009. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000691.
Lim, B. C., and K. J. Klein. 2006. "Team mental models and team performance: A field study of the effects of team mental model similarity and accuracy." *J. Organiz. Behav. Int. J. Ind. Occup. Organiz. Psychol. Behav.* 27 (4): 403–418. https://doi.org/10.1002/job.387.
Lloyd-walker, B. M., A. J. Mills, and D. H. Walker. 2014. "Enabling construction innovation: The role of a no-blame culture as a collaboration behavioural driver in project alliances." *Constr. Manage. Econ.* 32 (3): 229–245. https://doi.org/10.1080/01446193.2014.892629.
Locke, E. A., and G. P. Latham. 2002. "Building a practically useful theory of goal setting and task motivation: A 35-year odyssey." *Am. Psychol.* 57 (9): 705. https://doi.org/10.1037/0003-066X.57.9.705.

Luo, L., Q. He, J. Xie, D. Yang, and G. Wu. 2017. "Investigating the relationship between project complexity and success in complex construction projects." *J. Manage. Eng.* 33 (2): 04016036. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000471.

MacKinnon, D. P., C. M. Lockwood, J. M. Hoffman, S. G. West, and V. Sheets. 2002. "A comparison of methods to test the significance of the mediated effect." *Psychol. Methods* 7 (1): 83–104. https://doi.org/10.1037/1082-989X.7.1.83.

Manata, B., V. Miller, S. Mollaoglu, and A. J. Garcia. 2018. "Measuring key communication behaviors in integrated project delivery teams." *J. Manage. Eng.* 34 (4): 06018001. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000622.

Mathieu, J., M. T. Maynard, T. Rapp, and L. Gilson. 2008. "Team effectiveness 1997-2007: A review of recent advancements and a glimpse into the future." *J. Manage.* 34 (3): 410–476. https://doi.org/10.1177/0149206308316061.

Molenaar, K. R., A. D. Songer, and M. Barash. 1999. "Public-sector design/build evolution and performance." *J. Manage. Eng.* 15 (2): 54–62. https://doi.org/10.1061/(ASCE)0742-597X(1999)15:2(54).

Osborne, J. W., A. B. Costello, and J. T. Kellow. 2008. "Best practices in exploratory factor analysis." In *Best practices in quantitative methods* edited by J. W. Osborne, 86–99. Thousand Oaks, CA: SAGE Publications. https://doi.org/10.4135/9781412995627.

Ostroff, C., A. Kinicki, and R. Muhammad. 2013. "Organizational culture and climate." In *Handbook of psychology*, edited by I. B. Weiner, N. W. Schmitt, and S. Highhouse, 643–676. Hoboken, NJ: Wiley.

Pearce, C. L., and H. P. Sims, Jr. 2002. "Vertical versus shared leadership as predictors of the effectiveness of change management teams: An examination of aversive, directive, transactional, transformational, and empowering leader behaviors." *Group Dyn. Theory Res. Pract.* 6 (2): 172–197. https://doi.org/10.1037/1089-2699.6.2.172.

Pesämaa, O., J. Larsson, and P. E. Eriksson. 2018. "Role of performance feedback on process performance in construction projects: Client and contractor perspectives." *J. Manage. Eng.* 34 (4): 04018023. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000619.

Pesek, A. E., J. B. Smithwick, A. Saseendran, and K. T. Sullivan. 2019. "Information asymmetry on heavy civil projects: Deficiency identification by contractors and owners." *J. Manage. Eng.* 35 (4): 04019008. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000694.

Pinto, J. K., D. P. Slevin, and B. English. 2009. "Trust in projects: An empirical assessment of owner/contractor relationships." *Int. J. Project Manage.* 27 (6): 638–648. https://doi.org/10.1016/j.ijproman.2008.09.010.

Podsakoff, P. M., S. B. MacKenzie, J.-Y. Lee, and N. P. Podsakoff. 2003. "Common method biases in behavioral research: A critical review of the literature and recommended remedies." *J. Appl. Psychol.* 88 (5): 879. https://doi.org/10.1037/0021-9010.88.5.879.

Podsakoff, P. M., and D. W. Organ. 1986. "Self-reports in organizational research: Problems and prospects." *J. Manage.* 12 (4): 531–544. https://doi.org/10.1177/014920638601200408.

Quelhas, A. D., J. R. F. Filho, J. V. Neto, and V. Pereira. 2019. "Model to measure adherence of culture, climate, and organizational behavior in a construction company." *J. Manage. Eng.* 35 (4): 05019003. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000688.

Rahman, M. M., and M. M. Kumaraswamy. 2008. "Relational contracting and teambuilding: Assessing potential contractual and noncontractual incentives." *J. Manage. Eng.* 24 (1): 48–63. https://doi.org/10.1061/(ASCE)0742-597X(2008)24:1(48).

Rose, T., and K. Manley. 2010. "Motivational misalignment on an iconic infrastructure project." *Build. Res. Inf.* 38 (2): 144–156. https://doi.org/10.1080/09613210903503741.

Salas, E., C. S. Burke, and J. A. Cannon-Bowers. 2000. "Teamwork: Emerging principles." *Int. J. Manage. Rev.* 2 (4): 339–356. https://doi.org/10.1111/1468-2370.00046.

Salas, E., M. L. Shuffler, A. L. Thayer, W. L. Bedwell, and E. H. Lazzara. 2015. "Understanding and improving teamwork in organizations: A scientifically based practical guide." *Hum. Resour. Manage.* 54 (4): 599–622. https://doi.org/10.1002/hrm.21628.

Salas, E., D. E. Sims, and C. S. Burke. 2005. "Is there a 'big five' in teamwork?" *Small Group Res.* 36 (5): 555–599. https://doi.org/10.1177/1046496405277134.

Salas, E., D. E. Sims, and C. Klein. 2004. "Cooperation at work." In *Encyclopedia of applied psychology*, edited by C. Spielberg, 497–505. New York: Academic Press.

Savelsbergh, C. M., R. F. Poell, and B. I. van der Heijden. 2015. "Does team stability mediate the relationship between leadership and team learning? An empirical study among Dutch project teams." *Int. J. Project Manage.* 33 (2): 406–418. https://doi.org/10.1016/j.ijproman.2014.08.008.

Seltman, H. J. 2008. "Experimental design and analysis." Accessed October 28, 2019. http://www.stat.cmu.edu/hseltman/309/Book/Book.pdf.

Senescu, R. R., G. Aranda-Mena, and J. R. Haymaker. 2013. "Relationships between project complexity and communication." *J. Manage. Eng.* 29 (2): 183–197. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000121.

Shen, W., B. Choi, S. Lee, W. Tang, and C. T. Haas. 2018. "How to improve interface management behaviors in EPC projects: Roles of formal practices and social norms." *J. Manage. Eng.* 34 (6): 04018032. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000639.

Sun, J., X. Ren, and C. J. Anumba. 2019. "Analysis of knowledge-transfer mechanisms in construction project cooperation networks." *J. Manage. Eng.* 35 (2): 04018061. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000663.

Suprapto, M., H. L. Bakker, and H. G. Mooi. 2015. "Relational factors in owner–contractor collaboration: The mediating role of teamworking." *Int. J. Project Manage.* 33 (6): 1347–1363. https://doi.org/10.1016/j.ijproman.2015.03.015.

Tesluk, P., J. E. Mathieu, S. J. Zaccaro, and M. Marks. 1997. "Task and aggregation issues in the analysis and assessment of team performance." In *Team performance assessment and measurement: Theory, methods, and applications*, edited by M. T. Brannick, E. Salas, and C. W. Prince, 197–224. New York: Psychology Press, Taylor & Francis Group.

Toor, S. U. R. 2009. "Construction professionals' perception of critical success factors for large-scale construction projects." *Constr. Innovation* 9 (2): 149–167. https://doi.org/10.1108/14714170910950803.

Tran, D., J. Cameron Lampe, S. Bypaneni, and K. Molenaar. 2016. "An empirical comparison of cost growth between highway design-bid-build and design-build projects by project size." In *Proc., Construction Research Congress 2016*, 2029–2038. San Juan, Puerto Rico: ASCE Construction Research Congress. https://doi.org/10.1061/9780784479827.202.

Uhl-Bien, M., R. Marion, and B. McKelvey. 2007. "Complexity leadership theory: Shifting leadership from the industrial age to the knowledge era." *Leadership Q.* 18 (4): 298–318. https://doi.org/10.1016/j.leaqua.2007.04.002.

Van den Bossche, P., W. H. Gijselaers, M. Segers, and P. A. Kirschner. 2006. "Social and cognitive factors driving teamwork in collaborative learning environments: Team learning beliefs and behaviors." *Small Group Res.* 37 (5): 490–521. https://doi.org/10.1177/1046496406292938.

van der Hoek, M., S. Groeneveld, and B. Kuipers. 2018. "Goal setting in teams: Goal clarity and team performance in the public sector." *Rev. Publ. Person Admin* 38 (4): 472–493. https://doi.org/10.1177/0734371X16682815.

Walker, D. H. T., and B. M. Lloyd-Walker. 2014. "The ambience of a project alliance in Australia." *Eng. Project Organiz. J.* 4 (1): 2–16. https://doi.org/10.1080/21573727.2013.836102.

Walker, D. H. T., and B. M. Lloyd-Walker. 2015. *Collaborative project procurement arrangements*. Newton Square, PA: Project Management Institute.

Yeh, M.-L., H.-P. Chu, and P. Lue. 2005. "Influences of team longevity and stability on R&D performance." *Int. J. Electron. Bus. Manage.* 3 (3): 209–213.

Yeung, J. F., A. P. Chan, and D. W. Chan. 2007. "The definition of alliancing in construction as a Wittgenstein family-resemblance concept." *Int. J. Project Manage.* 25 (3): 219–231.