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Construction Innovation: Information, Pr
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Journal:	*Construction Innovation: Information, Process, Management*
Manuscript ID	CI-03-2023-0039.R1
Manuscript Type:	Research Article
Keywords:	Team Working, Team performance, Trust, Virtual project team, Structural Equation Modelling, Organisation

Impact of Trust in Virtual Project Teams: Structural Equation Modeling approach

Abstract

This study focuses on model development to analyse key factors affecting trust in Virtual Project Teams (VPTs). A questionnaire survey was conducted on construction professionals participating in virtual teams. Structural Equation Modelling (SEM) technique was performed to establish the effect of relevant factors on trust-building in VPTs. Team performance is highly affected by trust among the team members. Trust building can be enhanced by improving the quality of team communication, organisation culture, team bonding, and team members' characteristics. The model developed in this study would benefit team productivity and team members' learning in VPTs.

Introduction

Organisations are expanding their dependence on virtual project teams (VPTs) to produce commercial value (Sagar et al., 2022), as well as gather diverse knowledge banks, time and financial savings, and identify economical solutions for collaboration (Gibson & Gibbs, 2006). VPTs have gained significant traction and usage by many major corporations, from a 60% estimate in 2003 (Gibson & Gibbs, 2006; Martins et al., 2004), to 85% in 2016 (Hacker et al., 2019). A major study spanning 100 countries surveyed 3000 managers; it outlines that 40% of the workers were using VPTs for 50% of their work time (Hoch & Dulebohn, 2017). VPTs have been researched consistently and often in information systems, Human Resource Management (HRM), and other disciplines (including the construction domain) for two decades due to significant and growing dependence on information technology (Hacker et al., 2019). However, increased dependence on VPTs has its management issues (Jimenez et al., 2017; Lukić & Vračar, 2018). These issues have not been sufficiently addressed in the current VPTs research and remain unresolved (Hacker et al., 2019). Research also indicates that challenges in trust building directly affect virtual team failure (Kimble, 2011). It has also outlined that trust is a complex experience

for internal and external team members due to various interconnected and dependent participants in VPTs.

The building sector has reported low levels of productivity and performance due to trust between the client, design team and construction team (Nathaniel & Anthony, 2012). Trust significantly impacts the team's confidence in knowledge sharing within traditional settings and among VPTs (Arif et al., 2015; Sagar et al., 2021). Although a growing body of research addresses virtual teams and the function of trust (Bhat et al., 2017; Sagar et al., 2022), literature on the different variables impacting trust as a single entity in the construction industry is limited. Only a few publications in the past dealt with this issue and were limited to the education, information technology, or manufacturing sector in the United States or Europe. There is a great uptake of VPTs in the construction sector. However, significant challenges need to be explored and addressed due to the infancy of VPTs application in the construction industry. The Middle East attracts professionals from across the globe, making it a multicultural region with professionals from varied countries and backgrounds. The issue of trust in the context of VPTs is a major issue in the Middle East (Zakaria & Yusof, 2020). Therefore, it is crucial to understand trust in virtual project teams (VPTs) from professionals who work across different cultures. The current literature and knowledge on trust in virtual teams within the construction sector is limited (Kaur, 2017; Lau & Rowlinson, 2009). As a result, this study aimed to pinpoint the crucial elements contributing to trust in virtual project teams (VPTs) and examine the impact of different factors on trust within virtual teams. The researchers created an analytical trust model to offer practical guidance for managing VPTs in the construction industry.

Literature review

Trust in VPTs – Construction industry

The construction industry in the United Arab Emirates is worth billions of dollars and accounts for approximately 8% of the country's GDP (Ailabouni, Painting, & Ashton, 2009). The delivery of construction projects increasingly relies on virtual teams (Henderson, 2008; Ramalingam et al., 2014; Kaur, 2017; Sagar et al., 2021). It is a combined result of globalisation and multinational teams of consultants working on

different construction projects. Research outlines that successful implementation of VPTs requires a comprehensive awareness and outlining of diverse, interlinked and complex challenges that are not otherwise experienced in traditional project teams setup (Hosseini & Chileshe, 2013). While there are multiple challenges in VPTs, trust is the most critical factor influencing the team's performance and productivity (Brahm & Kunze, 2012).

There are multiple interlinked procedures, activities and stages in a construction project. It includes procurement processes, detailed design and engineering, project estimation, preliminary engineering, construction, and commission (Sagar et al., 2022). Construction projects are designed, developed and constructed using coordinated information at all project stages. Information management, including sharing and amending designs per requirements, is highly dependent on trust among the team members. Trust develops a willingness to collaborate, which leads to an obligation to share knowledge (Staples & Webster, 2008; Sagar et al., 2021). This obligation would result in the effectiveness of a virtual team (Pangil & Chan, 2014).

The effectiveness of a virtual project team (VPT) is highly dependent on the competence of its members in delivering work as promised, which is a crucial factor for success and efficiency. The ability of team members to deliver work is also influenced by their level of commitment to the team, which is, in turn, influenced by the level of trust within the team. Trust is also essential for timely and quality information exchange among team members (Jarvenpaa et al., 1998). Therefore, it has become imperative to explore trust within the context of the construction industry and business literature. The successful delivery of construction projects using VPTs depends on the trust, identity and cohesiveness of the team, and they need to be sternly appraised for the effectiveness of VPTs (Sagar et al., 2022; Kaur, 2017).

Trust is a major challenge faced by virtual teams (Morrison-Smith & Ruiz, 2020). A large amount of literature emphasizes the significance of trust in virtual team performance (Henttonen & Blomqvist, 2005; Khan, 2012; Malhotra et al., 2007). It is pivotal to team productivity and performance (Kanawattanachai & Yoo, 2002). Trust building to develop and successful and efficient team is also one of the most complex and challenging in multiple dimensions (Kaur, 2017, Sagar et al., 2022). Virtual communication and

international partnerships in a project set-up require trust to be earned by a collaborative approach for teams to perform efficiently (Lurey & Raisingham, 2001). Research indicates that trust and positive relationships between team members result in higher creativity, critical thinking and a productive environment (Reina & Reina, 1999). It also helps to produce higher-quality work (Nemiro et al., 2008).

Kaur (2017) identified five challenges that must be addressed for the effective management of VPTs: (1) Trust (2) Team cohesiveness (3) Communication (4) Team diversity and (5) Leadership. However, trust is crucial for Virtual Project Team managers to deal with challenges since it is core to the VPT function and operation (Lukić & Vračar, 2018). Trust is an essential element that influences VPT's productivity and performance. Different social and physical factors such as face-to-face conversation, cultural diversity, and long distance between project team members deter trust building. Studies have highlighted that trust is a foundation of positive relationships between construction teams and other stakeholders (Kaur, 2017; Hacker et al., 2019). Much literature outlines the importance of trust in relationships between clients, general contractors, subcontractors and suppliers in the construction sector. However, a lack of literature focuses on trust in VPTs (Pinto et al., 2009; Hosseini & Chileshe, 2013). Trust plays a significant role in the performance of virtual team members, as shown in studies by Khan (2012) and Lukić and Vračar (2018), and is crucial for the productivity and efficiency of a team's processes (Lukić & Vračar, 2018). The success of virtual project teams in the construction industry depends heavily on building trust, team identity, and cohesiveness, as emphasized by Chen and Messner (2010) and Kaur et al. (2015). Trust serves as the foundation of cross-disciplinary teams' work setups (Zolin et al., 2004). The lack of trust in team members is the main resistance to effective teamwork (Kaur et al., 2015). An extensive analysis of the literature suggests that most of the research on trust focuses on industry, and there is a lack of literature on the construction sector. There isn't convincing literature on VPTs in the construction sector (Kadefors, 2004; Lau & Rowlinson, 2009; Pinto et al., 2009). However, there is compelling work in other sectors, such as I.T sector (Ho & Richardson, 2013) and online societies (Lee et al., 2014). The study aims to focus on this situation and lack of literature in the construction sector.

Methodology

Research Model and proposed hypotheses

This section describes the literature review, which was extensively done to identify the factors included in the research framework. Research articles from reputed peer-reviewed journals were identified after a broad search based on appropriate keywords. Some existing relevant models helped the researchers to understand the role of trust in the performance of virtual project teams. Subsequently, those models helped provide the different indicators affecting trust in virtual project teams. The indicators have been cited in various research articles, and many researchers have commented on their importance in building trust in a virtual project team, as discussed in the following subsections.

Organizational Culture and Trust in virtual project teams

Project team members' understanding of project objectives and processes is crucial for achieving the organisations' goals (Sagar et al., 2022). Doney et al. (1998) outlined that lack of clarity among team members on project objectives and degree of trust building within an organisation poses a high risk to the team and its members. Thus, trust among team members and a clear understanding of team goals in crucial for successful team planning and delivery (Brahm & Kunze, 2012). Furst et al. (1999) suggested that establishing clear and transparent goals in a project can reduce uncertainty in team performance. They also emphasized that the team selection process and outcome are important factors in a team's success. Amah, Nwuche, & Chukuigwe (2013) pointed out that professionals are members of an organization before becoming team members. Hence, selection criteria govern the character and description of team members. Bell & Kozlowski (2002) suggested that the suitability of people towards a project should manage the organisations and selection of a VPT. Lack of suitability of team members could result in distrust in a team member and their capability. Barkhi et al. (2004) investigated the effect of rewarding team members based on their contribution to team's decision outcomes. They concluded that rewards scheme positively impacted the team members' trust towards the organization.

Bryant et al. (2009) also recommended that reward and inventive schemes at team and manager levels have a direct and compelling positive effect on the outcome and attitudes of team members in VPTs. Evaluation of a team includes analysing the transparency of outcomes, transparency and honesty in the availability of information and decision-making procedures, and clarity and fairness in team members' treatment at the interpersonal level (Bryant et al., 2009). An honest and impartial team analysis strongly affects team members' confidence in team evaluation, thus increasing their trust in team operation, governance and evaluation. Cohesion acts as a connection agent among team members, and the close operation and communication among the team members highly influence the probability of team success. It also contributes in team building a team. Also, any conflict between team members on task execution and distribution, and process contributes to range of equivalent solutions. It contributes to the efficient achievement of project and organisational goals. Based on this analysis, following hypothesis are proposed:

H1: A positive relationship exists between organisational culture and trust in virtual project teams.

H2: Conflict mediates the positive effect of organisational culture on trust.

H3: Cohesion increases the positive effect of organisational culture on trust.

Team diversity and trust among virtual project team members.

A team's diversity encompasses diversity in functions, culture, and different problem-solving approaches. Peters and Karren (2009) argued that diversity among team members in virtual projects ould result in differences in attitudes, values, and performance, leading to conflicts. Virtual teams with members from diverse backgrounds and cultures are more likely to experience these conflicts than homogenous teams (Jehn, 1995).

Shachaf (2008) argued that cultural diversity within virtual teams could present additional challenges for leaders and members, including language barriers that can lead to communication difficulties and conflicts. Additionally, Curşeu & Schruijer (2010) presented that, according to the similarity-attraction hypothesis, diversity within a team may lead to an increase in conflict, but can have a negative impact on the development of trust.

Diversity within a team may lead to increased conflict and decreased trust. Research has also shown that team members may view those who share their culture as more trustworthy and feel a stronger sense of belonging with them compared to those who do not share their culture (Zolin *et al.*, 2004). Tsui et al. (1992) discovered that psychological attachment among group members is negatively related to diversity within a work unit. Based on these findings, it can be inferred that diversity within a team may obstruct the interactions required for team members to fully invest in the team and each other. As a result, the researchers propose the following hypotheses:

H4: A negative relationship exists between the diversity of team members and trust in virtual project teams.

Communication and trust among virtual project team members

Effective communication is crucial in building trust among team members, especially in virtual project teams where members may be geographically dispersed and have different time zones and holidays (Sagar et al., 2021). The communication process may involve various tools and techniques, and training may be required to ensure that team members can communicate and collaborate effectively. According to Amah et al. (2013), it is recommended that managers provide training opportunities to their employees to acquire the necessary skills and experiences to become effective team players. Effective communication, particularly during the early stages of team development, is critical for establishing and sustaining trust, as Anderson et al. (2007) emphasised.

The global character of virtual teams can make communication a persistent challenge, resulting in diminished mutual understanding within the team (McDonough, Kahn & Barczak, 2001). This can be exacerbated when team members do not have a shared language and when only some are co-located while others are geographically dispersed (Crampton, 2001). The researchers are proposing the following hypotheses as a result:

H5: A positive relationship exists between communication between team members and trust in virtual project teams.

Team member's characteristics and trust in virtual project teams

Kramer and Lewicki (2010) suggest that initial trust in a relationship may be established based on fundamental factors, but as the relationship develops and team members become more acquainted with each other, trust may depend on the personal attributes of team members. As people gain a deeper understanding of their colleagues, they may form trust or distrust based on their perceived traits. The trust of team members can be influenced by several characteristics, such as their cognitive elements, ability, integrity, and benevolence. These attributes were described by Jarvenpaa et al. (1998) as dyadic trust attributes, which include the trustee's perceived benevolence, integrity, and ability. Benevolence refers to one party's willingness to benefit another, while ability represents the trustor's belief in the trustee's skills to fulfil their obligations as expected.

Sagar et al. (2021) argue that capability, honesty, and good intentions are the essential components of trust in virtual teams, which are crucial for different phases of virtual team formation and operation. Similarly, Jarvenpaa et al. (1998) emphasize the importance of team members' abilities, honesty, and good intentions for trust. According to Mukherjee et al. (2012), trustors in virtual teams evaluate the trustee's ability to make positive contributions to the team. In a dynamic and uncertain environment where the ability to respond quickly and adapt is crucial for seizing market opportunities, the trustor must have faith in the trustee's positive intentions towards the relationship, even without a formal agreement or prior commitment.

According to Kasper-Fuehrer and Ashkanasy (2001), the absence of formal contracts in virtual teams highlights the significance of benevolence in establishing "organizational trustworthiness." Business ethics and integrity are also crucial in virtual settings to convey trustworthiness. Trust among virtual project team members may be formed cognitively after evaluating their teammates' ability, benevolence, and integrity (Mukherjee et al., 2012). As a result of the strong bond between team members, their traits and characteristics may have a greater impact on the development of trust. The trust level among team members may be higher when they are more competent and have high levels of benevolence and integrity. Based on this, the researchers suggest the following hypotheses:

H6: A positive relationship exists between team member characteristics and trust in virtual project teams.

H7: Cohesion increases the positive effect of team member characteristics on trust.

Conflict on Cohesion relevance on the team in virtual projects

According to Dafoulas and Macaulay (2002) and Kaur (2017), virtual teams may require greater trust to succeed and avoid conflicts compared to traditional, co-located teams. Conflicts within a team can negatively affect both the relationships within the team and task performance (Sagar et al., 2021). Jehn (1995) suggests that differences in personal preferences, values, ideology, and political views among team members can result in relationship conflicts and generate tension, animosity, and annoyance. This, in turn, can decrease the overall cohesion of the team. Conflict based on emotional or interpersonal problems can greatly hinder a team's performance. In teams where the members are highly dependent on each other, this type of conflict is likely to significantly hinder the formation of trust. Amason (1996) suggested that relationship conflict can negatively impact decision-making, team unity, commitment, and decision acceptance. Additionally, it can lead to division, diminished trust, and weakened team relationships. Based on this, the researchers put forward a hypothesis:

H8: The more conflict among virtual team members, the less cohesion among them.

Impact of experience on diversity and communication in virtual projects

Experience is used as a moderating factor. This refers to the time an individual has spent working in virtual project teams and the number of virtual projects they have completed. This is significant because the more time a team spends together, the greater opportunity its members have to interact and form positive relationships, which can positively impact the team's performance (Kaur, 2017). Experience with virtual teams can play a role in reducing conflicts, particularly when team members have diverse backgrounds. This could be because more experienced team members can foster better team cohesion due to their maturity. Furthermore, senior members of the team, who typically possess extensive experience in their field and are responsible for teamwork, are more likely to provide dependable, objective, and trustworthy information (Hwang, 2012).

Trust: Theoretical model

Based on the reviewed literature and proposed hypotheses, it is suggested that positive team traits, communication, diversity, and a favorable organizational culture can enhance trust within virtual project teams in the construction industry. The role of two mediators, conflict and cohesion, and how they affect trust are also considered. The theoretical research model of trust, shown in Figure 1, includes variables that represent the main factors directly influencing trust, with the addition of a moderating variable that was be introduced in the analysis. The main task is to test whether the variables influence trust as hypothesized (H1 – H8). Given the inherently complex nature of virtual project teams in the construction sector, the researchers proposed that trust in virtual project teams, as a dependent variable, will increase with the development of positive organizational culture (H1) +ve, team member characteristics (H6) +ve, and degree of communication (H5) +ve. It has been observed that trust is negatively affected by the diversity of team members (H4) -ve. There are two mediators – conflict in the team and cohesion of the team, which should positively influence trust building if properly managed. A careful review of the model led the researcher to identify one prime moderator experience (age) in virtual project teams.

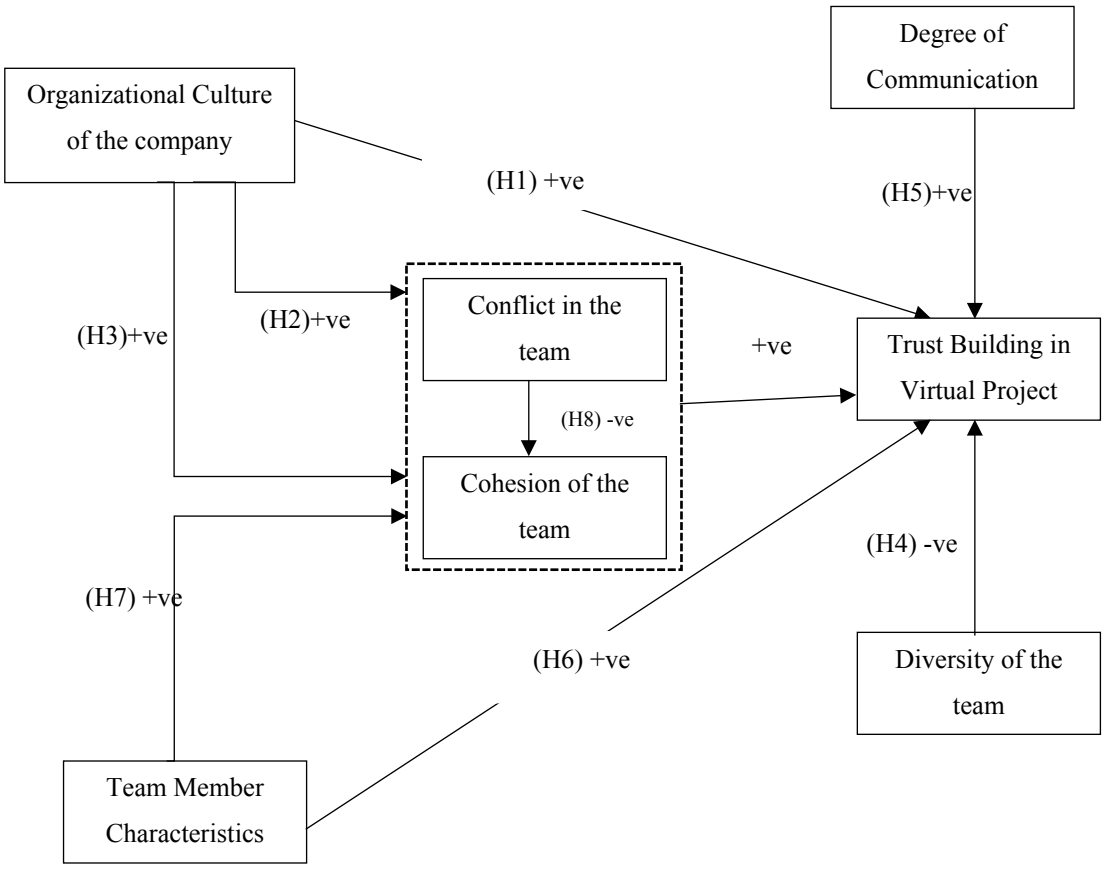

Figure 1: Trust building model in VPTs

(Note: H represent 'hypothesis', +ve – positive relationship, -ve – positive relationship)

Questionnaire Survey

In this study, a survey questionnaire was developed based on a theoretical model incorporating factors identified in previous literature by Kaur (2017). The questionnaire was then pre-tested with seven construction professionals to ensure content validity, following the guidelines by Bhatia and Awasthi (2018), and was subsequently modified based on their feedback. The survey questionnaire, which comprised 25 items across seven constructs, was finalized and is detailed in Table 1. The survey was aimed at professionals who work as either team members or project managers in different construction companies. The email addresses for virtual project team communities were sourced from online directories of construction companies, and the participants were provided with a link to an online questionnaire. The survey was conducted online.

The study recruited virtual project professionals from various construction companies through online directories, such as project managers or team members. These participants were then sent a link to an online survey, which mostly contained closed-ended questions

that required them to choose from predetermined options. The responses were measured using a 5-point Likert scale that ranged from "strongly disagree" to "strongly agree". Additionally, there were some open-ended questions to gather further information about the participant's background and job description. The survey was conducted through an online platform. Additionally, online surveys provide a convenient and accessible platform for participants to respond from the comfort of their location without travelling or scheduling appointments (Yun & Trumbo, 2000). Moreover, the anonymity of the respondents in online surveys can also increase their willingness to provide honest and complete answers, potentially leading to higher-quality data (Philbrick et al., 2010).

Table 1: Factors and measurement variables of the research study

Factor name	***Variables/ items***
Organizational Culture	OrgC1: Clear Objectives and Goals
	OrgC2: Recruitment Strategy
	OrgC3: Rewards
	OrgC4: Team Evaluation
	OrgC5: Availability of Mentor
	OrgC6: Task Interdependence in the organisation
Conflict within the team	Conf1: Conflict in the execution of Task
	Conf2: Conflict in delegation of task
	Conf3: Relationship conflict
	Conf4: Lack of Employee Satisfaction
Characteristics of team members	Char1: Integrity of the team member
	Char2: Benevolence of the team member
	Char3: Propensity to trust
	Char4: Functional diversity of the team
Trust within the team members	Tru1:Relying on the information provided by team
	Tru2:Accepting procedural suggestions from team
Diversity of the team	Div1: Cultural Diversity
	Div2: Differ in Problem Solving Approach

	Div3: Time difference and holidays
Communication of the team	Comm1: Training on core technical skills
	Comm2: Training on personal development and conflict resolution.
Cohesion in the team	Coh1: Cognitive ability of the team
	Coh2: Mutual Respect within the team
	Coh3: Affective (Caring) elements within the team
	Coh4: Technical ability of the team

Data analysis techniques

The main characteristics of the collected data were identified through descriptive statistics, and after cleaning and removing extreme values, 323 responses out of 403 participants were included in the final analysis. Confirmatory factor analysis (CFA) was used instead of exploratory factor analysis (EFA) as the measurement variables had been previously established in research and were expected to align with their respective construct. The reason for this approach was explained by Bhatia and Awasthi (2018), who stated that this method is more appropriate when the measurement variables have already been chosen from a well-established body of literature. Therefore, the researchers used a Structural Equation Modeling (SEM) approach to evaluate the relationship between trust-building and other factors in virtual teams. This method allows for the examination of both latent and observable variables through statistical analysis. A theoretical model must be developed to understand the connection between the key variables involved in trust-building in a virtual team environment to utilise SEM. This required identifying the key factors contributing to trust-building in such a setting. Thus, the initial creation of a theoretical model shows constructs of factors affecting trust-building. SEM is a statistical method that was utilized to test the hypothesis and examine the relationship between trust-building and other variables in a virtual team setting. The approach was previously employed in a study by De Campos et al. (2019). The theoretical model was tested by analyzing the entire system of variables simultaneously to determine the degree of consistency between the hypothesised model and the collected data.

Structural Equation Modelling (SEM) is a statistical method used to analyze the relationships between multiple variables, including both observed and underlying (latent) variables. One advantage of SEM is its ability to account for measurement errors, which can improve the accuracy of the analysis. This study employed SEM to determine if the proposed theoretical model aligns with the collected data, thereby establishing its validity. The trust model's validity and reliability were assessed through various tests, which provided valuable insights. The Comparative Fit Index (CFI) and Non-Normed Fit Index (NNFI) were used to evaluate how well the theoretical model aligned with the collected data. On the other hand, the Root Mean Square Error of Approximation (RMSEA) measured the level of error present in the model's fit. These evaluations were crucial in determining the effectiveness of the proposed trust model and how it accurately represents the relationships between variables in the real world.

The validity of the proposed trust model was analyzed using SEM. The SEM was used to evaluate the measurement and structural models. The model's accuracy was verified by comparing the Average Variance Extracted (AVE) of each component with the variance due to measurement error. To ensure validity, the model required an AVE greater than 0.50 (Fornell & Larcker, 1981) and a comparison between the square root of the AVE and correlations with other constructs in the model to confirm discriminant validity (Fornell & Larcker, 1981).

Results and discussion of findings

Descriptive statistics

According to the survey results, the majority of respondents were team members, comprising 73.7% of the total, while the remaining 26.3% were team leaders. A large proportion of participants had higher education, with 60.1% holding a Bachelor's degree, 31.6% holding a Master's degree, and only 8.4% having a diploma. Furthermore, the respondents had considerable experience working in virtual project teams, with an average of 6.9 years.

Measurement Model

The measurement model's validity was evaluated through three methods: reliability, convergent validity, and discriminant validity. Composite reliability values were used to

measure reliability, with a minimum threshold of 0.7 considered acceptable, according to Fornell and Larcker (1981). The results presented in Table 2 demonstrated that all composite reliability values ranged from 0.716 to 0.795, indicating that they are higher than the minimum acceptable threshold. To evaluate discriminant validity, the study used Fornell and Larcker's (1981) approach of comparing each construct's square root of the Average Variance Extracted (AVE) with the correlations between that construct and other constructs in the model. The results in Table 2 indicated that the square root of AVE for each construct was greater than the correlation values between that construct and other constructs in the model. This suggests that the discriminant validity was acceptable for all constructs.

Table 2: Validity and Reliability Values

	CR	Communication	OrgCul	Conflict	TeamMem Char	Trust	Diversity	Cohesion
Communication	0.795	**0.818**						
OrgCul	0.743	0.571	**0.752**					
Conflict	0.731	0.179	0.304	**0.751**				
Team member Char	0.758	0.148	0.135	0.063	**0.742**			
Trust	0.783	0.346	0.383	0.425	0.285	**0.721**		
Diversity	0.716	0.038	0.059	-0.043	0.298	0.200	**0.767**	
Cohesion	0.726	0.448	0.677	0.558	0.398	0.570	0.144	**0.756**

In order to ensure that the scales were measuring the same concept accurately and reliably, it was important to establish their convergent validity. This was done by checking that the Average Variance Extracted (AVE) value for each construct was greater than the measurement error variance for that particular construct. This was done by comparing the AVE to a benchmark of 0.50. The results in Table 3 showed that the AVE for each of the constructs ranged from 0.52 to 0.67, indicating that convergent validity was established. The results of the analysis support the convergent validity of the scales. The standardised

factor loadings of the items were examined to verify the convergent validity of the measurement variables. This process helps to confirm that the measurement variables are measuring the intended concept and not some other related or unrelated concept. Ensuring convergent validity is crucial because it confirms that the measurement variables accurately measure the same concept with reliability. The standardised loading value of each measurement variable was evaluated to ensure quality, requiring a value equal to or greater than 0.5, according to Kock (2014). All of the statistical results were significant, and any items that did not meet the required statistical standards, including OrgC6, Conf2, Conf4, Div3, and Coh4, were removed from the analysis. The Cronbach alpha (α) value was used to assess the reliability of each construct, and all of the Cronbach alpha values exceeded the 0.7 threshold value established by Nunnally (1978).

Table 3: Loading values, cronbach alpha (α), and AVE values

Construct	Standardized Loadings	Cronbach Alpha (α)	Average Variance Extracted (AVE)
Organizational Culture			
OrgC1	0.64	0.753	0.567
OrgC2	0.59		
OrgC3	0.63		
OrgC4	0.61		
OrgC5	0.55		
Conflict within the team		0.713	0.564
Conf1	0.60		
Conf3	0.75		
Team member characteristics		0.766	0.551
Char1	0.89		
Char2	0.67		
Char3	0.53		
Char4	0.54		
Trust		0.703	0.520
Tru1	0.69		
Tru2	0.76		
Diversity		0.700	0.588
Div1	0.98		
Div2	0.50		
Communication		0.757	0.669
Comm1	0.63		
Comm2	0.97		
Cohesion		0.757	0.573
Coh1	0.80		
Coh2	0.63		

Coh3	0.62		

Structural Model

The adequacy of a structural model is determined by its fit indices, which determine whether the model is acceptable or not. In this study, the model is deemed a good fit since all the goodness-of-fit indices meet the recommended thresholds. For instance, CMIN/DF (Minimum discrepancy) value, which should range from 3 to 1 (Carmines & McIver, 1981), is 1.882. Also, the Goodness of fit Index (GFI) is 0.904 (Hu & Bentler, 1995), Root Mean Square Error of Approximation (RMSEA) records 0.052 (MacCallum et al. 1996), Comparative Fit Index (CFI) is 0.913 (Raykov, 2005), which are all indications of good fit. It is possible to infer that the findings of this study were stable. As a result, the SEM model suited the data well, and the conceptual framework discussed in the previous section was validated. The final SEM model is presented in Figure 2. The justification for this paradigm is described in the section that follows.

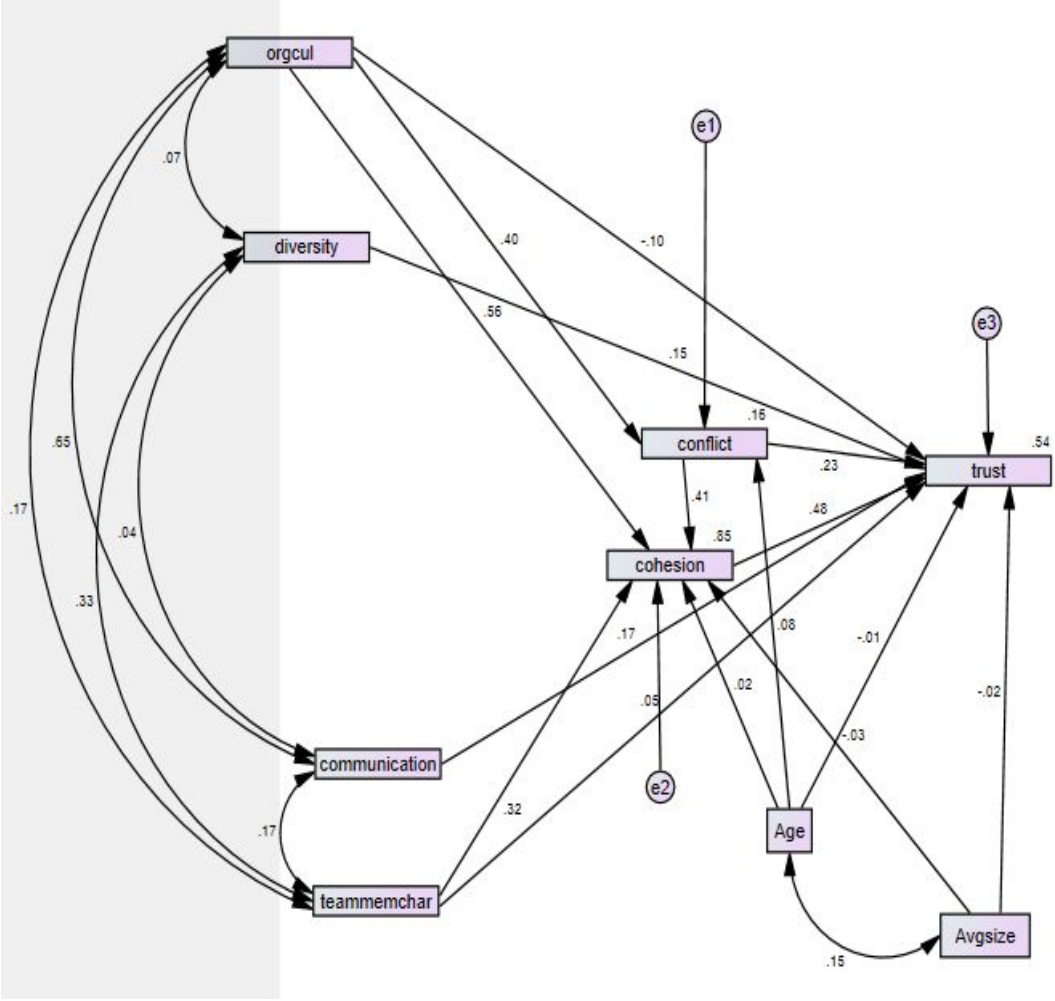

Figure 2: Final SEM Model of Trust

Discussion on Model of Trust and hypothesis testing

The model shown in Figure 2 constitutes various factors affecting trust positively or negatively. As shown in **Table 4**, after the SEM analysis was conducted, 3 out of the 11 hypotheses were rejected. The discussion of the different relationships between the variables was based on the results of the statistical data analysis.

Table 4: Results of the hypothesis test.

Hypothesis Number	Statement of Hypothesis	Coefficient	p-values	Results
H1	*A positive relationship exists between organizational culture and trust in virtual project teams.*	*0.065*	*0.000*	*Supported*

H2	*Conflict increases the positive effect of organizational culture on trust.*	*0.243*	*0.001*	*Supported*
H3	*Cohesion increases the positive effect of organizational culture on trust.*	*0.464*	*0.001*	*Supported*
H4	*A negative relationship exists between diversity of team members and trust in virtual project teams.*	*0.000*	*0.991*	*Not supported; came out to be positive relationship*
H5	*A positive relationship exists between communication of team members and trust in virtual project teams.*	*0.168*	*0.004*	*Supported*
H6	*A positive relationship exists between characteristics of team member on trust in virtual project teams.*	*0.149*	*0.001*	*Supported*
H7	*Cohesion increases the positive effect of team member characteristics on trust.*	*0.149*	*0.001*	*Supported, full mediation*
H8	*The more conflict among virtual team members, the less is the cohestion among them.*	*0.203*	*0.001*	*Supported*

The result of hypothesis 1 verification

The company's organisational culture encompasses various components such as setting clear goals and objectives, outlining a recruitment strategy, providing incentives to team members, ensuring unbiased performance appraisals, offering mentorship programs to employees, and the team's level of interdependence of tasks. Research has shown that team members committed to the team's objectives, especially long-term goals critical to the team's overall success, are more likely to pursue the team's objectives actively (Sagar et al., 2021; Kaur, 2017). Thus, it is crucial to establish a clear understanding of the team's objectives and goals during the planning stage to foster trust among team members (Brahm & Kunze, 2012). Choosing team members also holds significant importance in determining

a team's success. Amah et al. (2013) proposed that individuals become members of organizations before they join teams, indicating that the organization's selection criteria can affect the type of individuals who are chosen to be part of the team.

Additionally, Barkhi et al. (2004) discovered in their research that rewarding team members based on the results of their individual or team decisions could improve team members' trust in the organization. It is crucial to have fairness in team evaluations to encourage trust and motivation among team members. When team members perceive that the evaluation process is just and unbiased, they tend to be more dedicated to the team's objectives and less inclined to resist change (Bryant et al., 2009). Mentoring and coaching team members can also increase their skills and improve their performance, leading to a more effective and cohesive team (Sagar et al., 2021).

The result of hypotheses 2 and 3 verification

The study's findings align with previous research on the subject and support the idea that team members dedicated to the team and its goals are more likely to cooperate in pursuit of organizational objectives. This positive correlation between trust, collaboration, and goal attainment can be further enhanced when teams work through task-related conflicts constructively and transparently, ultimately contributing to the development of mutual trust among team members.

Researchers have shown that conflicts arising from tasks, processes, and relationships can harm the effectiveness of remote teams (Hinds & Bailey, 2003; Sagar et al., 2021). While some conflicts can be beneficial, it is essential to effectively manage conflicts that have a negative impact on team results and organizational objectives. In virtual teams, active conflict management and early conflict detection may be crucial (Kaur, 2017). Process conflict is a type of conflict that arises from disagreement or differences in opinions about how work should be done. On the other hand, relational conflict is typically caused by a lack of understanding about personal situations or differences among team members (Wakefield, Leidner, & Garrison, 2008). Organizations must address relational and process conflict promptly and effectively to maintain a positive organizational culture and improve team performance. Addressing conflict can help to create a culture of trust, cooperation, and commitment to the organization's objectives, and it can help to foster positive outcomes and achieve the team's objectives.

The study's findings indicate that virtual teams are susceptible to performance and team dynamics challenges, including low cohesion and trust. In traditional teams, high levels of team cohesion, which is the sense of unity and shared purpose among team members, can facilitate cooperation and help teams achieve common goals (Brahm & Kunze, 2012). Virtual teams may face challenges in building trust and avoiding misunderstandings due to the lack of face-to-face interaction (Blackburn et al., 2003). To address these issues, virtual teams can use communication and collaboration technologies, like video conferencing and instant messaging, to enhance interpersonal interactions and facilitate regular and transparent communication. Effective communication and cooperation among virtual team members can promote trust and strengthen team cohesion. Strong trust among team members can help reduce the potential negative impacts of limited interaction and virtual communication on team cohesion (Kaur, 2017). A high trust climate can foster a sense of shared identity and purpose, leading to more effective communication and collaboration among team members and, ultimately, better organizational outcomes.

The result of Hypothesis 4 verification

The data analysis revealed that diversity did not negatively impact trust levels in virtual teams operating in the construction sector. This could be attributed to the fact that these teams may include members from various cultural backgrounds, leading to an environment that encourages trust through enhanced comprehension and respect of differing views and work styles. Additionally, it is possible that the virtual nature of the teams, with its increased focus on communication and collaboration, has helped to mitigate any potential negative effects of diversity on trust. Overall, virtual teams in the construction sector can effectively manage diversity to promote trust and positive outcomes for the organization.

However, the data collected from experts as part of this research showed that diversity can actually enhance a team's trust. Teams comprising individuals from different backgrounds and with various levels of expertise and experience can benefit from this diversity. Despite this, Peters & Karren (2009) noted that diversity within a team could sometimes result in distrust due to differences in attitudes, values, and performance among team members. Research data suggests that diversity can foster trust among team members. Teams with

members from different backgrounds or cultures can benefit from their varying perspectives, skills, and experiences. Although differences among team members can sometimes cause conflicts, these can be overcome by the team's collective ability to understand and respect each other's differences. On the other hand, people are more likely to trust others who share similar characteristics and values, which is why trust is more prevalent in homogeneous teams. Diversity among team members can provide an opportunity for mutual learning and trust-building through understanding and cooperation, as emphasized by Costa (2003).

The result of Hypothesis 5 verification

The findings of the study indicate that establishing and sustaining trust among members of virtual teams is closely linked to effective communication. The relationship between communication and trust-building is statistically significant and underscores the crucial role that efficient and regular communication practices play in virtual team settings. The findings of Sagar et al. (2021) support that improved communication leads to increased trust among virtual team members, further emphasizing communication's critical role in virtual team performance and success. As per the findings of Amah et al. (2013), offering training programs to employees is a useful method for managers to enhance team performance. These training sessions can aid in building the necessary skills required to work collaboratively within a team and create a sense of achievement and contentment among employees. Potential topics for the training program may involve coaching, communication, conflict resolution, negotiation, and problem-solving.

The result of hypothesis 6 verification

The analysis of Hypothesis 6 showed that certain team members' characteristics could positively impact trust development in a team. Virtual teams often consist of individuals with diverse qualities, including skill level, honesty, kindness, expertise, dependability, and professional conduct. According to Kramer and Lewicki (2010), trust in virtual teams may start out being based on basic factors. Still, as the relationship develops and team members better understand each other, they may form trust or distrust based on their individual characteristics. Additionally, Kramer & Lewicki (2010) suggest that trust in virtual teams

may depend on the competence of team members. Competence refers to a team member's ability to perform tasks effectively and efficiently. Furthermore, the results of Sagar et al. (2021) indicate that reliability, professionalism, and other related characteristics are also important components that can positively impact trust in virtual teams. These findings suggest that team members' characteristics are crucial in developing trust among virtual teams. Trustworthiness is not only based on individual skills but also on personal qualities.

The result of hypothesis 7 verification

The analysis revealed that Hypothesis 7 was supported, indicating that team cohesion positively affects the association between team member characteristics and trust. The findings suggest that trust is primarily influenced by the cognitive aspects of team member characteristics, such as their competency, professional ethics and constancy, rather than the affective components like care and emotional connection. These findings align with Kanawattanachai and Yoo's (2002) and Sagar et al. (2021) research. According to Nakayama et al. (2006), trust is associated with competency, loyalty, and openness. Besides having favourable qualities in team members, team cohesion also plays a significant role in trust building. When a team has a tight-knit bond and a strong sense of unity, the impact of team member characteristics on building trust is expected to be more potent.

The result of hypothesis 8 verification

The statistical analysis results showed that this hypothesis was supported, and the literature also supports this idea. The findings from the statistical analysis support the hypothesis, which is in line with previous research. Conflicts arise from perceived incompatibilities or disagreements among team members. Dafoulas and Macaulay (2002) and Kaur (2017) have noted that virtual teams require a higher level of trust to operate effectively and prevent delays and conflicts compared to traditional, co-located teams. Team members play a crucial role in a team by contributing through both social interactions and task-related activities. When there are incompatible interpersonal dynamics among team members, it can lead to relationship conflict, which includes tension, animosity, and annoyance. This can negatively impact team cohesion and trust in highly interdependent groups. (Jehn,

1995; Sagar et al., 2021). In teams where conflict is prevalent, there is a risk of reduced trust and cohesion among team members. If such conflicts are not managed appropriately, they can damage relationships and hinder learning, resulting in a lack of trust. The relationship between conflict and cohesion is inverse, indicating that as conflict increases, cohesion decreases. It is essential to effectively address and manage conflicts to sustain positive relationships and maintain team cohesion.

The result of moderating effect of experience

The study's findings support the notion that individuals with more experience working in virtual project teams are better equipped to handle diversity and communication challenges, reducing conflicts' negative impact. This aligns with previous research, which has demonstrated that experience and expertise can assist individuals in navigating the difficulties of virtual work and developing stronger relationships with their team members (Kong et al., 2016; Xiong et al., 2018). These results have significant implications for organizations seeking to establish and manage virtual project teams, as they indicate that prioritizing the recruitment of experienced individuals may be advantageous. Additionally, it appears that increasing experience in virtual teams can lead to increased maturity and improved cohesion among team members. It seems that gaining experience working in or leading virtual teams, culturally diverse ones, can improve cohesion and trust within a team. Developing effective communication practices and sharing experiences and goals can also help build strong team relationships. Azimi et al. (2011) suggest that certain measures can be taken to optimize the contributions of seasoned team members across multiple projects. Cultivating expertise and fostering strong bonds among team members can promote cohesiveness and triumph in virtual teams.

Implications of Model of Trust

The trust model created through Structural Equation Modeling (SEM) has significant implications. Firstly, it highlights the significance of effective communication in building trust within virtual project teams. To enhance communication and trust among virtual team members, it is recommended to use suitable communication tools and strategies, provide

training on conflict resolution and interpersonal skills, and improve problem-solving techniques. Weak communication within a team can lead to a lack of mutual comprehension and hinder overall team understanding.

Second, having diversity among team members can contribute to building trust within the team. This is likely due to the diverse team members bringing different skills and alternative solutions to the tasks. Furthermore, a well-defined and structured organizational culture that communicates objectives and expectations can enhance trust among team members. However, policy ambiguity, unfair evaluation methods, and unstructured reward systems can lead to a lack of trust among team members. Therefore, management needs to establish a structured approach to the company's organizational culture to foster trust among team members. Third, organizations should consider team members' previous experiences and expertise in virtual team settings. Individuals who have previous experience working in virtual teams may be better equipped to handle the challenges that come with virtual collaboration and have a positive influence on team performance. Additionally, a diverse team with varying backgrounds, viewpoints, and abilities can bring new and creative ideas to the project. Still, it is crucial to manage diversity effectively to reduce the potential for conflict. In the end, selecting the appropriate team members and ensuring their effective management and communication can play a crucial role in the success of virtual projects.

Fourth, teams consisting of individuals with diverse cultural and functional backgrounds may encounter disputes, particularly regarding their relationships. Such conflicts, stemming from personal ego issues, can diminish the trust shared among team members. Conversely, conflicts arising from the team's tasks can be advantageous, as they foster constructive discussions and encourage examining novel solutions to challenges. Nonetheless, the team must regulate the occurrence of these conflicts to prevent them from becoming excessive and interfering with the team's overall productivity. Fifth, assembling a well-rounded team with a diverse range of individuals is vital. This can facilitate more robust connections and trust between team members. When team members believe in each other's abilities and collaborate effectively, it can lead to enhanced knowledge sharing and prompt project completion. Furthermore, incorporating experienced team members can

decrease conflicts, improve information exchange, and refine team communication, fostering overall team cohesiveness and success.

Conclusion

This study aimed to explore interrelationships between trust and various factors that enhance VPTs in the construction industry. Virtual teams consist of individuals from diverse cultural backgrounds and countries working together on various projects. The research focuses on multidisciplinary VPTs and seeks to comprehend the factors that impact their effectiveness. By examining existing literature, it was discovered that the performance of virtual teams is heavily influenced by the level of trust established among team members. The study identified various factors that can impact the trust level within virtual project teams and introduced a model to evaluate the effect of these factors on trust. The final SEM supports the hypothesized positive interrelationships between trust and organizational culture, team diversity, degree of communication and team members' characteristics. Conflict within the team behaves in two different ways. First, the task conflict brings more discussions and different perspectives to the problem; hence, it helps build trust in team members' capabilities towards achieving the company's goal. Second, if the conflicts result in relationship controversy, it will affect the bonding of the team members as it leads to ego and hence affects trust building. Cohesion of the team helps in building trust among team members. The more bonding the team members are, the less conflicts will occur.

The trust model developed in this research, can provide useful guidance to construction management professionals who aim to cultivate trust among members of virtual teams. It underscores essential trust-related themes that senior management and project managers should consider when building and managing virtual project teams.

This study's investigation of the critical factors that influence the success or failure of virtual project teams in the construction sector adds to the current understanding of this topic. Previously, such information was not available specifically in the construction industry context. The findings of this study are expected to draw the interest of professionals and policymakers in this field. In particular, project managers can benefit

from these research insights, which offer guidance on improving team cooperation and performance in virtual teams, leading to increased individual learning.

References

Ailabouni, N., Painting, N., & Ashton, P. (2009). Factors affecting employee productivity in the UAE construction industry. *25th Annual ARCOM Conference*, (September), 555–564.

Amah, E., Nwuche, C. A., & Chukuigwe, N. (2013). Result Oriented Target Setting and Leading High Performance Teams. *Industrial Engineering Letters Www.iiste.org*, *3*(9), 47–60.

Amason, A. C. (1996). Distinguishing the effects of functional and dysfunctional conflict on strategic decision making: Resolving a paradox for top management teams. *Academy of management journal*, *39*(1), 123-148.

Anderson, A. H., McEwan, R., Bal, J., & Carletta, J. (2007). Virtual team meetings: An analysis of communication and context. *Computers in Human Behavior*, *23*(5), 2558-2580.

Arif, M., Mohammed, A.-Z. & Aman Deep, G. (2015). Understanding knowledge sharing in the jordanian construction industry. *Construction Innovation, 15*(3), 333-354.

Azimi Lolaty, H., Ashktorab, T., Bagheri Nesami, M., & Bagherzadeh Ladari, R. (2011). Experience of professional communication among nurses working in educational hospitals: A phenomenological study. *Journal of Mazandaran university of medical sciences*, *21*(85), 108-125.

Barkhi, R., Jacob, V. S., & Pirkul, H. (2004). The influence of communication mode and incentive structure on GDSS process and outcomes. *Decision Support Systems*, *37*(2), 287-305.

Bell, B., & Kozlowski, S. (2002). A typology of virtual teams implications for effective leadership. *Group & Organization Management*, *27*(1), 14–49.

Bhat, S. K., Pande, N., & Ahuja, V. (2017). Virtual team effectiveness: An empirical study using SEM. *Procedia Computer Science*, *122*, 33-41.

Bhatia, M. S., & Awasthi, A. (2018). Assessing relationship between quality management systems and business performance and its mediators: SEM approach. International *Journal of Quality & Reliability Management, 35*(8), 1490-1507

Brahm, T., & Kunze, F. (2012). The role of trust climate in virtual teams. *Journal of Managerial Psychology*, *27*(6), 595–614.

Bryant, S. M., Albring, S. M., & Murthy, U. (2009). The effects of reward structure, media richness and gender on virtual teams. *International Journal of Accounting Information Systems*, *10*(4), 190-213.

Carmines, E.G. & McIver, J.P. (1981). Analyzing models with unobserved variables. Carmines, E.G. & McIver, J.P. (1981). Analyzing models with unobserved variables. in Bohrnstedt, G.W. & Borgatta, E.F. [Eds.] Social measurement: Current issues. Beverly Hills: Sage.

Chatfield, A. T., Shlemoon, V. N., Redublado, W., & Darbyshire, G. (2014). Creating Value through Virtual Teams: A Current Literature Review. *Australasian Journal of Information Systems*, *18*(3). https://doi.org/10.3127/ajis.v18i3.1104

Chen, C. & Messner, J. (2010). A recommended practices system for a global virtual engineering team. *Architectural Engineering and Design Management*, 6, 207-221.

Costa, A. (2003). Work team trust and effectiveness. Personnel Review, 32: 605-622. doi:10.1108/00483480310488360

Crampton, C. D. (2001). The mutual knowledge problem and its consequences for dispersed collaboration. *Organization science*, *12*(3), 346-371.

Curşeu, P. L., & Schruijer, S. G. (2010). Does conflict shatter trust or does trust obliterate conflict? Revisiting the relationships between team diversity, conflict, and trust. *Group Dynamics: Theory, Research, and Practice*, *14*(1), 66.

Dafoulas, G., & Macaulay, L. (2002). Investigating cultural differences in virtual software teams. *The Electronic Journal of Information Systems in Developing Countries*, *7*(1), 1-14.

de Campos, E. A. R., Resende, L. M., & Pontes, J. (2019). Barriers, external aspects and trust factors in horizontal networks of companies: a theoretical propos l for the

construction of a model for evaluation of trust. *Journal of Intelligent Manufacturing*, *30*(4), 1547-1562.

Doney, P.M., Cannon, J.P., et al. (1998). Understanding the Influence of National Culture on the Development of Trust. Academy of Management Review 23(3); 601-620.

Fornell, C., & Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement errors. *Journal of Marketing Research,* 18, 39–50.

Furst, S., Blackburn, R., & Rosen, B. (1999). Virtual team effectiveness : a proposed research agenda. *Information Systems Research*, *9*, 249–270.

Gibson, C. B., & Gibbs, J. L. (2006). Unpacking the Concept of Virtuality: The Effects of Geographic Dispersion, Electronic Dependence, Dynamic Structure, and National Diversity on Team Innovation. *Administrative Science Quarterly*, *51*(3), 451–495.

Hacker, J. V., Johnson, M., Saunders, C., & Thayer, A. L. (2019). Trust in virtual teams: A multidisciplinary review and integration. *Australasian Journal of Information Systems*, *23*, 1-36

Henderson, LS. (2008).The impact of project managers' communication competencies: Validation and extension of a research model for virtuality, satisfaction, and productivity on project teams, *Project Management Journal,* 39(2), 48-59.

Henttonen, K., Blomqvist, K., (2005). Managing distance in a global virtual team: the evolution of trust through technology-mediated relational communication. *Strategic Change 14*, 107–119.

Hinds, P. J., & Bailey, D. E. (2003). Out of sight, out of sync: Understanding conflict in distributed teams. *Organization science*, *14*(6), 615-632.

Ho, S., & Richardson, A. (2013). Trust and distrust in open source software development. *Journal of Computer Information Systems,* 84–93.

Hoch, J. E., & Dulebohn, J. H. (2017). Team personality composition, emergent leadership and shared leadership in virtual teams: A theoretical framework. *Human Resource Management Review*, *27*(4), 678–693.

Hosseini, M. R & Chileshe, N. (2013). Global Virtual Engineering Teams (GVETs): A fertile ground for research in Australian construction projects context. *International Journal of Project Management, 31*(8), 1101-1117.

Hu, L.-T., & Bentler, P. (1995). Evaluating model fit. In R. H. Hoyle (Ed.), *Structural Equation Modeling. Concepts, Issues, and Applications* (pp. 76-99). London: Sage.

Hwang, M. I. (2018). Relationship between teamwork and team performance: Experiences from an ERPsim competition. *Journal of Information Systems Education*, *29*(3), 157-168.

Jarvenpaa, S. L., Knoll, K., & Leidner, D. E. (1998). Is Anybody Out There? Antecedents of Trust in Global Virtual Teams. *Journal of Management Information Systems*, *14*(4), 29–64.

Jarvenpaa, S. L., Shaw, T. R., & Staples, D. S. (2004). Toward contextualized theories of trust: The role of trust in global virtual teams. *Information systems research*, *15*(3), 250-67.

Jehn, K. A. (1995). A multimethod examination of the benefits and detriments of intragroup conflict. *Administrative science quarterly*, 256-282.

Jimenez, A., Boehe, D. M., Taras, V., & Caprar, D. V. (2017). Working Across Boundaries: Current and Future Perspectives on Global Virtual Teams. *Journal of International Management*, *23*(4), 341–349.

Kadefors, A. (2004). Trust in project relationships—inside the black box. *International Journal of Project Management, 22*(3), 175–182.

Kanawattanachai, P., & Yoo, Y. (2002). Dynamic nature of trust in virtual teams. The Journal of Strategic Information Systems, 2(10), 42–58.

Kasper-Fuehrera, E. C., & Ashkanasy, N. M. (2001). Communicating trustworthiness and building trust in interorganizational virtual organizations. *Journal of management*, *27*(3), 235-254.

Kaur, S. (2017). Model for assessment of trust within VPTs of construction sector in the Middle East (Doctoral dissertation, University of Salford).

Kaur, S., Arif, M. & Akre, V. (2015). *Factors affecting Trust in Virtual Project Teams in Construction Sector in Middle East.* in 12th Post-Graduate Research Conference 2015, Media City U.K., 10-12 June 2015, pp 262- 276.

Khan, M.S., (2012). Role of trust and relationships in geographically distributed teams: exploratory study on development sector. *International Journal of Networking and Virtual Organisations, 10,* 40–58.

Kimble, C. (2011). Building effective virtual teams: How to overcome the problems of trust and identity in virtual teams. *Global Business and Organizational Excellence*, *30*(2), 6–15.

Kock, N. (2014). Advanced mediating effects tests, multi-group analyses, and measurement model assessments in PLS-based SEM. *International Journal of e-Collaboration*, 10(3),1-13.

Kramer, R. M., & Lewicki, R. J. (2010). Repairing and enhancing trust: Approaches to reducing organizational trust deficits. *Academy of Management annals*, *4*(1), 245-277.

Lau, E., & Rowlinson, S. (2009). Interpersonal trust and inter firm trust in construction projects. *Construction Management and Economics*, *27*(6), 539–554.

Lee, H., Ahn, H., Kim, H., & Lee, J. (2014). Comparative Analysis of Trust in Online Communities. *Procedia Computer Science*, *31*(ITQM 2014), 1140–1149. doi:10.1016/j.procs.2014.05.370

Lipnack, J., & Stamps, J. (1997). Virtual Teams: Reaching Across Space, Time, and Organizations with Technology, John Wiley & Sons, Inc., New York, 1997

Lukić, J. M., & Vračar, M. M. (2018). Building and nurturing trust among members in VPTs. *Strategic Management-International Journal of Strategic Management and Decision Support Systems in Strategic Management*, *23*(3), 010-016.

Lurey, J., & Raisinghani, M. (2001). An empirical study of best practices in virtual teams. *Information & Management*, *38*, 523–544.

MacCallum, R. C. & Austin, J. T. (2000). Applications of structural equation modeling in psychological research. Annual Review of Psychology, 51, 201-226.

MacCallum, R.C., Browne, M.W., and Sugawara, H., M. (1996), "Power Analysis and Determination of Sample Size for Covariance Structure Modeling," *Psychological Methods*, 1 (2), 130-49

Malhotra, A., Majchrzak, A., Rosen, B. (2007). Leading Virtual Team. *Academy of Management Perspectives, 2,* 60 -69.

Martins, L. L., Gilson, L. L., & Maynard, M. T. (2004). Virtual Teams: What Do We Know and Where Do We Go From Here? *Journal of Management*, *30*(6), 805–835.

McDermott, P., Khalfan, M., & Swan, W. (2005). Trust in construction projects. *Journal of Financial Management of Property and Construction*, *10*(1), 19–32.

Mcdonough, E.F., K.B. Kahn and G. Barczak, 2001. An investigation of the use of global, virtual, and collocated new product development teams. The Journal of Product Innovation Management, 18: 110-120.

Morrison-Smith, S., & Ruiz, J. (2020). Challenges and barriers in virtual teams: a literature review. *SN Applied Sciences*, *2*(6), 1-33.

Mukherjee, D., Renn, R. W., Kedia, B. L., & Mukherjee, D. (2012). Development of interorganizational trust in virtual organizations: An integrative framework. *European Business Review*. *24*(3), 255–271.

Nakayama, M. K., Binotto, E., & Pilla, B. S. (2006, August). Trust in virtual teams: A performance indicator. In *IFIP World Computer Congress, TC 3* (pp. 105-113). Springer, Boston, MA.

Nathaniel, A., & Anthony, C. I. (2012). Barriers to the Uptake of Concurrent Engineering in the Nigerian Construction Industry. *International Journal of Engineering Business Management*, *4*, 1–8.

Nemiro J, Beyerlein M, Beyerlein S, and Bradley L (2008). The Handbook of High-Performance Virtual Teams. San Francisco: Jossey-Bass.

Nunnally, J. C. (1978). Psychometric theory (2nd ed.). New York, NY: McGraw-Hill.

Pangil, F., & Chan, J. M. (2014). The mediating effect of knowledge sharing on the relationship between trust and virtual team effectiveness. *Journal of Knowledge Management, 18*(1), 92–106

Peters, L., & Karren, R. (2009). An examination of the roles of trust and functional diversity on virtual team performance ratings. *Group & Organization Management*, *34*(4), 479–504. doi:10.1177/1059601107312170

Philbrick, J. H., Smith, F. R., & Bart, B. (2010). Using web surveys to determine audience characteristics and product preferences. *American Journal of Business Education (AJBE)*, *3*(4), 1-6.

Pinto, J.K., Slevin, D.P. & English, B. (2009). Trust in projects: an empirical assessment of owner/contractor relationships, *International Journal of Project Management, 27*(6), 638-648.

Ramalingam, S, Lobo, S, Mahalingam, A & Whyte, J. (2014), Achieving reliability in transnational work on complex projects: new directions for research, *Engineering Project Organization Journal, 4* (4), 193-208.

Reina, D. Reina, M. (1999). Trust and Betrayal in the Workplace. San Francisco: Berre-Koehler Publishers Inc.

Sagar, S. K., Arif, M., Oladinrin, O. T., & Rana, M. Q. (2021). Exploring factors affecting trust in construction virtual project teams. *Journal of Architectural Engineering Technology*. Journal of Architectural Engineering Technology.

Sagar, S. K., Oladinrin, O. T., Arif, M., & Rana, M. Q. (2022). Interpretive structural model of trust factors in construction virtual project teams. *Construction Innovation*. https://wlv.openrepository.com/bitstream/handle/2436/624519/Sagar_et_al_Interpretive_structural_2022.pdf?sequence=2&isAllowed=y

Staples, D. S., & Webster, J. (2008). Exploring the effects of trust, task interdependence and virtualness on knowledge sharing in teams. *Information systems journal, 18*(6), 617-640.

Tsui, A. S., Egan, T. D., & O'Reilly III, C. A. (1992). Being different: Relational demography and organizational attachment. *Administrative science quarterly*, 549-579.

Wakefield, R. L., Leidner, D. E., & Garrison, G. (2008). Research note—a model of conflict, leadership, and performance in virtual teams. *Information systems research*, *19*(4), 434-455.

Yun, G. W., & Trumbo, C. W. (2000). Comparative response to a survey executed by post, e-mail, & web form. *Journal of computer-mediated communication*, *6*(1), JCMC613.

Zakaria, N., & Yusof, S. A. M. (2020). Crossing cultural boundaries using the internet: Toward building a model of swift trust formation in global virtual teams. *Journal of International Management*, *26*(1), 100654.

Zolin, R., Hinds, P. J., Fruchter, R., & Levitt, R. E. (2004). Interpersonal trust in cross-functional, geographically distributed work: A longitudinal study. *Information and organisation*, *14*(1), 1-26.

Modifications to revised manuscript

Manuscript ID: CI-03-2023-0039

Title: Impact of Trust in Virtual Project Teams: Structural Equation Modeling (SEM) approach

Construction Innovation: Information, Process, Management

	Reviewer 1 Comments:	Authors' Changes and Responses
1.	Originality: Does the paper contain new and/or significant information adequate to justify publication?: Yes, it does. Role of trust in virtual project teams is a timely and critical topic. Overall good paper that can be accepted for publication with few revisions.	The authors appreciate the reviewer for this comment. The few revisions are duly addressed in the revised version.
2.	Relationship to Seminal Literature: Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?: It seems to me that most relevant literature is covered.	Thank you for this comment as well.
3.	Research Methodology: Is the paper's argument built on an appropriate base of theory, concepts, or other ideas? Has the research or equivalent intellectual work on which the paper is based been well designed? Are the methods employed, robust, defendable and appropriate?: The authors list questionnaire survey under methodology but in my opinion, the section on "Research Model and proposed hypotheses" should also fall under it. Overall, the key factors and related hypotheses are well laid out. But, authors should provide a paragraph explaining how they identified/developed these factors.	Thank you for this comment. We have research Model and proposed hypotheses under research methodology as suggested. *Thank you for your observation. We have now revised this section as follows:* *This section describes the review of literature which was extensively done to identify the factors that were included in the research framework. Research articles from reputed peer-reviewed journals were identified after broad search on basis of appropriate keywords. Some existing relevant models helped the researchers to understand the role of trust in the performance of virtual project teams. Subsequently, those models helped in providing the different indicators affecting trust in virtual project teams. The indicators have been cited in various research articles and many researchers have commented on their importance with respect to building trust in a virtual project team as discussed in the following subsections.*

	The questionnaire covers factors and measurement variables adequately. I would suggest that the authors provide more details about the "Trust: Theoretical model." Please provide how you arrived at this model and also provide legend for various signs used.	Thank you for this comment. We appreciate the reviewer. This section has been revised accordingly.
4.	Results: Are results presented clearly and analysed appropriately? Do the conclusions adequately tie together all elements of the paper?: Results and discussion of findings are well laid out. I would like authors to rework the last section - "Conclusion." This section is more like a summary. I believe that some good conclusions/inferences can be drawn from the work done.	We also appreciate the reviewer for this comment. The conclusion section has been duly revised.
5.	Implications for research, practice and/or society: Does the paper identify clearly any implications for research, practice and/or society? Does the paper bridge the gap between theory and practice? How can the research be used in practice (economic and commercial impact), in teaching, to influence public policy, in research (contributing to the body of knowledge)? What is the impact upon society (influencing public attitudes, affecting quality of life)? Are these implications consistent with the findings and conclusions of the paper?: Generally identifies adequate implications for the practice of VPT, not sure about the focus on construction?	Thank you for this comment. We have removed construction from the title to avoid confusion. However, the study addressed trust in VPT in the construction industry as construction professionals were contacted for data collection.
6.	Quality of Communication: Does the paper clearly express its case, measured against the technical language of the field and the expected knowledge of the journal's readership? Has attention been paid to the clarity of expression and readability, such as sentence structure, jargon use, acronyms, etc. Do the figures/tables aid the clarity of the paper?: There are few things I would suggest author to make this paper better and of publishable quality: 1. The title says Construction VPT but the paper really does not make the case for the construction industry or attributes related to construction. Either change the title or add construction related focus.	Thank you for this comment. We have removed construction from the title to avoid confusion. However, the study addressed trust in VPT in the construction industry as construction professionals were contacted for data collection.

	2. Couple places it says that the focus is on United Arab Emirates (UAE), but it seems like an afterthought or forced upon. The work in the paper in the context of UAE is not supported. 3. The paper needs good editing, especially in the beginning and the end.	This has been revised as well. Thank you for this comment. We have subjected the paper to thorough editing. The revised version now reads better.

Impact of Trust in ~~Construction~~ Virtual Project Teams: Structural Equation Modeling ~~(SEM)~~ approach

Abstract

This study focuses on model development to analyse key factors affecting trust in Virtual Project Teams (VPTs). A questionnaire survey was conducted on construction professionals participating in virtual teams. Structural Equation Modelling (SEM) technique was performed to establish the effect of relevant factors on trust-building in VPTs. Team performance is highly affected by ~~the~~ trust among the team members. Trust building can be enhanced by improving the quality of team communication, organisation culture, team bonding, and team members' characteristics. The model developed in this study would benefit team productivity and team members' learning in VPTs.

Introduction

Organisations are expanding their dependence on virtual project teams (VPTs) to produce commercial value (Sagar et al., 2022), as well as gather diverse knowledge banks, time and financial savings, and identify economical solutions for collaboration (Gibson & Gibbs, 2006). VPTs have gained significant traction and usage by many~~number of~~ major corporations, from a 60% estimate in 2003 (Gibson & Gibbs, 2006; Martins et al., 2004), to 85% in 2016 (Hacker et al., 2019). A major study spanning 100 countries surveyed 3000 managers; it outlines that 40% of the workers were using VPTs for 50% of their work time (Hoch & Dulebohn, 2017). VPTs have been researched consistently and often in information systems, Human Resource Management (HRM), and other disciplines (including the construction domain) for two decades due to significant and growing dependence on information technology (Hacker et al., 2019). However, increased dependence on VPTs has its ~~own~~ management issues (Jimenez et al., 2017; Lukić & Vračar, 2018). These issues have not been sufficiently ~~dealt with~~addressed in the current VPTs research and remain unresolved (Hacker et al., 2019). Research also indicates that challenges in trust building ~~have direct effect on~~directly affect virtual team failure (Kimble,

2011). It has also outlined that trust is a complex experience for internal and external team members due to various interconnected and dependent participants in VPTs.

~~Building~~ The building sector has reported low levels of productivity and performance due to trust between the client, design team and construction team (Nathaniel & Anthony, 2012). Trust significantly impacts the team's confidence in knowledge sharing within traditional settings and among VPTs (Arif et al., 2015; Sagar et al., 2021). Although a growing body of research addresses virtual teams and the function of trust (Bhat et al., 2017; Sagar et al., 2022), literature on the different variables impacting trust as a single entity in the construction industry is limited. Only a few publications in the past dealt with this issue and were limited to the education, information technology, or manufacturing sector in the United States or Europe. There is a great uptake of VPTs in the construction sector. However, significant challenges need to be explored and addressed due to the infancy of VPTs application in the construction industry. The Middle East attracts professionals from across the globe, making it a multicultural region with professionals from varied countries and backgrounds. The issue of trust in the context of VPTs is a major issue in the Middle East (Zakaria & Yusof, 2020). Therefore, it is crucial to understand trust in virtual project teams (VPTs) from professionals who work across different cultures~~,~~ ~~focusing on the United Arab Emirates (UAE)~~. The current ~~body of~~ literature and knowledge on trust in virtual teams within the construction sector is limited (Kaur, 2017; Lau & Rowlinson, 2009). As a result, this study aimed to pinpoint the crucial elements contributing to trust in virtual project teams (VPTs) and examine the impact of different factors on trust within virtual teams. The researchers created an analytical trust model to offer practical guidance for managing VPTs in the construction industry.

Literature review

Trust in VPTs – Construction industry

The construction industry in the United Arab Emirates is worth billions of dollars and accounts for approximately 8% of the country's GDP (Ailabouni, Painting, & Ashton, 2009). The delivery of construction projects increasingly relies on virtual teams (Henderson, 2008; Ramalingam et al., 2014; Kaur, 2017; Sagar et al., 2021). It is a

combined result of globalisation and multinational teams of consultants working on different construction projects. Research outlines that successful implementation of VPTs requires a comprehensive awareness and outlining of diverse, interlinked and complex challenges that are not otherwise experienced in traditional project teams setup (Hosseini & Chileshe, 2013). While there are multiple challenges in VPTs, trust is the most critical factor influencing the team's performance and productivity (Brahm & Kunze, 2012).

There are multiple inter-linked procedures, activities and stages in a construction project. It includes procurement processes, detailed design and engineering, project estimation, preliminary engineering, construction, and commission (Sagar et al., 2022). Construction projects are designed, developed and constructed using coordinated information at all project stages. Information management, including sharing and amending designs ~~are~~ per requirements, is highly dependent on trust among the team members. Trust develops a willingness to collaborate, which leads to an obligation to share knowledge (Staples & Webster, 2008; Sagar et al., 2021). This obligation would result in the effectiveness of a virtual team (Pangil & Chan, 2014).

The effectiveness of a virtual project team (VPT) is highly dependent on the competence of its members in delivering work as promised, which is a crucial factor for success and efficiency. The ability of team members to deliver work is also influenced by their level of commitment to the team, which is, in turn, influenced by the level of trust within the team. Trust is also essential for timely and quality information exchange among team members (Jarvenpaa et al., 1998). Therefore, it has become imperative to explore trust within the context of the construction industry and business literature. The successful delivery of construction projects using VPTs depends on the trust, identity and cohesiveness of the team, and they need to be sternly appraised for the effectiveness of VPTs (Sagar et al., 2022; Kaur, 2017).

Trust is a major challenge faced by virtual teams (Morrison-Smith & Ruiz, 2020). A large amount of literature emphasizes the significance of trust in virtual team performance (Henttonen & Blomqvist, 2005; Khan, 2012; Malhotra et al., 2007). It is pivotal to team productivity and performance (Kanawattanachai & Yoo, 2002). ~~Turst~~ Trust building to develop and successful and efficient team is also one of the most complex and challenging

in multiple dimensions (Kaur, 2017, Sagar et al., 2022). Virtual communication and international partnerships in a project set-up require trust to be earned by a collaborative approach for teams to perform efficiently (Lurey & Raisingham, 2001). Research indicates that trust and positive relationships between team members result in higher creativity, critical thinking and a productive environment (Reina & Reina, 1999). It also helps to produce higher-quality work (Nemiro et al., 2008).

Kaur (2017) identified five challenges that must be addressed for the effective management of VPTs: (1) Trust (2) Team cohesiveness (3) Communication (4) Team diversity and (5) Leadership. However, trust is crucial for Virtual Project Team managers to deal with challenges since it is core to the VPT function and operation (Lukić & Vračar, 2018). Trust is an essential element that influences VPT's productivity and performance. Different social and physical factors such as face-to-face conversation, cultural diversity, and long-distance between project team members deter trust building. Studies have highlighted that trust is a foundation of positive relationships between construction teams and other stakeholders (Kaur, 2017; Hacker et al., 2019). ~~A considerable amount of~~Much literature outlines the importance of trust in relationships between clients, general contractors, subcontractors and suppliers in the construction sector. However, a lack of literature focuses on trust in VPTs (Pinto et al., 2009; Hosseini & Chileshe, 2013). Trust plays a significant role in the performance of virtual team members, as shown in studies by Khan (2012) and Lukić and Vračar (2018), and is crucial for the productivity and efficiency of a team's processes (Lukić & Vračar, 2018). The success of virtual project teams in the construction industry depends heavily on building trust, team identity, and cohesiveness, as emphasized by Chen and Messner (2010) and Kaur et al. (2015). Trust serves as the foundation of cross-disciplinary teams' work set-ups (Zolin et al., 2004). The ~~absence of trust in team members is considered the main resistance for~~lack of trust in team members is the main resistance to effective teamwork (Kaur et al., 2015). An extensive analysis of the literature suggests that most of the research on trust focuses on industry, and there is a lack of literature on the construction sector. There isn't convincing literature on VPTs in the construction sector (Kadefors, 2004; Lau & Rowlinson, 2009; Pinto et al., 2009). However, there is compelling work in other sectors, such as I.T sector (Ho & Richardson,

2013) and online societies (Lee et al., 2014). The study aims to focus on this situation and lack of literature in the construction sector.

Methodology

Research Model and proposed hypotheses

This section describes the literature review, which was extensively done to identify the factors included in the research framework. Research articles from reputed peer-reviewed journals were identified after a broad search based on appropriate keywords. Some existing relevant models helped the researchers to understand the role of trust in the performance of virtual project teams. Subsequently, those models helped provide the different indicators affecting trust in virtual project teams. The indicators have been cited in various research articles, and many researchers have commented on their importance in building trust in a virtual project team, as discussed in the following subsections.

Organizational Culture and Trust in virtual project teams

Project team members' understanding of project objectives and processes is crucial for achieving the organisations' goals (Sagar et al., 2022). Doney et al. (1998) outlined that lack of clarity among team members on project objectives and degree of trust building within an organisation poses a high risk to the team and its members. Thus, trust among team members and a clear understanding of team goals in crucial for successful team planning and delivery (Brahm & Kunze, 2012). Furst et al. (1999) suggested that establishing clear and transparent goals in a project can reduce uncertainty in team performance. They also emphasized that the team selection process and outcome are important factors in a team's success. Amah, Nwuche, & Chukuigwe (2013) pointed out that professionals are members of an organization before becoming team members. Hence, selection criteria govern the character and description of team members. Bell & Kozlowski (2002) suggested that the suitability of people towards a project should manage the organisations and selection of a VPT. Lack of suitability of team members could result in distrust in a team member and their capability. Barkhi et al. (2004) investigated the effect of rewarding team members based on their contribution to team's decision outcomes. They

concluded that rewards scheme positively impacted the team members' trust towards the organization.

Bryant et al. (2009) also recommended that reward and inventive schemes at team and manager levels have a direct and compelling positive effect on the outcome and attitudes of team members in VPTs. Evaluation of a team includes analysing the transparency of outcomes, transparency and honesty in the availability of information and decision-making procedures, and clarity and fairness in team members' treatment at the interpersonal level (Bryant et al., 2009). An honest and impartial team analysis strongly affects team members' confidence in team evaluation~~;~~ , thus increasing their trust in team operation, governance and evaluation. Cohesion acts as a connection agent among team members, and the close operation and communication among the team members highly influence the probability of team success. It also contributes in team building a team. Also, any conflict between team members on task execution and distribution, and ~~prcoess~~ process contributes to range of equivalent solutions. It contributes to the efficient achievement of project and organisational goals. Based on this analysis, following hypothesis are proposed:

H1: A positive relationship exists between organisational culture and trust in virtual project teams.

H2: Conflict mediates the positive effect of organisational culture on trust.

H3: Cohesion increases the positive effect of organisational culture on trust.

Team diversity and trust among virtual project team members.

A team's diversity encompasses diversity in functions, culture, and different problem-solving approaches. Peters and Karren (2009) argued that diversity among team members in virtual projects ~~can result in differences in attitudes, values, and performance, which may lead~~ould result in differences in attitudes, values, and performance, leading to conflicts. Virtual teams with members from diverse backgrounds and cultures are more likely to experience these conflicts than homogenous teams (Jehn, 1995).

Shachaf (2008) argued that cultural diversity within virtual teams could present additional challenges for leaders and members, including language barriers that can lead to communication difficulties and conflicts. Additionally, Curşeu & Schruijer (2010)

presented that, according to the similarity-attraction hypothesis, diversity within a team may lead to an increase in conflict, but can have a negative impact on the development of trust.

Diversity within a team may lead to increased conflict and decreased trust. Research has also shown that team members may view those who share their culture as more trustworthy and feel a stronger sense of belonging with them compared to those who do not share their culture (Zolin *et al.*, 2004). Tsui et al. (1992) discovered that psychological attachment among group members is negatively related to diversity within a work unit. Based on these findings, it can be inferred that diversity within a team may obstruct the interactions required for team members to ~~invest in the team and each other fully~~fully invest in the team and each other. As a result, the researchers propose the following hypotheses:

H4: A negative relationship exists between the diversity of team members and trust in virtual project teams.

Communication and trust among virtual project team members

Effective communication is crucial in building trust among team members, especially in virtual project teams where members may be geographically dispersed and have different time zones and holidays (Sagar et al., 2021). The communication process may involve ~~the use of~~ various tools and techniques, and training may be required to ensure that team members can communicate and collaborate effectively. According to Amah et al. (2013), it is recommended that managers provide training opportunities to their employees to acquire the necessary skills and experiences to become effective team players. Effective communication, particularly during the early stages of team development, is critical for establishing and sustaining trust, as Anderson et al. (2007) emphasised.

The global character of virtual teams can make communication a persistent challenge, resulting in diminished mutual understanding within the team (McDonough, Kahn & Barczak, 2001). This can be exacerbated when team members do not have a shared language and when only some are co-located while others are geographically dispersed (Crampton, 2001). The researchers are proposing the following hypotheses as a result:

H5: A positive relationship exists between communication between team members and trust in virtual project teams.

Team member's characteristics and trust in virtual project teams

Kramer and Lewicki (2010) suggest that initial trust in a relationship may be established based on fundamental factors, but as the relationship develops and team members become more acquainted with each other, trust may depend on the personal attributes of team members. As people gain a deeper understanding of their colleagues, they may form trust or distrust based on their perceived traits. The trust of team members can be influenced by several characteristics, such as their cognitive elements, ability, integrity, and benevolence. These attributes were described by Jarvenpaa et al. (1998) as dyadic trust attributes, which include the trustee's perceived benevolence, integrity, and ability. Benevolence refers to one party's willingness to benefit another, while ability represents the trustor's belief in the trustee's skills to fulfil their obligations as expected.

Sagar et al. (2021) argue that capability, honesty, and good intentions are the essential components of trust in virtual teams, which are crucial for different phases of virtual team formation and operation. Similarly, Jarvenpaa et al. (1998) emphasize the importance of team members' abilities, honesty, and good intentions for trust. According to Mukherjee et al. (2012), trustors in virtual teams evaluate the trustee's ability to make positive contributions to the team. In a dynamic and uncertain environment where the ability to respond quickly and adapt is crucial for seizing market opportunities, the trustor ~~needs to~~must have faith in the trustee's positive intentions towards the relationship, even without a formal agreement or prior commitment.

According to Kasper-Fuehrer and Ashkanasy (2001), the absence of formal contracts in virtual teams highlights the significance of benevolence in establishing "organizational trustworthiness." Business ethics and integrity are also crucial in virtual settings to convey trustworthiness. Trust among virtual project team members may be formed cognitively after evaluating their teammates' ability, benevolence, and integrity (Mukherjee et al., 2012). As a result of the strong bond between team members, their traits and characteristics may have a greater impact on the development of trust. The trust level among team members may be higher when they are more competent and have high levels of benevolence and integrity. Based on this, the researchers suggest the following hypotheses:

H6: A positive relationship exists between team member characteristics and trust in virtual project teams.

H7: Cohesion increases the positive effect of team member characteristics on trust.

Conflict on Cohesion relevance on the team in virtual projects

According to Dafoulas and Macaulay (2002) and Kaur (2017), virtual teams may require ~~a greater degree of~~greater trust to succeed and avoid conflicts compared to traditional, co-located teams. Conflicts within a team can negatively affect both the relationships within the team and task performance (Sagar et al., 2021). Jehn (1995) suggests that differences in personal preferences, values, ideology, and political views among team members can result in relationship conflicts and generate tension, animosity, and annoyance. This, in turn, can decrease the overall cohesion of the team. Conflict based on emotional or interpersonal problems can greatly hinder a team's performance. In teams where the members are highly dependent on each other, this type of conflict is likely to ~~hinder the formation of trust significantly~~significantly hinder the formation of trust. Amason (1996) suggested that relationship conflict can negatively impact decision-making, team unity, commitment, and decision acceptance. Additionally, it can lead to division, diminished trust, and weakened team relationships. Based on this, the researchers put forward a hypothesis:

H8: The more conflict among virtual team members, the less cohesion among them.

Impact of experience on diversity and communication in virtual projects

Experience is used as a moderating factor. This refers to the time an individual has spent working in virtual project teams and the number of virtual projects they have completed. This is significant because the more time a team spends together, the greater opportunity its members have to interact and form positive relationships, which can positively impact the team's performance (Kaur, 2017). Experience with virtual teams can play a role in reducing conflicts, particularly when team members have diverse backgrounds. This could be because more experienced team members can foster better team cohesion due to their maturity. Furthermore, senior members of the team, who typically possess extensive

experience in their field and are responsible for teamwork, are more likely to provide dependable, objective, and trustworthy information (Hwang, 2012).

Trust: Theoretical model

Based on the reviewed literature and proposed hypotheses, it is suggested that positive team traits, communication, diversity, and a favorable organizational culture can enhance trust within virtual project teams in the construction industry. The role of two mediators, conflict and cohesion, and how they affect trust are also considered. The theoretical research model of trust, shown in Figure 1, includes variables that represent the main factors directly influencing trust, with the addition of a moderating variable that ~~will~~ was be introduced in the analysis. The main task is to test whether the variables influence trust as hypothesized (H1 – H8). Given the inherently complex nature of virtual project teams in the construction sector, the researchers proposed that trust in virtual project teams, as a dependent variable, will increase with the development of positive organizational culture (H1) +ve, team member characteristics (H6) +ve, and degree of communication (H5) +ve. It has been observed that trust is negatively affected by the diversity of team members (H4) -ve. There are two mediators – conflict in the team and cohesion of the team, which should positively influence trust building if properly managed. A careful review of the model led the researcher to identify one prime moderator experience (age) in virtual project teams.

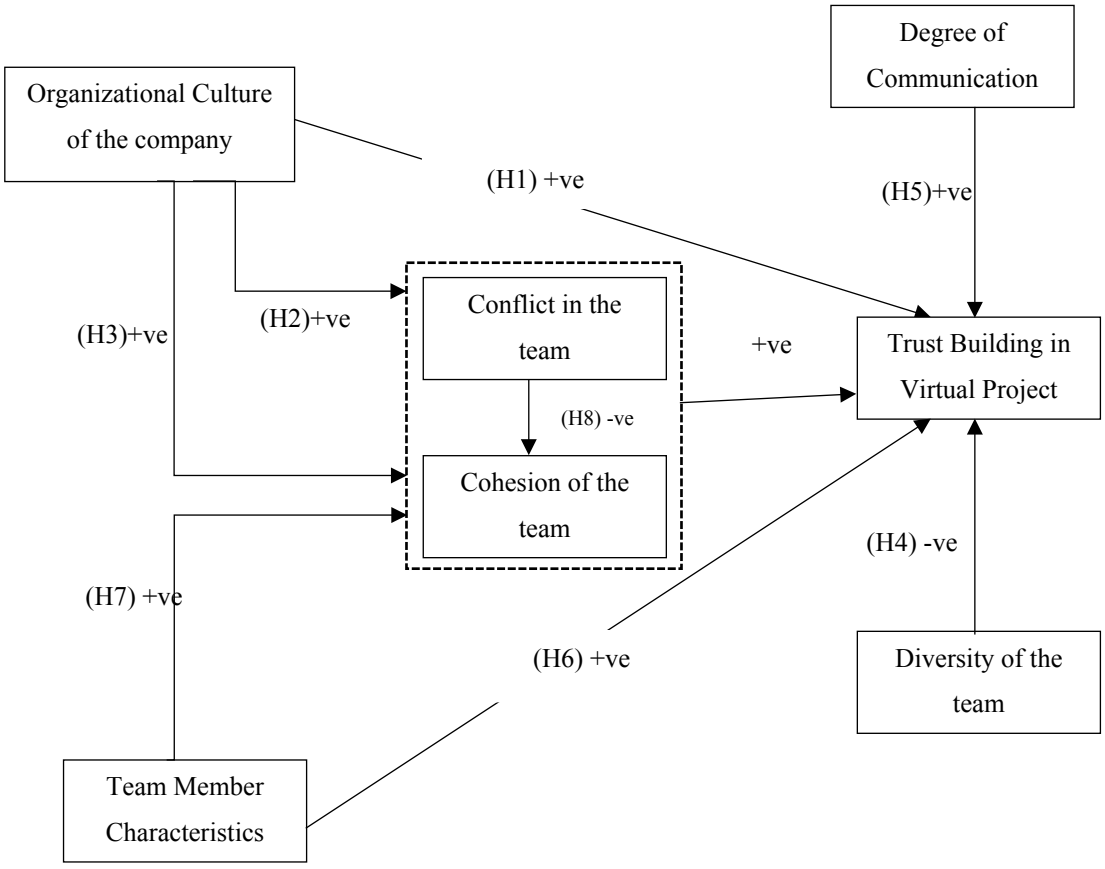

Figure 1: Trust building model in VPTs

(Note: H represent 'hypothesis', +ve – positive relationship, -ve – positive relationship)

~~Methodology~~

Questionnaire Survey

In this study, a survey questionnaire was developed based on a theoretical model ~~that incorporated~~incorporating factors identified in previous literature by Kaur (2017). The questionnaire was then pre-tested with seven construction professionals to ensure content validity, following the guidelines by Bhatia and Awasthi (2018), and was subsequently modified based on their feedback. The survey questionnaire, which comprised 25 items across seven constructs, was finalized and is detailed in Table 1. The survey was aimed at

professionals who work as either team members or project managers in different construction companies. The email addresses for virtual project team communities were sourced from online directories of construction companies, and the participants were provided with a link to an online questionnaire. The survey was conducted online.

The study recruited virtual project professionals~~, such as project managers or team members, from various construction companies through online directorie~~ from various construction companies through online directories, such as project managers or team members. These participants were then sent a link to an online survey, which mostly contained closed-ended questions that required them to choose from predetermined options. The responses were measured using a 5-point Likert scale that ranged from "strongly disagree" to "strongly agree". Additionally, there were some open-ended questions to gather further information about the participant's background and job description. The survey was conducted through an online platform. Additionally, online surveys provide a convenient and accessible platform for participants to respond from the comfort of their location without travelling or scheduling appointments (Yun & Trumbo, 2000). Moreover, the anonymity of the respondents in online surveys can also increase their willingness to provide honest and complete answers, potentially leading to higher-quality data (Philbrick et al., 2010).

Table 1: Factors and measurement variables of the research study

Factor name	***Variables/ items***
Organizational Culture	OrgC1: Clear Objectives and Goals
	OrgC2: Recruitment Strategy
	OrgC3: Rewards
	OrgC4: Team Evaluation
	OrgC5: Availability of Mentor
	OrgC6: Task Interdependence in the organisation
Conflict within the team	Conf1: Conflict in the execution of Task
	Conf2: Conflict in delegation of task
	Conf3: Relationship conflict
	Conf4: Lack of Employee Satisfaction

Characteristics of team members	Char1: Integrity of the team member
	Char2: Benevolence of the team member
	Char3: Propensity to trust
	Char4: Functional diversity of the team
Trust within the team members	Tru1:Relying on the information provided by team
	Tru2:Accepting procedural suggestions from team
Diversity of the team	Div1: Cultural Diversity
	Div2: Differ in Problem Solving Approach
	Div3: Time difference and holidays
Communication of the team	Comm1: Training on core technical skills
	Comm2: Training on personal development and conflict resolution.
Cohesion in the team	Coh1: Cognitive ability of the team
	Coh2: Mutual Respect within the team
	Coh3: Affective (Caring) elements within the team
	Coh4: Technical ability of the team

Data analysis techniques

The main characteristics of the collected data were identified through descriptive statistics, and after cleaning and removing extreme values, 323 responses out of 403 participants were included in the final analysis. Confirmatory factor analysis (CFA) was used instead of exploratory factor analysis (EFA) as the measurement variables had been previously established in research and were expected to align with their respective construct. The reason for this approach was explained by Bhatia and Awasthi (2018), who stated that this method is more appropriate when the measurement variables have already been chosen from a well-established body of literature. Therefore, the researchers used a Structural Equation Modeling (SEM) approach to evaluate the relationship between trust-building and other factors in virtual teams. This method allows for the examination of both latent and observable variables through statistical analysis. A theoretical model must be developed to understand the connection between the key variables involved in trust-building in a virtual team environment to utilise SEM. This required identifying the key

factors contributing to trust-building in such a setting. Thus, the initial creation of a theoretical model shows constructs of factors affecting trust-building. SEM is a statistical method that was utilized to test the hypothesis and examine the relationship between trust-building and other variables in a virtual team setting. The approach was previously employed in a study by De Campos et al. (2019). The theoretical model was tested by analyzing the entire system of variables simultaneously to determine the degree of consistency between the hypothesised model and the collected data.

Structural Equation Modelling (SEM) is a statistical method used to analyze the relationships between multiple variables, including both observed and underlying (latent) variables. One advantage of SEM is its ability to account for measurement errors, which can improve the accuracy of the analysis. This study employed SEM to determine if the proposed theoretical model aligns with the collected data, thereby establishing its validity. The trust model's validity and reliability were assessed through various tests, which provided valuable insights. The Comparative Fit Index (CFI) and Non-Normed Fit Index (NNFI) were used to evaluate how well the theoretical model aligned with the collected data. On the other hand, the Root Mean Square Error of Approximation (RMSEA) measured the level of error present in the model's fit. These evaluations were crucial in determining the effectiveness of the proposed trust model and how it accurately represents the relationships between variables in the real world.

The validity of the proposed trust model was analyzed using SEM. The SEM was used to evaluate the measurement and structural models. The model's accuracy was verified by comparing the Average Variance Extracted (AVE) of each component with the variance due to measurement error. To ensure validity, the model required an AVE greater than 0.50 (Fornell & Larcker, 1981) and a comparison between the square root of the AVE and correlations with other constructs in the model to confirm discriminant validity (Fornell & Larcker, 1981).

Results and discussion of findings

Descriptive statistics

According to the survey results, the majority of respondents were team members, comprising 73.7% of the total, while the remaining 26.3% were team leaders. A large

proportion of participants had higher education, with 60.1% holding a Bachelor's degree, 31.6% holding a Master's degree, and only 8.4% having a diploma. Furthermore, the respondents had considerable experience working in virtual project teams, with an average of 6.9 years.

Measurement Model

The measurement model's validity was evaluated through three methods: reliability, convergent validity, and discriminant validity. Composite reliability values were used to measure reliability, with a minimum threshold of 0.7 considered acceptable, according to Fornell and Larcker (1981). The results presented in Table 2 demonstrated that all composite reliability values ranged from 0.716 to 0.795, indicating that they are higher than the minimum acceptable threshold. To evaluate discriminant validity, the study used Fornell and Larcker's (1981) approach of comparing each construct's square root of the Average Variance Extracted (AVE) with the correlations between that construct and other constructs in the model. The results in Table 2 indicated that the square root of AVE for each construct was greater than the correlation values between that construct and other constructs in the model. This suggests that the discriminant validity was acceptable for all constructs.

Table 2: Validity and Reliability Values

	CR	Communication	OrgCul	Conflict	TeamMem Char	Trust	Diversity	Cohesion
Communication	0.795	**0.818**						
OrgCul	0.743	0.571	**0.752**					
Conflict	0.731	0.179	0.304	**0.751**				
Team member Char	0.758	0.148	0.135	0.063	**0.742**			
Trust	0.783	0.346	0.383	0.425	0.285	**0.721**		
Diversity	0.716	0.038	0.059	-0.043	0.298	0.200	**0.767**	
Cohesion	0.726	0.448	0.677	0.558	0.398	0.570	0.144	**0.756**

In order to ensure that the scales were measuring the same concept accurately and reliably, it was important to establish their convergent validity. This was done by checking that the Average Variance Extracted (AVE) value for each construct was greater than the measurement error variance for that particular construct. This was done by comparing the AVE to a benchmark of 0.50. The results in Table 3 showed that the AVE for each of the constructs ranged from 0.52 to 0.67, indicating that ~~the~~ convergent validity was established. The results of the analysis support the convergent validity of the scales. The standardised factor loadings of the items were examined to verify the convergent validity of the measurement variables. This process helps to confirm that the measurement variables are measuring the intended concept and not some other related or unrelated concept. Ensuring convergent validity is crucial because it confirms that the measurement variables a~~re accurately measuring~~ccurately measure the same concept with reliability. The standardised loading value of each measurement variable was evaluated to ensure quality, requiring a value equal to or greater than 0.5, according to Kock (2014). All of the statistical results were significant, and any items that did not meet the required statistical standards, including OrgC6, Conf2, Conf4, Div3, and Coh4, were removed from the analysis. The Cronbach alpha (α) value was used to assess the reliability of each construct, and all of the Cronbach alpha values exceeded the 0.7 threshold value established by Nunnally (1978).

Table 3: Loading values, cronbach alpha (α), and AVE values

Construct	Standardized Loadings	Cronbach Alpha (α)	Average Variance Extracted (AVE)
Organizational Culture			
OrgC1	0.64	0.753	0.567
OrgC2	0.59		
OrgC3	0.63		
OrgC4	0.61		
OrgC5	0.55		
Conflict within the team		0.713	0.564
Conf1	0.60		
Conf3	0.75		
Team member characteristics		0.766	0.551
Char1	0.89		
Char2	0.67		
Char3	0.53		
Char4	0.54		

Trust		0.703	0.520
Tru1	0.69		
Tru2	0.76		
Diversity		0.700	0.588
Div1	0.98		
Div2	0.50		
Communication		0.757	0.669
Comm1	0.63		
Comm2	0.97		
Cohesion		0.757	0.573
Coh1	0.80		
Coh2	0.63		
Coh3	0.62		

Structural Model

The adequacy of a structural model is determined by its fit indices, which determine whether the model is acceptable or not. In this study, the model is deemed a good fit since all the goodness-of-fit indices meet the recommended thresholds. For instance, CMIN/DF (Minimum discrepancy) value, which should range from 3 to 1 (Carmines & McIver, 1981), is 1.882. Also, the Goodness of fit Index (GFI) is 0.904 (Hu & Bentler, 1995), Root Mean Square Error of Approximation (RMSEA) records 0.052 (MacCallum et al. 1996), Comparative Fit Index (CFI) is 0.913 (Raykov, 2005), which are all indications of good fit. It is possible to infer that the findings of this study were stable. As a result, the SEM model suited the data well, and the conceptual framework discussed in the previous section was validated. The final SEM model is presented in Figure 2. The justification for this paradigm is described in the section that follows.

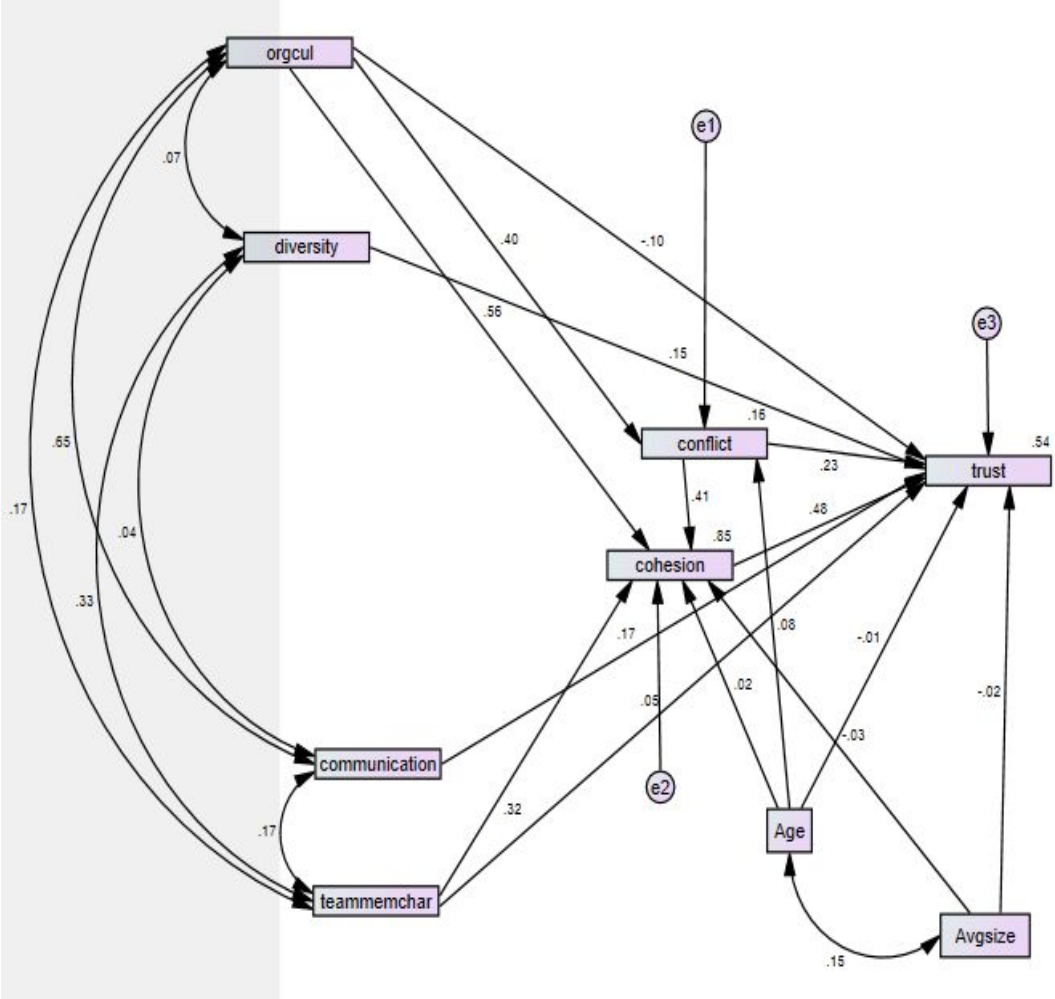

Figure 2: Final SEM Model of Trust

Discussion on Model of Trust and hypothesis testing

The model shown in ~~figure~~ Figure 2 constitutes various factors affecting trust positively or negatively. As shown in **Table 4**, after the SEM analysis was conducted, 3 out of the 11 hypotheses were rejected. The discussion of the different relationships between the variables was based on the results of the statistical data analysis.

Table 4: Results of the hypothesis test.

Hypothesis Number	Statement of Hypothesis	Coefficient	p-values	Results
H1	*A positive relationship exists between organizational culture and trust in virtual project teams.*	*0.065*	*0.000*	*Supported*

H2	*Conflict increases the positive effect of organizational culture on trust.*	*0.243*	*0.001*	*Supported*
H3	*Cohesion increases the positive effect of organizational culture on trust.*	*0.464*	*0.001*	*Supported*
H4	*A negative relationship exists between diversity of team members and trust in virtual project teams.*	*0.000*	*0.991*	*Not supported; came out to be positive relationship*
H5	*A positive relationship exists between communication of team members and trust in virtual project teams.*	*0.168*	*0.004*	*Supported*
H6	*A positive relationship exists between characteristics of team member on trust in virtual project teams.*	*0.149*	*0.001*	*Supported*
H7	*Cohesion increases the positive effect of team member characteristics on trust.*	*0.149*	*0.001*	*Supported, full mediation*
H8	*The more conflict among virtual team members, the less is the cohestion among them.*	*0.203*	*0.001*	*Supported*

The result of hypothesis 1 verification

The company's organisational culture encompasses various components such as setting clear goals and objectives, outlining a recruitment strategy, providing incentives to team members, ensuring unbiased performance appraisals, offering mentorship programs to employees, and the ~~level of interdependence of tasks within the team~~team's level of interdependence of tasks. Research has shown that team members committed to the team's objectives, especially long-term goals critical to the team's overall success, are more likely to ~~actively pursue the team's objectives~~pursue the team's objectives actively (Sagar et al., 2021; Kaur, 2017). Thus, it is crucial to establish a clear understanding of the team's objectives and goals during the planning stage to foster trust among team members (Brahm

& Kunze, 2012). ~~The process of c~~Choosing team members also holds significant importance in determining a team's success. Amah et al. (2013) proposed that individuals become members of organizations before they join teams, indicating that the organization's selection criteria can affect the type of individuals who are chosen to be part of the team~~.~~. Additionally, Barkhi et al. (2004) discovered in their research that rewarding team members based on the results of their individual or team decisions could improve team members' trust in the organization. It is crucial to have fairness in team evaluations to encourage trust and motivation among team members. When team members perceive that the evaluation process is just and unbiased, they tend to be more dedicated to the team's objectives and less inclined to resist change (Bryant et al., 2009). Mentoring and coaching ~~to~~ team members can also increase their skills and improve their performance, leading to a more effective and cohesive team (Sagar et al., 2021).

The result of hypotheses 2 and 3 verification

The study's findings align with previous research on the subject and support the idea that team members dedicated to the team and its goals are more likely to cooperate in pursuit of organizational objectives. This positive correlation between trust, collaboration, and goal attainment can be further enhanced when teams work through task-related conflicts constructively and transparently, ultimately contributing to the development of mutual trust among team members.

Researchers have shown that conflicts arising from tasks, processes, and relationships can harm the effectiveness of remote teams (Hinds & Bailey, 2003; Sagar et al., 2021). While some conflicts can be beneficial, it is essential to effectively manage conflicts that have a negative impact on team results and organizational objectives. In virtual teams, active conflict management and early conflict detection may be crucial (Kaur, 2017). Process conflict is a type of conflict that arises from disagreement or differences in opinions about how work should be done. On the other hand, relational conflict is typically caused by a lack of understanding about personal situations or differences among team members (Wakefield, Leidner, & Garrison, 2008). Organizations ~~need to~~must address relational and process conflict promptly and effectively to maintain a positive organizational culture and improve team performance. Addressing conflict can help to create a culture of trust,

cooperation, and commitment to the organization's objectives, and it can help to foster positive outcomes and achieve the team's objectives.

The study's findings indicate that virtual teams are susceptible to performance and team dynamics challenges, including ~~issues such as~~ low cohesion and trust. In traditional teams, high levels of team cohesion, which is the sense of unity and shared purpose among team members, can facilitate cooperation and help teams achieve common goals (Brahm & Kunze, 2012). Virtual teams may face challenges in building trust and avoiding misunderstandings due to the lack of face-to-face interaction (Blackburn et al., 2003). To address these issues, virtual teams can use communication and collaboration technologies, like video conferencing and instant messaging, to enhance interpersonal interactions and facilitate regular and transparent communication. Effective communication and cooperation among virtual team members can promote trust and strengthen team cohesion. Strong trust among team members can help reduce the potential negative impacts of limited interaction and virtual communication on team cohesion (Kaur, 2017). A high trust climate can foster a sense of shared identity and purpose, leading to more effective communication and collaboration among team members and, ultimately, better organizational outcomes.

The result of Hypothesis 4 verification

The data analysis revealed that diversity did not negatively impact trust levels in virtual teams operating in the construction sector. This could be attributed to the fact that these teams may include members from various cultural backgrounds, leading to an environment that encourages trust through enhanced comprehension and respect of differing views and work styles. Additionally, it is possible that the virtual nature of the teams, with its increased focus on communication and collaboration, has helped to mitigate any potential negative effects of diversity on trust. Overall, virtual teams in the construction sector can effectively manage diversity to promote trust and positive outcomes for the organization.

However, the data collected from experts as part of this research showed that diversity can actually enhance a team's trust. Teams comprising individuals from different backgrounds and with various levels of expertise and experience can benefit from this diversity. Despite this, Peters & Karren (2009) noted that diversity within a team could sometimes result in

distrust due to differences in attitudes, values, and performance among team members. Research data suggests that diversity can foster trust among team members. Teams with members from different backgrounds or cultures can benefit from their varying perspectives, skills, and experiences. Although differences among team members can sometimes cause conflicts, these can be overcome by the team's collective ability to understand and respect each other's differences. On the other hand, people are more likely to trust others who share similar characteristics and values, which is why trust is more prevalent in homogeneous teams. Diversity among team members can provide an opportunity for mutual learning and trust-building through understanding and cooperation, as emphasized by Costa (2003).

The result of Hypothesis 5 verification

The findings of the study indicate that establishing and sustaining trust among members of virtual teams is closely linked to effective communication. The ~~result of the~~ relationship between communication and trust-building is statistically significant and underscores the crucial role that efficient and regular communication practices play in virtual team settings. The findings of Sagar et al. (2021) support ~~the idea~~ that improved communication leads to increased trust among virtual team members, further emphasizing communication's critical role in virtual team performance and success. As per the findings of Amah et al. (2013), offering training programs to employees is a useful method for managers to enhance team performance. These training sessions can aid in building the necessary skills required to work collaboratively within a team and create a sense of achievement and contentment among employees. Potential topics for the training program may involve coaching, communication, conflict resolution, negotiation, and problem-solving.

The result of hypothesis 6 verification

The analysis of Hypothesis 6 showed that certain team members' characteristics could positively impact trust development in a team. Virtual teams often consist of individuals with diverse qualities, including skill level, honesty, kindness, expertise, dependability, and professional conduct. According to Kramer and Lewicki (2010), trust in virtual teams may start out being based on basic factors. Still, as the relationship develops and team members

better understand each other, they may form trust or distrust based on their individual characteristics. Additionally, Kramer & Lewicki (2010) suggest that trust in virtual teams may depend on the competence of team members. Competence refers to a team member's ability to perform tasks effectively and efficiently. Furthermore, the results of Sagar et al. (2021) indicate that reliability, professionalism, and other related characteristics are also important components that can positively impact trust in virtual teams. These findings suggest that team members' characteristics are crucial in developing trust among virtual teams. Trustworthiness is not only based on individual skills but also on personal qualities.

The result of hypothesis 7 verification

The analysis revealed that Hypothesis 7 was supported, indicating that team cohesion positively affects the association between team member characteristics and trust. The findings suggest that trust is primarily influenced by the cognitive aspects of team member characteristics, such as their competency, professional ethics and constancy, rather than the affective components like care and emotional connection. These findings align with Kanawattanachai and Yoo's (2002) and Sagar et al. (2021) research. According to Nakayama et al. (2006), trust is associated with competency, loyalty, and openness. Besides having favourable qualities in team members, team cohesion also plays a significant role in trust building. When a team has a tight-knit bond and a strong sense of unity, the impact of team member characteristics on building trust is expected to be more potent.

The result of hypothesis 8 verification

The statistical analysis results showed that this hypothesis was supported, and the literature also supports this idea. The findings from the statistical analysis support the hypothesis, which is in line with previous research. Conflicts arise from perceived incompatibilities or disagreements among team members. Dafoulas and Macaulay (2002) and Kaur (2017) have noted that virtual teams require a higher level of trust to operate effectively and prevent delays and conflicts compared to traditional, co-located teams. Team members play a crucial role in a team by contributing through both social interactions and task-related activities. When there are incompatible interpersonal dynamics among team members, it

can lead to relationship conflict, which includes tension, animosity, and annoyance. This can negatively impact team cohesion and trust in highly interdependent groups. (Jehn, 1995; Sagar et al., 2021). In teams where conflict is prevalent, there is a risk of reduced trust and cohesion among team members. If such conflicts are not managed appropriately, they can damage relationships and hinder learning, resulting in a lack of trust. The relationship between conflict and cohesion is inverse, indicating that as conflict increases, cohesion decreases. It is essential to effectively address and manage conflicts to sustain positive relationships and maintain team cohesion.

The result of moderating effect of experience

The study's findings support the notion that individuals with more experience working in virtual project teams are better equipped to handle ~~challenges related to diversity and communication, reducing the negative impact of conflicts~~diversity and communication challenges, reducing conflicts' negative impact. This aligns with previous research, which has demonstrated that experience and expertise can assist individuals in navigating the difficulties of virtual work and developing stronger relationships with their team members (Kong et al., 2016; Xiong et al., 2018). These results have significant implications for organizations seeking to establish and manage virtual project teams, as they indicate that prioritizing the recruitment of experienced individuals may be advantageous. Additionally, it appears that increasing experience in virtual teams can lead to increased maturity and improved cohesion among team members. It seems that gaining experience working in or leading virtual teams, ~~especially ones that are culturally diverse~~culturally diverse ones, can improve cohesion and trust within a team. Developing effective communication practices and sharing experiences and goals can also help build strong team relationships. Azimi et al. (2011) suggest that certain measures can be taken to optimize the contributions of seasoned team members across multiple projects. Cultivating expertise and fostering strong bonds among team members can promote cohesiveness and triumph in virtual teams.

Implications of Model of Trust

The trust model created through Structural Equation Modeling (SEM) has significant implications. Firstly, it highlights the significance of effective communication in building trust within virtual project teams. To enhance communication and trust among virtual team members, it is recommended to use suitable communication tools and strategies, provide training on conflict resolution and interpersonal skills, and improve problem-solving techniques. Weak communication within a team can lead to a lack of mutual comprehension and hinder overall team understanding.

Second, ~~in United Arab Emirates's (UAE) case,~~ having diversity among team members can contribute to building trust within the team. This is likely due to the diverse team members bringing different skills and alternative solutions to the tasks. Furthermore, a well-defined and structured organizational culture that communicates objectives and expectations can enhance trust among team members. However, policy ambiguity, unfair evaluation methods, and unstructured reward systems can lead to a lack of trust among team members. Therefore, ~~it is essential for management~~management needs to establish a structured approach to the company's organizational culture to foster trust among team members. Third, organizations should consider team members' previous experiences and expertise in virtual team settings. Individuals who have previous experience working in virtual teams may be better equipped to handle the challenges that come with virtual collaboration and have a positive influence on team performance. Additionally, a diverse team with varying backgrounds, viewpoints, and abilities can bring new and creative ideas to the project. Still, it is crucial to ~~managing~~ manage diversity effectively to reduce the potential for conflict. In the end, selecting the appropriate team members and ensuring their effective management and communication can play a crucial role in the success of virtual projects.

Fourth, teams consisting of individuals with diverse cultural and functional backgrounds may encounter disputes, particularly regarding their relationships. Such conflicts, stemming from personal ego issues, can diminish the ~~level of~~ trust shared among team members. Conversely, conflicts arising from the team's tasks can be advantageous, as they foster constructive discussions and encourage examining novel solutions to challenges. Nonetheless, the team must regulate the occurrence of these conflicts to prevent them from becoming excessive and interfering with the team's overall productivity. Fifth, assembling

a well-rounded team with a diverse range of individuals is vital. This can facilitate more robust connections and trust between team members. When team members believe in each other's abilities and collaborate effectively, it can lead to enhanced knowledge sharing and prompt project completion. Furthermore, incorporating experienced team members can decrease conflicts, improve information exchange, and refine team communication, fostering overall team cohesiveness and success.

Conclusion

This study aimed to explore interrelationships between trust and various factors that enhance ~~Virtual Project Teams (~~VPTs~~)~~ in the construction industry. ~~These~~ Virtual teams consist of individuals from diverse cultural backgrounds and countries working together on various projects. The research focuses on multidisciplinary VPTs and seeks to comprehend the factors that impact their effectiveness. By examining existing literature, it was discovered that the performance of virtual teams is heavily influenced by the level of trust established among team members. The study identified various factors that can impact the trust level within virtual project teams and introduced a model to evaluate the effect of these factors on trust. The final SEM supports the hypothesized positive interrelationships between trust and organizational culture, team diversity, degree of communication and team members' characteristics. Conflict within the team behaves in two different ways. First, the task conflict brings more discussions and different perspectives to the problem; hence, it helps build trust in team members' capabilities towards achieving the company's goal. Second, if the conflicts result in relationship controversy, it will affect the bonding of the team members as it leads to ego and hence affects trust building. Cohesion of the team helps in building trust among team members. The more bonding the team members are, the less conflicts will occur.

~~This~~ The trust model~~,~~ developed ~~through~~ in this ~~the~~ research, can provide useful guidance to construction management professionals who aim to cultivate trust among members of virtual teams. It underscores essential trust-related themes that senior management and project managers should consider when building and managing virtual project teams.

This study's investigation of the critical factors that influence the success or failure of virtual project teams in the construction sector adds to the current understanding of this

topic. Previously, such information was not available specifically in the construction industry context. The findings of this study are expected to draw the interest of professionals and policymakers in this field. In particular, project managers can benefit from ~~this~~ these research~~'s~~ insights, which offer guidance on improving team cooperation and performance in virtual teams, leading to increased individual learning.

References

Ailabouni, N., Painting, N., & Ashton, P. (2009). Factors affecting employee productivity in the UAE construction industry. *25th Annual ARCOM Conference*, (September), 555–564.

Amah, E., Nwuche, C. A., & Chukuigwe, N. (2013). Result Oriented Target Setting and Leading High Performance Teams. *Industrial Engineering Letters Www.iiste.org*, *3*(9), 47–60.

Amason, A. C. (1996). Distinguishing the effects of functional and dysfunctional conflict on strategic decision making: Resolving a paradox for top management teams. *Academy of management journal*, *39*(1), 123-148.

Anderson, A. H., McEwan, R., Bal, J., & Carletta, J. (2007). Virtual team meetings: An analysis of communication and context. *Computers in Human Behavior*, *23*(5), 2558-2580.

Arif, M., Mohammed, A.-Z. & Aman Deep, G. (2015). Understanding knowledge sharing in the jordanian construction industry. *Construction Innovation, 15*(3), 333-354.

Azimi Lolaty, H., Ashktorab, T., Bagheri Nesami, M., & Bagherzadeh Ladari, R. (2011). Experience of professional communication among nurses working in educational hospitals: A phenomenological study. *Journal of Mazandaran university of medical sciences*, *21*(85), 108-125.

Barkhi, R., Jacob, V. S., & Pirkul, H. (2004). The influence of communication mode and incentive structure on GDSS process and outcomes. *Decision Support Systems*, *37*(2), 287-305.

Bell, B., & Kozlowski, S. (2002). A typology of virtual teams implications for effective leadership. *Group & Organization Management*, *27*(1), 14–49.

Bhat, S. K., Pande, N., & Ahuja, V. (2017). Virtual team effectiveness: An empirical study using SEM. *Procedia Computer Science*, *122*, 33-41.

Bhatia, M. S., & Awasthi, A. (2018). Assessing relationship between quality management systems and business performance and its mediators: SEM approach. International *Journal of Quality & Reliability Management, 35*(8), 1490-1507

Brahm, T., & Kunze, F. (2012). The role of trust climate in virtual teams. *Journal of Managerial Psychology*, *27*(6), 595–614.

Bryant, S. M., Albring, S. M., & Murthy, U. (2009). The effects of reward structure, media richness and gender on virtual teams. *International Journal of Accounting Information Systems*, *10*(4), 190-213.

Carmines, E.G. & McIver, J.P. (1981). Analyzing models with unobserved variables. Carmines, E.G. & McIver, J.P. (1981). Analyzing models with unobserved variables. in Bohrnstedt, G.W. & Borgatta, E.F. [Eds.] Social measurement: Current issues. Beverly Hills: Sage.

Chatfield, A. T., Shlemoon, V. N., Redublado, W., & Darbyshire, G. (2014). Creating Value through Virtual Teams: A Current Literature Review. *Australasian Journal of Information Systems*, *18*(3). https://doi.org/10.3127/ajis.v18i3.1104

Chen, C. & Messner, J. (2010). A recommended practices system for a global virtual engineering team. *Architectural Engineering and Design Management*, 6, 207-221.

Costa, A. (2003). Work team trust and effectiveness. Personnel Review, 32: 605-622. doi:10.1108/00483480310488360

Crampton, C. D. (2001). The mutual knowledge problem and its consequences for dispersed collaboration. *Organization science*, *12*(3), 346-371.

Curşeu, P. L., & Schruijer, S. G. (2010). Does conflict shatter trust or does trust obliterate conflict? Revisiting the relationships between team diversity, conflict, and trust. *Group Dynamics: Theory, Research, and Practice*, *14*(1), 66.

Dafoulas, G., & Macaulay, L. (2002). Investigating cultural differences in virtual software teams. *The Electronic Journal of Information Systems in Developing Countries*, *7*(1), 1-14.

de Campos, E. A. R., Resende, L. M., & Pontes, J. (2019). Barriers, external aspects and trust factors in horizontal networks of companies: a theoretical propos l for the construction of a model for evaluation of trust. *Journal of Intelligent Manufacturing*, *30*(4), 1547-1562.

Doney, P.M., Cannon, J.P., et al. (1998). Understanding the Influence of National Culture on the Development of Trust. Academy of Management Review 23(3); 601-620.

Fornell, C., & Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement errors. *Journal of Marketing Research,* 18, 39–50.

Furst, S., Blackburn, R., & Rosen, B. (1999). Virtual team effectiveness : a proposed research agenda. *Information Systems Research*, *9*, 249–270.

Gibson, C. B., & Gibbs, J. L. (2006). Unpacking the Concept of Virtuality: The Effects of Geographic Dispersion, Electronic Dependence, Dynamic Structure, and National Diversity on Team Innovation. *Administrative Science Quarterly*, *51*(3), 451–495.

Hacker, J. V., Johnson, M., Saunders, C., & Thayer, A. L. (2019). Trust in virtual teams: A multidisciplinary review and integration. *Australasian Journal of Information Systems*, *23*, 1-36

Henderson, LS. (2008).The impact of project managers' communication competencies: Validation and extension of a research model for virtuality, satisfaction, and productivity on project teams, *Project Management Journal,* 39(2), 48-59.

Henttonen, K., Blomqvist, K., (2005). Managing distance in a global virtual team: the evolution of trust through technology-mediated relational communication. *Strategic Change 14*, 107–119.

Hinds, P. J., & Bailey, D. E. (2003). Out of sight, out of sync: Understanding conflict in distributed teams. *Organization science*, *14*(6), 615-632.

Ho, S., & Richardson, A. (2013). Trust and distrust in open source software development. *Journal of Computer Information Systems,* 84–93.

Hoch, J. E., & Dulebohn, J. H. (2017). Team personality composition, emergent leadership and shared leadership in virtual teams: A theoretical framework. *Human Resource Management Review*, *27*(4), 678–693.

Hosseini, M. R & Chileshe, N. (2013). Global Virtual Engineering Teams (GVETs): A fertile ground for research in Australian construction projects context. *International Journal of Project Management, 31*(8), 1101-1117.

Hu, L.-T., & Bentler, P. (1995). Evaluating model fit. In R. H. Hoyle (Ed.), *Structural Equation Modeling. Concepts, Issues, and Applications* (pp. 76-99). London: Sage.

Hwang, M. I. (2018). Relationship between teamwork and team performance: Experiences from an ERPsim competition. *Journal of Information Systems Education*, *29*(3), 157-168.

Jarvenpaa, S. L., Knoll, K., & Leidner, D. E. (1998). Is Anybody Out There? Antecedents of Trust in Global Virtual Teams. *Journal of Management Information Systems*, *14*(4), 29–64.

Jarvenpaa, S. L., Shaw, T. R., & Staples, D. S. (2004). Toward contextualized theories of trust: The role of trust in global virtual teams. *Information systems research*, *15*(3), 250-67.

Jehn, K. A. (1995). A multimethod examination of the benefits and detriments of intragroup conflict. *Administrative science quarterly*, 256-282.

Jimenez, A., Boehe, D. M., Taras, V., & Caprar, D. V. (2017). Working Across Boundaries: Current and Future Perspectives on Global Virtual Teams. *Journal of International Management*, *23*(4), 341–349.

Kadefors, A. (2004). Trust in project relationships—inside the black box. *International Journal of Project Management, 22*(3), 175–182.

Kanawattanachai, P., & Yoo, Y. (2002). Dynamic nature of trust in virtual teams. The Journal of Strategic Information Systems, 2(10), 42–58.

Kasper-Fuehrera, E. C., & Ashkanasy, N. M. (2001). Communicating trustworthiness and building trust in interorganizational virtual organizations. *Journal of management*, *27*(3), 235-254.

Kaur, S. (2017). Model for assessment of trust within VPTs of construction sector in the Middle East (Doctoral dissertation, University of Salford).

Kaur, S., Arif, M. & Akre, V. (2015). *Factors affecting Trust in Virtual Project Teams in Construction Sector in Middle East.* in 12th Post-Graduate Research Conference 2015, Media City U.K., 10-12 June 2015, pp 262- 276.

Khan, M.S., (2012). Role of trust and relationships in geographically distributed teams: exploratory study on development sector. *International Journal of Networking and Virtual Organisations, 10,* 40–58.

Kimble, C. (2011). Building effective virtual teams: How to overcome the problems of trust and identity in virtual teams. *Global Business and Organizational Excellence*, *30*(2), 6–15.

Kock, N. (2014). Advanced mediating effects tests, multi-group analyses, and measurement model assessments in PLS-based SEM. *International Journal of e-Collaboration*, 10(3),1-13.

Kramer, R. M., & Lewicki, R. J. (2010). Repairing and enhancing trust: Approaches to reducing organizational trust deficits. *Academy of Management annals*, *4*(1), 245-277.

Lau, E., & Rowlinson, S. (2009). Interpersonal trust and inter firm trust in construction projects. *Construction Management and Economics*, *27*(6), 539–554.

Lee, H., Ahn, H., Kim, H., & Lee, J. (2014). Comparative Analysis of Trust in Online Communities. *Procedia Computer Science*, *31*(ITQM 2014), 1140–1149. doi:10.1016/j.procs.2014.05.370

Lipnack, J., & Stamps, J. (1997). Virtual Teams: Reaching Across Space, Time, and Organizations with Technology, John Wiley & Sons, Inc., New York, 1997

Lukić, J. M., & Vračar, M. M. (2018). Building and nurturing trust among members in VPTs. *Strategic Management-International Journal of Strategic Management and Decision Support Systems in Strategic Management*, *23*(3), 010-016.

Lurey, J., & Raisinghani, M. (2001). An empirical study of best practices in virtual teams. *Information & Management*, *38*, 523–544.

MacCallum, R. C. & Austin, J. T. (2000). Applications of structural equation modeling in psychological research. Annual Review of Psychology, 51, 201-226.

MacCallum, R.C., Browne, M.W., and Sugawara, H., M. (1996), "Power Analysis and Determination of Sample Size for Covariance Structure Modeling," *Psychological Methods*, 1 (2), 130-49

Malhotra, A., Majchrzak, A., Rosen, B. (2007). Leading Virtual Team. *Academy of Management Perspectives, 2,* 60 -69.

Martins, L. L., Gilson, L. L., & Maynard, M. T. (2004). Virtual Teams: What Do We Know and Where Do We Go From Here? *Journal of Management*, *30*(6), 805–835.

McDermott, P., Khalfan, M., & Swan, W. (2005). Trust in construction projects. *Journal of Financial Management of Property and Construction*, *10*(1), 19–32.

Mcdonough, E.F., K.B. Kahn and G. Barczak, 2001. An investigation of the use of global, virtual, and collocated new product development teams. The Journal of Product Innovation Management, 18: 110-120.

Morrison-Smith, S., & Ruiz, J. (2020). Challenges and barriers in virtual teams: a literature review. *SN Applied Sciences*, *2*(6), 1-33.

Mukherjee, D., Renn, R. W., Kedia, B. L., & Mukherjee, D. (2012). Development of interorganizational trust in virtual organizations: An integrative framework. *European Business Review*. *24*(3), 255–271.

Nakayama, M. K., Binotto, E., & Pilla, B. S. (2006, August). Trust in virtual teams: A performance indicator. In *IFIP World Computer Congress, TC 3* (pp. 105-113). Springer, Boston, MA.

Nathaniel, A., & Anthony, C. I. (2012). Barriers to the Uptake of Concurrent Engineering in the Nigerian Construction Industry. *International Journal of Engineering Business Management*, *4*, 1–8.

Nemiro J, Beyerlein M, Beyerlein S, and Bradley L (2008). The Handbook of High-Performance Virtual Teams. San Francisco: Jossey-Bass.

Nunnally, J. C. (1978). Psychometric theory (2nd ed.). New York, NY: McGraw-Hill.

Pangil, F., & Chan, J. M. (2014). The mediating effect of knowledge sharing on the relationship between trust and virtual team effectiveness. *Journal of Knowledge Management, 18*(1), 92–106

Peters, L., & Karren, R. (2009). An examination of the roles of trust and functional diversity on virtual team performance ratings. *Group & Organization Management*, *34*(4), 479–504. doi:10.1177/1059601107312170

Philbrick, J. H., Smith, F. R., & Bart, B. (2010). Using web surveys to determine audience characteristics and product preferences. *American Journal of Business Education (AJBE)*, *3*(4), 1-6.

Pinto, J.K., Slevin, D.P. & English, B. (2009). Trust in projects: an empirical assessment of owner/contractor relationships, *International Journal of Project Management, 27*(6), 638-648.

Ramalingam, S, Lobo, S, Mahalingam, A & Whyte, J. (2014), Achieving reliability in transnational work on complex projects: new directions for research, *Engineering Project Organization Journal, 4* (4), 193-208.

Reina, D. Reina, M. (1999). Trust and Betrayal in the Workplace. San Francisco: Berre-Koehler Publishers Inc.

Sagar, S. K., Arif, M., Oladinrin, O. T., & Rana, M. Q. (2021). Exploring factors affecting trust in construction virtual project teams. *Journal of Architectural Engineering Technology*. Journal of Architectural Engineering Technology.

Sagar, S. K., Oladinrin, O. T., Arif, M., & Rana, M. Q. (2022). Interpretive structural model of trust factors in construction virtual project teams. *Construction Innovation*.

https://wlv.openrepository.com/bitstream/handle/2436/624519/Sagar_et_al_Interpretive_structural_2022.pdf?sequence=2&isAllowed=y

Staples, D. S., & Webster, J. (2008). Exploring the effects of trust, task interdependence and virtualness on knowledge sharing in teams. *Information systems journal, 18*(6), 617-640.

Tsui, A. S., Egan, T. D., & O'Reilly III, C. A. (1992). Being different: Relational demography and organizational attachment. *Administrative science quarterly*, 549-579.

Wakefield, R. L., Leidner, D. E., & Garrison, G. (2008). Research note—a model of conflict, leadership, and performance in virtual teams. *Information systems research*, *19*(4), 434-455.

Yun, G. W., & Trumbo, C. W. (2000). Comparative response to a survey executed by post, e-mail, & web form. *Journal of computer-mediated communication*, *6*(1), JCMC613.

Zakaria, N., & Yusof, S. A. M. (2020). Crossing cultural boundaries using the internet: Toward building a model of swift trust formation in global virtual teams. *Journal of International Management*, *26*(1), 100654.

Zolin, R., Hinds, P. J., Fruchter, R., & Levitt, R. E. (2004). Interpersonal trust in cross-functional, geographically distributed work: A longitudinal study. *Information and organisation*, *14*(1), 1-26.