Challenges negating virtual construction project team performance in the Middle East

Sukhwant Kaur Sagar
Durham College School of Business IT and Management, Oshawa, Canada
Mohammed Arif
School of Architecture, Technology and Engineering, University of Brighton, UK
Olugbenga Timo Oladinrin
Architecture and Built Environment, University of Wolverhampton, Wolverhampton, UK, and
Muhammed Qasim Rana
School of Architecture and Built Environment, University of Wolverhampton, Wolverhampton, UK

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Abstract

Purpose – Over the last couple of decades, many organisations are increasingly adopting virtual team concepts, and construction companies in the Middle East are no exception. Members of a virtual team are geographically scattered and represent a diverse range of cultures. Thus, challenging issues emerge more frequently than in a traditional team. There are challenges associated with space and time as well as high client's demand. Therefore, this study aims to identify and probe the causes of the challenges in virtual project teams in the construction industry of the Middle East.

Design/methodology/approach – A list of challenges was derived through a comprehensive review of relevant literature. Questionnaire survey was conducted with professionals who are involved in construction virtual project teams. Further, the factor analysis technique was used to analyse the survey responses.

Findings – The results show that the challenges in virtual team arrangement in the Middle East construction industry can be grouped into seven categories, namely, organisational culture, conflict within the team, characteristics of the team members, trust within the team members diversity of the team, communication and training, and cohesion in the team. Understanding of these factors will drive the needed platform to support effective virtual project teams in the Middle East.

Originality/value – This study raises the prospect that organisations may establish an environment for team members to achieve higher levels of virtual cooperation by concentrating on these potentially crucial factors. This, in turn, will encourage further innovation and performance within construction organisations.

Keywords Virtual team, Construction industry, Middle East, Organisational culture, Team cohesion

Paper type Research paper

1. Introduction

In today's globalised world, where crucial technological changes are occurring, organisations are experiencing unexpected possibilities and obstacles in achieving their goals. Such changes have compelled organisations to restructure and embrace new ways of working. Virtual team is one of the new ways of organising and achieving organisational goals (Lilian, 2014). Virtual teams are geographically and organisationally dispersed knowledge workers (such as architects, engineers, project managers and quantity surveyors) who work across time zones to achieve the goal of a specific project. Physical contact in virtual teams is limited or absent entirely due to such dispersion, implying that cooperation is supported through

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information technology (IT) solutions such as computer-based communication. This type of electronically enabled teamwork is recognised to present both opportunities and challenges to corporate organisations, of which construction is no exception. Many multinational organisations have diverse nationalities, vast geographical distances and time zones. According to Oertig and Buergi (2006), academic scholarship has reported increasing geographically scattered project teams operating within matrix organisations, assuming that their job is highly challenging. The use of information and communication technologies (ICTs) in the construction business has brought together diverse team members of a construction project from all over the world (Shaikh, 2018). As virtual teamwork is more complex than working face-to-face (Heimer and Vince, 1998), managing such a virtual team working in a construction project remains a challenging task (Shaikh, 2018).

The Middle East has become the destination for many multinational companies attracted by the massive development programme, especially in the construction sector. The construction industry in the Middle East has been expanding progressively and, at the same time, is facing some challenges. Throughout the project life cycle, the continuing market pressure to reduce costs, improve quality and reduce time to market is becoming a threat to many construction companies. Most multinational companies operating in this region have their headquarters located outside the Middle East, hence collaborating virtually with the client teams and other project participants. This is because globalisation and changing customer needs require many organisations to adopt virtual project teams for their business activities. There are various issues associated with virtual project teams, such as establishing, managing and controlling virtual teams; maintaining trust among team members; information sharing; and communication. Although computer-supported collaborative work has increased, many distributed virtual teams are not benefiting from the tools and approaches used. This is because of the lack of efficient and empirically proven methods, which can judge a team's performance based on human factors and cultural differences. The Middle East is a multicultural region with people from various backgrounds and countries working on multiple projects; hence, managing virtual teams cannot be overemphasised. As remote work becomes more of a reality than a passing trend, virtual teams have become more significant, especially in this era of the Covid-19 pandemic. Zuofa and Ochieng (2021) opined that remote working and virtual teams may still pose newer challenges for delivering projects. Construction project teams increasingly utilise virtual project teams to deliver projects (Kaur, 2017; Ramalingam *et al.*, 2014). Due to the pressure from globalisation, it is becoming necessary for construction organisations to adopt virtual project teams to deal with the challenges of the contemporary business environment (Chen and Messner, 2010). The organisations have to predict and overcome virtual project teams' challenges by implementing effective managerial strategies to achieve desirable outcomes (Yen *et al.*, 2002). Successful implementation of virtual project teams within the construction sector requires an in-depth understanding of the unique challenges quite different from the challenges encountered in face-to-face teams (Hosseini and Chileshe, 2013).

Against this backdrop, the lack of studies on virtual project teams in the construction literature has been questioned (Iorio and Taylor, 2015; Hosseini *et al.*, 2018). Also, many previous studies on virtual teams have focused on various challenges faced by virtual teams (Zuofa and Ochieng, 2017). Moreover, the results of the studies from other industry sectors, such as telecommunication, health care industry, agricultural industry, cannot be relied upon for the construction sector due to the obvious specific approach of the industry. For instance, multiculturalism has a negligible impact on virtuality in construction project teams (Hosseini *et al.*, 2016). By contrast, multiculturalism contributes to virtuality in non-construction contexts (Foster *et al.*, 2015). This implies that knowledge of virtual project teams should be created within the natural context of the construction industry. As a result, the construction industry has remained in need of creating knowledge to supply the industry with essential information on the challenges faced in deploying virtual project teams on construction projects (Hosseini and

Chileshe, 2013). There are challenges such as difficulty in setting up the virtual project teams and insufficient guidelines for managing virtual project teams in the construction sector of the Middle East (Kaur *et al.*, 2015). Therefore, the companies fear implementing virtual project teams, even though globalisation and changing customer needs require teams to increase the performance of the projects. Hence, the earlier we identify and address challenges associated with virtual teams, the better for achieving construction project goals. There was reluctance already for virtual project teams in the construction industry. However, with Covid-19, we have been forced into virtual interactions. Therefore, it is even more important to understand the issues or reluctance towards virtual teams to achieve greater effectiveness across a team that has been forced upon us due to the Covid-19 pandemic. There is a lack of empirically based study of the perspectives of construction professionals on the greatest challenges virtual project teams have to manage, especially in the Middle East. To add knowledge on the field and fill the research gap, the study aims to identify and analyse the challenges faced by virtual team members in (both building and infrastructural) construction projects. This will underline the need for construction organisations to be conscious of these challenges and increase team awareness for improved performance.

2. Literature review

2.1 Virtual teams concept

To have an international presence in a global marketplace, more and more companies feel the need for creating virtual project teams. The organisations can assign the most qualified people to appropriate projects by dynamically allocating people to projects based on expertise rather than location. This will reduce the expense and wasted productivity caused by extensive travel or frequent relocation (Goldman and Filliben, 2000). A global virtual team is defined as a temporary team formed on a need basis for a particular task duration and staffed by people from across the world (Jarvenpaa *et al.*, 1998). From the perspective of Lu (2015), virtual teams are groups of individuals collaborating in the execution of a specific project to achieve a common goal while geographically distributed, often away from their parent organisation. El-sheikh *et al.* (2014) stated that a multicultural virtual project team is a team whose members have different cultural backgrounds belonging to other countries.

Amongst the different definitions of a virtual team, the most widely accepted definition was given by Powell *et al.* (2004 p. 7) as follows: "virtual teams as groups of geographically, organizationally and/or time dispersed workers brought together by information technologies to accomplish one or more organisation tasks". For the construction industry, distributed teams could be defined as "groups of geographically, organisationally and/or time dispersed intelligent workers with different skills and in different positions of the hierarchy heavily relied on ICTs to accomplish engineering tasks which for all are held accountable" (Hosseini and Chileshe, 2013, p. 1,103). In this study, we defined virtual project teams as groups of professional individuals collaborating to execute a specific construction project while geographically and often temporally dispersed, working from different professional domains to achieve the project aim.

Virtual teams have become a norm with most corporate companies such as consulting firms, technology infrastructures and e-commerce because of globalisation because of improved telecommunications infrastructures (Zuofa and Ochieng, 2017). The virtual teams are also being increasingly examined in academic literature (Morrison-Smith and Ruiz, 2020), in open-source software development (Ho and Richardson, 2013) and online communities (Lee *et al.*, 2014). There is a strong need for virtual project teams in the construction sector, which would benefit organisations to achieve a global scope of work for these companies in the Middle East. Hosseini *et al.* (2018) revealed that many more construction companies have instituted virtual workplaces and have reaped reduced real estate expense benefits, increased productivity, higher profit and improved customer service, environmental benefits and access to global markets.

2.2 Virtual teams in the context of the Middle East construction industry

The Middle East has become the destination for many multinational companies attracted by the massive development programme, especially that in the construction sector. Middle Eastern countries have outstanding national development goals to diversify their economies and reduce their dependency on oil and gas reserves and a desire to be recognised on the global arena. To achieve these plans, many construction and infrastructure projects will be needed, and the construction industry will play a significant role in this. The Dubai World Expo 2020 and the FIFA World Cup 2022 in Qatar are two major planned projects. There is desire for faster completion of projects, which necessitates multitasking and improved collaboration among project teams (El-sheikh *et al.*, 2014). The construction industry in the region has been expanding progressively, and at the same time, is facing several challenges. The Middle East is a multicultural region with people from various backgrounds and different countries working on multiple kinds of projects. Hence, it is essential to understand the phenomenon of these virtual project teams that relate across multiple cultures. International organisations winning major construction contracts in the Middle East may find it difficult to effectively attract skilled professionals and unskilled labour on the scale required to complete projects on time (Harris, 2014). This gives rise to remote engagement of construction experts outside of the region. Hence, these needs and challenges required many organisations to adopt virtual project teams for their business activities.

2.3 Challenges of virtual project teams

Even though virtual project teams have many advantages, new challenges also arise (Morrison-Smith and Ruiz, 2020). The distributed teams provide disappointing results if the challenges facing virtual project teams are overlooked. It is imperative to tackle the challenges to reap the same benefits of virtual project teams (Morrison-Smith and Ruiz, 2020; Mukherjee *et al.*, 2012). Against this backdrop, very few studies have investigated distributed teams' challenges within the construction context, as Hosseini and Chileshe (2013) pointed out. Some of the problems that virtual project teams experience include the following: trusting the team members who are never seen, time delays in replies, lack of synergy among cross-cultural team members, communications breakdowns due to cultural variances, unresolved conflicts among culturally different members, different holidays (Vinaja, 2003). The key findings reported by Vakola and Wilson (2004) were the challenge of developing trust, leadership and managing virtual aspects of communication. Hosseini and Chileshe (2013) also mentioned that virtual teams face particular challenges involving trust, communication, deadlines and team cohesiveness.

Virtual teams are challenged because they are virtual; they exist through computer-mediated communication technology rather than face-to-face interactions (Hardin *et al.*, 2007). Some of the challenges that occur in the literature are identified as shown in Table 1. Research into the challenges faced in virtual project teams has resulted in determining the factors associated with project success in virtual teams. Several challenges have been identified for traditional or co-located project teams in previous studies; however, it is not guaranteed that the findings from such findings directly translate to effective collaboration in the context of virtual teams. Other studies have looked at the factors that influence team work in general. Mattessich and Monsey (1992) identified 19 key factors required for effective teamwork, including the ability to compromise, mutual respect and trust, and flexibility.

Similarly, Patel *et al.* (2012) produced a framework for collaborative engineering projects in the automotive, aerospace and construction industries based on the classification of seven criteria related to collaboration. In a recent study, Morrison-Smith and Ruiz (2020) conducted an extensive review of factors affecting virtual teams in general terms. While the findings from these studies are relevant, they apply to a broad range of contexts. Hence, it is difficult to determine how the factors reported in these research affect virtual teams. This study differs

Code	Variables	Sources
V1	Objectives/goal setting	Amah *et al.* (2013), Tan *et al.* (2019)
V2	Recruitment strategy	Mansor *et al.* (2012), Amah *et al.* (2013)
V3	Reward plan	Mansor *et al.* (2012), Amah *et al.* (2013)
V4	Team evaluation (justice)	Fang and Chiu (2010)
V5	Availability of mentor	Amah *et al.* (2013)
V6	Functional diversity of the team	Paul and McDaniel (2004), Vinaja (2003)
V7	Cultural diversity	Amah *et al.* (2013), Morrison-Smith and Ruiz (2020)
V8	Differences in problem-solving approach	Davidavičienė *et al.* (2020)
V9	Cognitive ability of the team	Lu (2015)
V10	Technical ability of team	Kuo and Thompson (2014)
V11	Integrity of the team member	Mansor *et al.* (2012)
V12	Benevolence of the team member	Morrison-Smith and Ruiz (2020)
V13	Propensity to trust	Morrison-Smith and Ruiz (2020), Garro-Abarca *et al.* (2021)
V14	Task interdependence	Morrison-Smith and Ruiz (2020)
V15	Mutual respect within the team	Mansor *et al.* (2012)
V16	Affective elements (e.g. caring, emotional connection to each other)	Kuo and Thompson (2014)
V17	Lack of employee satisfaction	Mansor *et al.* (2012)
V18	Conflict for the execution of task	Davidavičienė *et al.* (2020), Morrison-Smith and Ruiz (2020)
V19	Conflict for delegation of task	Amah *et al.* (2013), Morrison-Smith and Ruiz (2020)
V20	Relationship conflict	Jehn (1997), Davidavičienė *et al.* (2020)
V21	Time difference and holidays	Vinaja (2003), Gustavo *et al.* (2012)
V22	Training on personal development and conflict resolution	Iorio and Taylor (2015), Amah *et al.* (2013)
V23	Training on core technical skills	Mansor *et al.* (2012), Cheng *et al.* (2021)
V24	Accepting procedural suggestions from team	Davidavičienė *et al.* (2020)
V25	Relying on the information provided by team	Mansor *et al.* (2012)
V26	Team size	Mansor *et al.* (2012), Amah *et al.* (2013)
V27	Communication	Vinaja (2003), Amah *et al.* (2013)
V28	Network security	Mansor *et al.* (2012)
V29	Task complexity	Amah *et al.* (2013)
V30	Task–technology fit	Cheng *et al.* (2021)
V31	Lack of team monitoring	De Jong and Elfring (2010)
V32	Risk of revealing identity	Mansor *et al.* (2012)
V33	Knowledge sharing issue	Davidavičienė *et al.* (2020), Fang and Chiu (2010)
V34	Group cohesiveness	Amah *et al.* (2013)
V35	Perceptions of the process	Chidambaram and Jones (1993)
V36	Decision quality	Paul *et al.* (2004)
V37	Group heterogeneity	Paul *et al.* (2004), Vinaja (2003)
V38	Satisfaction of outcomes	Kärnä *et al.* (2009)
V39	Lack of team effort	De Jong and Elfring (2010)
V40	Language barriers	Gustavo *et al.* (2012)

Table 1.
Factors affecting virtual teams

because it focuses solely on virtual teams working within the context of the construction project.

3. Methodology

3.1 Prior literature and pre-testing

The first essential step in this study was to establish a comprehensive collection of variables from prior studies on virtual teams. The Web of Science (Core Collection) was searched to

collect articles used for this study because the Web of Science Core Collection contains comprehensive literature databases with high-quality and influential articles (Cui *et al.*, 2018). Suitable search terms include "barriers", "challenges", "obstacles," "virtual team", "virtual project team" and "construction virtual project team". An initial search was made using the document type "article or review" and the "title/abstract/keyword" section of Web of Science, limited to papers published between 2000 and 2021. The initial search yielded 326 items. However, not all of the initially discovered publications included studies on the challenges of virtual project teams. Some just occurred to have some of the search terms in their title, abstract or keywords. Therefore, a brief of the abstracts was undertaken, and in some cases, where the abstracts did not give enough information, the contents of the initial discovered publications were reviewed. Following the filtering, 149 articles were identified as relevant and valid for further investigation. It is important to note that this study is not a comprehensive evaluation of all literature on the subject. A total of 149 research articles were reviewed and methodically analysed to identify 40 indicators.

The set of 40 factors was then sent to seven participants from the construction sector for re-testing. Key professionals were identified and used as agents to reach other professionals (snowballing) for inclusion in the sample for the pilot study. These participants are professionals who have been involved or are currently involving in construction projects in the Middle East, although they are located in different regions, including Oman, Dubai, Muscat, Sharjah, the UK, the USA, Holland, Qatar and Saudi Arabia. All the participants are graduates and have at least ten years of working experience, including a minimum of three years of such experience in the Middle East, and they have all participated in virtual project teams before. The pilot study was used to assess the clarity, explicitness, meaning and suitability of the questions provided in capturing the factors for virtual project teams in the construction industry of the Middle East. The pilot study helped modify the questionnaire and further refine the instructions' clarity. The 40 factors were compressed to 25 factors by the professionals. The pilot study validates the researcher's synthesis of the literature in the field by testing the adequacy of the research instruments and thereby assisting in developing the primary data collection instrument to be used in the actual data collection. The modified indicators affecting virtual teams extracted from the literature are shown in Table 1 with their sources. In building a virtual team, all of these issues must be at least implicitly addressed to have an effective virtual team (Morrison-Smith and Ruiz, 2020). The final questionnaire comprised two major sections: (1) general personal information of respondents and (2) questions on the opinions of the professionals on challenging factors for virtual project teams in construction in the Middle East.

3.2 Questionnaire survey

A Web questionnaire survey was created using SurveyMonkey for this research. Questionnaire survey is one of the widely used methods in virtual team research to measure and evaluate practitioners' perceptions and opinions (Odubiyi and Oke, 2016; Moore and Abadi, 2005). The Web-based questionnaire instrument was posted on Construction Network and LinkedIn groups. These postings were done only after taking formal approvals from the Webmaster and the leaders of these communities. Hence, in the case of such Web surveys, the respondents were self-selected; however, they must have been involved in delivering construction projects in the Middle East for inclusion. Respondents were asked to rate their level of agreement with each of the 25 identified factors on a five-point Likert scale from 1 to 5, with "1" representing "strongly disagree", "3" representing "neutral/no comment" and "5" representing "strongly agree" on the statements with reference to a specific virtual team project in which they had participated. The respondents who answered the questionnaire formed a self-sampled population. They are graduates in their respective fields to understand the research study. Also, the mailing lists of some chosen virtual team project communities were obtained from the online directories of construction companies. *The Emirates Oil and Gas Directory*, *Middle East Building and*

Construction Directory, and *The Blue Book Building* were also referred to get the e-mail IDs of the construction projects' team members and project managers. The questionnaire survey targeted only experienced and knowledgeable construction professionals such as quantity surveyors, architects, engineers, builders and construction managers/builders. These professionals must be working or have worked in various virtual project teams in the Middle East and were believed to provide valuable information needed for this research study. These respondents were sent a link to the online questionnaire instrument. A six-week period was given to the professionals, and after sending a series of reminders within the period, 403 responses were received. However, 80 responses found to be incomplete and unengaged were removed, leaving 323 valid responses for further analysis.

The respondents were asked to indicate the number of years they have been involved in virtual project teams in the Middle East. They had a great working experience in virtual project teams in the Middle East with an average of 6.9 years. Out of the 323 responses, 194 have a bachelor's degree, 102 have a master's degree, whereas only 27 reported having a diploma. This indicates that the respondents are graduates and can understand the research. The respondents obtained their experience from various countries in the Middle East, including Iraq, Kingdom of Saudi Arabia, Kuwait, Oman, Qatar and the UAE. The average size of virtual project teams in which respondents have worked comes out to be nine, with a minimum of three people and a maximum of 18 people in a team. This further validates that these teams are created on a need basis and are very specific to their job description. Average tenure of virtual project teams where the respondents have worked is only 3.05. Tenure refers to the average life of the team in years. This verifies the definition of virtual project teams, which says that virtual project teams are short-lived and are created only to fulfil specific projects in different geographically dispersed locations (Hosseini and Chileshe, 2013; Jarvenpaa *et al.*, 1998). The internal consistency of questionnaire scale was computed using the Cronbach's alpha method. According to Nunnally (1978), a Cronbach's alpha score greater than 0.70 indicates that the data set has strong internal consistency and reliability. The Cronbach's alpha (α) coefficient for the 25 scale-based questions achieves a high score of 0.799, indicating the study instrument's high level of consistency and dependability.

3.3 Analytical techniques

The Statistical Package for Social Sciences 21.0 was used to perform statistical tests, including reliability analysis (using Cronbach's alpha) and factor analysis. Reliability analysis was used to determine the reliability of the data collected from the questionnaire survey. Reliability analysis was determined by the Cronbach's alpha test, which is a measure of internal consistency, and it checks how closely related a set of items are as a group (Santos, 1999). The factor analysis approach is frequently used to reduce a large number of interconnected variables to a small number of distinct groups (Brown, 2015). It is a multivariate statistical approach commonly used in construction management research to discover and understand non-correlated groups of components (Fang *et al.*, 2004). Factor analysis helped to group various factors affecting virtual project teams of the construction sector in the Middle East.

4. Data analysis and results

Exploratory factor analysis (EFA) was conducted to discover the measure's factor structure and examine its internal reliability. Principal component analysis was employed to uncover the underlying grouped variables because of its simplicity and special features of data reduction capability for extraction. The total percentage of variation explained by each component was analysed to determine how many factors would be necessary to describe that set of data. Prior to running EFA, the researcher confirmed that all requirements were met. This study satisfied the variable to sample size ratio of 1:5 (Lingard and Rowlinson, 2006), with the variable to sample size ratio of 1:13. For the extraction factors, the Kaiser–Meyer–

Olkin (KMO) measure of sample adequacy and the Barlett's test of sphericity can be employed. The KMO statistic has a value between 0 and 1. For a suitable EFA to proceed, the KMO value should be greater than the acceptable threshold of 0.5 (Norusis, 1993). The KMO value is 0.828, which indicates a "good" degree of common variation and is considerably over the acceptable threshold of 0.50. Barlett's test for sphericity is used to test the hypothesis that the correlation matrix is an identity matrix, indicating no relationship amongst the items (Pett *et al.*, 2003). The value of the test statistic for Barlett's sphericity is large (chi-square value = 2,599.799), and the associated significance level is small (p-value = 0.000), implying that the population correlation matrix is not an identity matrix.

The Cronbach's alpha reliability coefficient was used to assess internal consistency (reliability) between 0 and 1, based on the average inter-item correlation. The general guideline is that if the alpha value is more than 0.70, it may be inferred that the measuring scale used is trustworthy (Norusis, 1993). The total alpha value for the 25 factors was found to be 0.799 in this study, indicating a good internal consistency (reliability) in terms of the correlations among the 25 variables, and the measuring scale used is reliable. Oblique rotation technique was used because it is ideal for obtaining several theoretically significant variables (Hair *et al.*, 1998), and the results are not complicated (Fabrigar *et al.*, 1999). Promax is a popular oblique rotation approach that has been used by several researchers (Chan and Lee, 2009; Kärnä *et al.*, 2009). As a result, the promax rotation approach was eventually used in this study for further discussion.

The total variance explained (Table 2) is looked upon to determine the number of significant factors. It is important to note that only extracted and rotated values are meaningful for interpretation. The factors are arranged in ascending order based on the most

Total variance explained

	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings[a]
Factor	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total
1	5.772	23.089	23.089	2.121	8.484	8.484	3.748
2	2.621	10.485	33.574	4.296	17.186	25.670	3.050
3	2.115	8.460	42.034	1.985	7.938	33.608	2.541
4	1.675	6.699	48.733	1.553	6.212	39.820	2.327
5	1.203	4.814	53.547	0.976	3.903	43.723	1.824
6	1.142	5.566	58.113	0.866	3.465	47.188	2.448
7	1.015	4.060	62.173	0.542	2.168	49.355	3.596
8	0.917	3.666	65.839				
9	0.833	3.333	69.172				
10	0.779	3.117	72.289				
11	0.688	2.751	75.040				
12	0.620	2.482	77.522				
13	0.608	2.434	79.956				
14	0.565	2.258	82.214				
15	0.547	2.186	84.400				
16	0.504	2.018	86.418				
17	0.458	1.834	88.252				
18	0.436	1.743	89.995				
19	0.431	1.723	91.718				
20	0.411	1.645	93.363				
21	0.396	1.585	94.948				
22	0.357	1.428	96.376				
23	0.332	1.328	97.704				

Note(s): [a]Rotation converged in 7 iterations

Table 2.
Truncated SPSS output for the total variance explained for extracted factors

explained variance. Seven main factors are significant. The extraction sum of squared loadings is identical to the initial eigenvalues, except for factors that have eigenvalues less than 1, which are not shown.

The loadings of the factors determine the strength of the relationships. The largest loadings can identify factors, but it is also essential to examine the zero and low loadings to confirm their identification (Gorsuch, 1983). The reliability of the factor is determined by looking at the relationship between the individual rotated factor loading and the magnitude of the absolute sample size. The larger the sample size, the smaller loadings are allowed for a factor to be considered significant (Stevens, 2002). According to a rule of thumb, using an alpha level of 0.01 (two-tailed), a rotated factor loading for a sample size of at least 300 would need to be at least 0.32 to be considered statistically meaningful (Tabachnick and Fidell, 2007). The values represent the extent to which separate factors contribute to each underlying aggregated factor. The factor loadings and interpretation of the retrieved individual factors were found to be reasonably consistent. The pattern matrix (Table 3) shows the factor loadings of each variable on seven factors. This results from promax rotation and suppressing small coefficients (less than 0.3), which helps in the interpretation. The factor loadings show that the factors are fairly desirable. The higher the absolute value of the loading, the more the factor contributes to the variable.

The seven-factor groupings are labelled as shown in Figure 1. There are no rules for naming factors, except to give names that best represent the variables within the factors. The reliability analysis test was performed for each group factor. The factor names were given by understanding the definitions of these variables. Again, Cronbach's alpha (α) was used to test

	Factor						
	1	2	3	4	5	6	7
V1	0.833						
V2	0.703						
V3	0.542						
V4	0.464						
V5	0.356						
V14	0.351						
V18		0.769					
V19		0.759					
V20		0.629					
V17		0.577					
V11			0.843				
V12			0.749				
V13			0.675				
V6			0.668				
V25				0.876			
V24				0.606			
V7					0.696		
V8					0.721		
V21					0.706		
V23						0.846	
V22						0.794	
V9							0.617
V15							0.599
V16							0.715
V10							0.808

Extraction method: Maximum likelihood
Rotation method: Promax with Kaiser normalisation.[a]

Note(s): a. Rotation converged in 7 iterations

Table 3.
Factor components

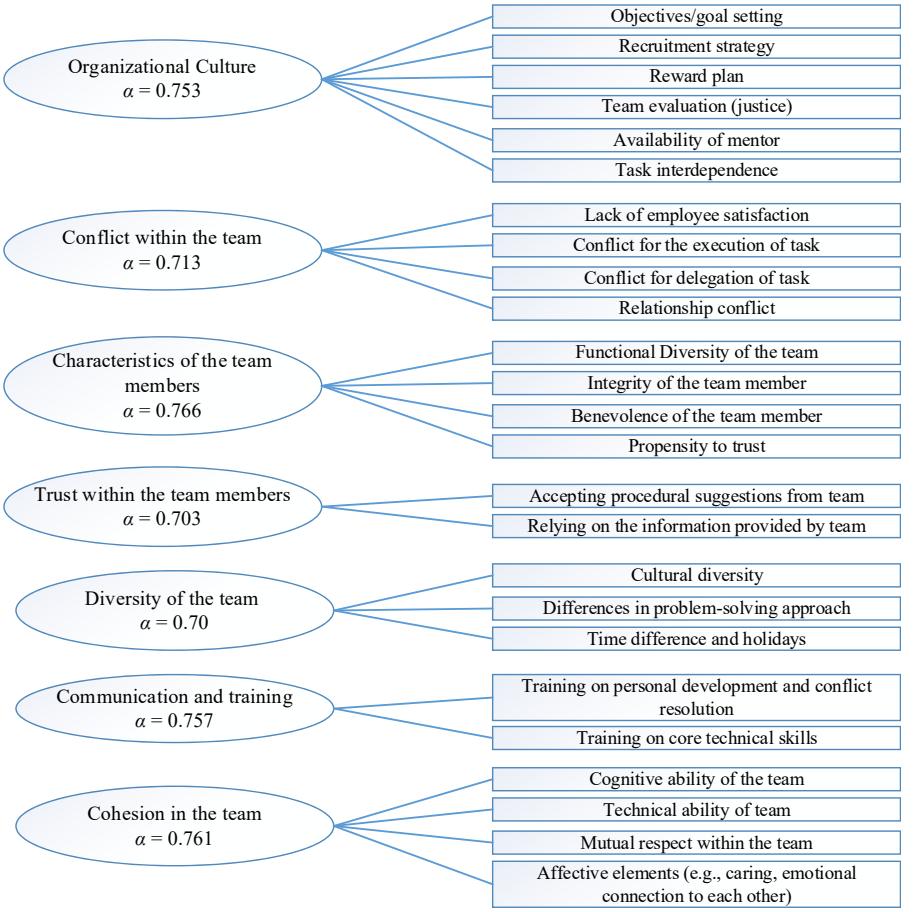

Figure 1.
Group factors for challenges in virtual project teams

the reliability of each factor formed, as shown in Figure 1. It is believed that the seven-factor solution derived forms the underlying groupings for challenging factors for virtual team projects.

5. Discussion

This study identified factors that influence virtual teams in the construction sector. By applying factor analysis on the initial 25 items, the analysis produced seven major factors that could explain the challenges of virtual project teams in the construction sector of the Middle East. The factors are discussed further in the following details.

5.1 Organisational culture

This factor consists of six sub-factors: objectives/goal setting, recruitment strategy, reward plan, team evaluation (justice), availability of mentor and task interdependence. Organisational culture includes norms regarding the free flow of information, shared leadership and cross-boundary collaboration. Organisations must provide the virtual project

teams with appropriate physical, financial and social support. These support systems should include evaluation and compensation systems, training development programmes, information systems that provide relevant, accurate and timely information for the group. The organisational culture becomes the motivational factor for the virtual project teams to develop confidence in the internal operational issues. This agrees with Katane and Dube (2017) who emphasised the importance of organisational culture on the success of virtual project teams. Setting objectives or goals for effective virtual team management, having the highest loading of 0.833, is a challenging factor observed in construction organisations. Amah *et al.* (2013) found that goal setting improves performance by stretching the intensity and persistence of employee effort. The virtual team members channelise their behaviours' towards improved work performance when they have clearer role perceptions.

5.2 Conflict within the team

Four sub-factors, namely, conflict for the execution of task, conflict for delegation of task, relationship conflict and lack of employee satisfaction, that indicate a team conflict regarding virtual teams in the construction sector. These four sub-factors relate to task conflict and relationship conflict, aligning with Jehn (1997), who argued that intra-team conflict could be divided into two types: task conflict and relationship conflict. Disagreement in perspectives, thoughts about the substance and aim of the task, and attitudes on decision-making procedures are all examples of task conflict. Interpersonal friction and disagreement over personal concerns constitute relationship conflict. Members' tension, hostility and irritability are all part of it. In this study, task conflict-related factors greatly influence virtual project teams in construction, having higher factor loadings of 0.760 (conflict for task execution) and 0.759 (conflict for delegation of task). This agrees with Chidambaram and Jones (1993) who posited that virtual teams function more in task-oriented contexts and less in socially focused environments. The teams become more effective when they have well-defined tasks rather than unclear and ill-defined tasks (Amah *et al.*, 2013).

5.3 Characteristics of the team members

The factor structure consists of four sub-factors that relate to the characteristics of the team members. The sub-factors include integrity of the team member, benevolence of the team member, propensity to trust and functional diversity of the team. Among the sub-factors, integrity of the team member had the highest factor loading of 0.843. Integrity has always been a concern to various team members during virtual project teams. According to Mansor *et al.* (2012) and Morrison-Smith and Ruiz (2020), in a virtual team collaboration context, the team leader's integrity and zero tolerance for violations of commonly established ethical principles are critical in motivating other team members to accept responsibility for their decisions and actions and act in a trustworthy manner. The next highest factor loading is the benevolence of the team member with a value of 0.749.

5.4 Trust within the team members

This factor grouping consists of two sub-factors, namely, relying on the information provided by the team and accepting procedural suggestions from the team relating to trust within the team members. Among the two factors in this group, relying on the information provided by the team, recorded the highest factor loading of 0.876. Since most construction projects are unique and are usually one-off, it is difficult for team members to establish trust in virtual collaboration. This aligns with Garro-Abarca *et al.* (2021), who revealed that trust within the team is a major determinant of virtual team performance. Kuo and Thompson (2014) proposed that team members have little or no basis for judging the new teammate's

trustworthiness because of a lack of past information about the individuals. Those team members who have this ability or willingness to trust are expected to engage in trusting behaviours because they are especially inclined to trust teammates without knowing their trustworthiness and view new teammates as trustworthy based on limited information.

5.5 Diversity of the team

There are three sub-factors in this group, of which all factors relate to the diversity of teams within the virtual construction arrangements. The sub-factors include cultural diversity, differences in a problem-solving approach and time differences and holidays. Diversity or group heterogeneity results in increased conflict among team members and affects the team's performance (Paul and McDaniel, 2004). Differences in the problem-solving approach recorded the highest factor loading of 0.721 in this factor grouping. Construction is a multi-stakeholder sector involving various professionals with diverse perspectives to solve problems. Hence, it becomes more difficult to get team members to agree, especially when working virtually. The cultural diversity and communication barriers result in weakened team performance resulting in project complexity (Dube and Paré, 2001). Hosseini *et al.* (2016) claimed that diversity in culture and language have a negligible impact on virtuality in construction project teams because participants often speak technical language. Another important sub-factor is time difference and holidays. Gustavo *et al.* (2012) proved that when time zones are not overlapping between regions, it reduces communication between the teams.

5.6 Communication and training

This component emphasises the challenges associated with communication and training to managing virtual project teams in the construction industry. Training on personal development and conflict resolution and training on core technical skills are the two sub-factors in this grouping. Communication is key in virtual project team management. However, communication becomes a challenge in the virtual environment due to time delays in sending feedback, lack of a common frame of reference for all members, differences in salience and interpretation of a written text, and assurance of participation from remote team members (Amah *et al.*, 2013). This challenge could be compounded by the lack of training needed by team members for effective communication. Training is one of the requirements to work virtually in a collaborative fashion (Iorio and Taylor, 2015). Amah *et al.* (2013) suggested that the training makes employees good team players and helped them acquire skills and experiences. The training also could allow employees to experience the satisfaction that teamwork can provide. Cheng *et al.* (2021) revealed that computer training related to more advanced skills sets might help build virtual team efficacy in the case of collective computer efficacy.

5.7 Cohesion in the team

This factor consists of four sub-factors related to cohesion in the team, including cognitive ability of the team, technical ability of the team, mutual respect within the team and affective elements (e.g. caring, emotional connection to each other). Cognitive and technical ability are related to task cohesion, while mutual respect and affective elements are socially related. Group cohesion is one of the determinants that can directly affect the virtual team's performance (Garro-Abarca *et al.*, 2021). Hence, cohesion (both social and task) must be developed and strengthened for effective virtual teamwork (Lu, 2015). Given that construction projects are short-lived, it is difficult to develop bonding among team members for shorter projects as the deadline for the project does not give them enough time to bond. If the projects are for longer durations, initially, the virtual teams begin with lower cohesion, then they develop the bonding over a period of time. This is because they get enough time to exchange social information to create stronger cohesion.

Therefore, time factor plays a great role in developing cohesion among the team members (Chidambaram, 1996).

5.8 Implication of findings

Organisations are increasingly leveraging advancement in communication technology to improve performance by forming virtual teams, and construction organisations are not excepted. When experts and valued members of organisations are geographically located at distant, the formation of virtual teams allows organisations to access information, skills and views that would not be available through traditional team formation. To meet the demands of today's hypercompetitive global economy and high rate of infrastructural development in the Middle East, virtual teams will enable construction companies to aggregate the capabilities of their own personnel as well as those of trade partners and consultancy firms. Nonetheless, despite the availability of technology to support remote operations of experts, virtual teams frequently fail to achieve their full potential due to challenges, some of which have been discussed in this study. Unlike traditional team, in a virtual team arrangement, organisations structure their duties through networks of teams, which poses managerial issues that are distinct from those seen in traditional hierarchical relationships. Since team members work remotely from the construction site, their manager and one another, typical social and cultural norms for influencing team members' attitudes and fostering cooperative conduct are unavailable. Moreso, in virtual teams, especially with construction projects, it is difficult to observe the progress made by team members directly. Establishing trust in virtual teams can be more difficult in construction project teams due to the one-off nature of most projects as members may have no past to draw on, no future to look forward to and may never even meet face-to-face. To this end, an understanding of factors affecting virtual team's development will help construction managers, team leaders and members to facilitate and improve team success.

6. Conclusion

The vast majority of individuals participating in collaboration, equipped with knowledge of what makes virtual teams unique and the essential instruments for increasing virtual team performance, are expected to benefit greatly from virtuality. Because of globalisation, construction companies have realised the importance of virtual project teams and started implementing them. However, many of them have realised the challenges associated with virtual project teams and hence wanted to address this issue. Therefore, this study helped to understand the concept and challenges of the virtual project teams in the construction sector. The paper adopted a questionnaire survey on targeted professionals with virtual project team experience to evaluate 25 variables extracted from the literature review. The factor analysis technique (principal component analysis) was used to establish the factor structure for the set of 25 variables. The results indicate seven clusters of factors affecting virtual teams: organisational culture, conflict within the team, characteristics of the team members, trust within the team members, diversity of the team, communication and training, and cohesion in the team.

This research has several implications for the Middle East construction companies. Most construction companies are involved in large infrastructural projects involving many professionals and stakeholders with different backgrounds and perspectives. Virtual teams must develop mechanisms for eliminating challenges to leverage experiences and insights critical for accomplishing project goals. Organisations embracing virtual teams must overcome coordination barriers of working across distance and time, engaging cross-cultural and team diversity, establishing trust and team cohesion as team members having minimal opportunities to identify common values, such as construction projects, and numerous other challenges associated with virtual work. This study would benefit construction professionals

by educating them on the steps necessary for greater team cooperation in virtual teams. The factors will drive the needed platform to support effective virtual project teams in the Middle East. The study has some limitations that may affect its generalisability. First, based on experts' opinions, only 25 variables are taken from the list of 40 factors extracted from the literature for the study. These variables can be extended. More experts can be invited and engaged in qualitative research to understand their challenges in different regions. Second, the overall analysis ignored the sensitivities of the challenging factors to different construction project types and territories in the Middle East; thus, bespoke studies may have to be conducted in different regions and tailored for specific projects. The study has several implications for research as it is the first to study the factors affecting virtual project teams in construction in the Middle East. Countries in the Middle East can contextualise the findings in the study, which provides a valuable reference for further contextual investigations in different regions. In this era of Covid-19, virtual environments are revolutionising the factors affecting team performance, and more research is needed to address this revolution.

References

Amah, E., Nwuche, C.A. and Chukuigwe, N. (2013), "Result oriented target setting and leading high performance teams", *Industrial Engineering Letters Www.iiste.org*, Vol. 3 No. 9, pp. 47-60.

Brown, T.A. (2015), *Confirmatory Factor Analysis for Applied Research*, Guilford Publications, New York.

Chan, E.H. and Lee, G.K. (2009), "Design considerations for environmental sustainability in high density development: a case study of Hong Kong", *Environment, Development and Sustainability*, Vol. 11 No. 2, pp. 359-374.

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

Cheng, X., Bao, Y., Yu, X. and Shen, Y. (2021), "Trust and group efficiency in multinational virtual team collaboration: a longitudinal study", *Group Decision and Negotiation*, Vol. 30 No. 3, pp. 529-551.

Chidambaram, L. (1996), "Relational development in computer-supported groups", *MIS Quarterly*, Vol. 20 No. 2, pp. 143-163.

Chidambaram, L. and Jones, B. (1993), "Impact of communication medium and computer support on group perceptions and performance: a comparison of face-to-face and dispersed meetings", *MIS Quarterly*, Vol. 17 No. 4, pp. 465-491.

Cui, Y., Liu, Y. and Mou, J. (2018), "Bibliometric analysis of organisational culture using CiteSpace", *South African Journal of Economic and Management Sciences*, Vol. 21 No. 1, pp. 1-12.

Davidavičienė, V., Al Majzoub, K. and Meidute-Kavaliauskiene, I. (2020), "Factors affecting knowledge sharing in virtual teams", *Sustainability*, Vol. 12 No. 17, p. 6917.

De Jong, B.A. and Elfring, T. (2010), "How does trust affect the performance of ongoing teams? The mediating role of reflexivity, monitoring, and effort", *Academy of Management Journal*, Vol. 53 No. 3, pp. 535-549.

Dube, L. and Paré, G. (2001), "Global virtual teams", *Communications of the ACM*, Vol. 44 No. 12, pp. 71-73.

El-sheikh, M.Y., Mohamedtahwia, A., Al-halwany, A.A. and Shiha, E. (2014), "The application and impact of using virtual team in Middle East (case study)", *IISTE International Journals*, Vol. 6 No. 3, pp. 164-168.

Fabrigar, L.R., Wegener, D.T., MacCallum, R.C. and Strahan, E.J. (1999), "Evaluating the use of exploratory factor analysis in psychological research", *Psychological Methods*, Vol. 4 No. 3, p. 272.

Fang, Y.-H. and Chiu, C.-M. (2010), "In justice we trust: exploring knowledge-sharing continuance intentions in virtual communities of practice", *Computers in Human Behavior*, Vol. 26 No. 2, pp. 235-246.

Fang, D.P., Xie, F., Huang, X.Y. and Li, H. (2004), "Factor analysis-based studies on construction workplace safety management in China", *International Journal of Project Management*, Vol. 22 No. 1, pp. 43-49.

Foster, M.K., Abbey, A., Callow, M.A., Zu, X. and Wilbon, A.D. (2015), "Rethinking virtuality and its impact on teams", *Small Group Research*, Vol. 46 No. 3, pp. 267-299.

Garro-Abarca, V., Palos-Sanchez, P. and Aguayo-Camacho, M. (2021), "Virtual teams in times of pandemic: factors that influence performance", *Frontiers in Psychology*, Vol. 12, p. 232.

Goldman, M.D. and Filliben, E.M. (2000), "Corporate governance: current trends and likely developments for the twenty-first century", *Delaware Journal of Corporate Law*, Vol. 25, p. 683.

Gorsuch, R.L. (1983), *Factor Analysis*, 2nd ed., Erlbaum, Hillsdale, NJ.

Gustavo, P., Ferreira, S., Pinheiro, E., Lima, D. and Gouvea, S.E. (2012), "Perception of virtual team's performance: a multinational exercise", *International Journal of Production Economics*, Vol. 140 No. 1, pp. 416-430.

Hair, J.F., Anderson, R.E., Tatham, R.L. and Black, W.C. (1998), *Multivariate Data Analysis*, Prentice-Hall, Upper Saddle, New Jersey.

Hardin, A.M., Fuller, M.A. and Davison, R.M. (2007), "I know I can, but can we? Culture and efficacy beliefs in global virtual teams", *Small Group Research*, Vol. 38 No. 1, pp. 130-155.

Harris, E.C. (2014), "Middle East major construction programmes mitigating the delivery risk", *Middle East Business*, available at: https://middleeast-business.com/middle-east-major-construction-programmes/.

Heimer, C. and Vince, R. (1998), "Sustainable learning and change in international teams: from imperceptible behaviour to rigorous practice", *Leadership and Organization Development Journal*, Vol. 19 No. 2, pp. 83-88.

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

Hosseini, M.R. and Chileshe, N. (2013), "Global virtual engineering teams (GVETs): a fertile ground for research in Australian construction projects context", *International Journal of Project Management*, Vol. 31 No. 8, pp. 1101-1117.

Hosseini, M.R., Chileshe, N., Baroudi, B., Zuo, J. and Mills, A. (2016), "Factors affecting perceived level of virtuality in hybrid construction project teams (HCPTs): a qualitative study", *Construction Innovation*, Vol. 16 No. 4, pp. 460-482.

Hosseini, M.R., Bosch-Sijtsema, P., Arashpour, M., Chileshe, N. and Merschbrock, C. (2018), "A qualitative investigation of perceived impacts of virtuality on effectiveness of hybrid construction project teams", *Construction Innovation*, Vol. 18 No. 1, pp. 109-131.

Iorio, J. and Taylor, J.E. (2015), "Precursors to engaged leaders in virtual project teams", *International Journal of Project Management*, Vol. 33 No. 2, pp. 395-405.

Jarvenpaa, S.L., Knoll, K. and Leidner, D.E. (1998), "Is anybody out there? Antecedents of trust in global virtual teams", *Journal of Management Information Systems*, Vol. 14 No. 4, pp. 29-64.

Jehn, K.A. (1997), "A qualitative analysis of conflict types and dimensions in organisational groups", *Administrative Science Quarterly*, pp. 530-557.

Kärnä, S., Junnonen, J.M. and Sorvala, V.M. (2009), "Modelling structure of customer satisfaction with construction", *Journal of Facilities Management*, Vol. 7 No. 2, pp. 111-127.

Katane, J. and Dube, S. (2017), "The influence of organisational culture and project management maturity in virtual project teams", *Cell*, Vol. 72 No. 398, p. 4764.

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

Kaur, S., Arif, M. and Akre, V. (2015), "Factors affecting trust in virtual project teams in construction sector in Middle East", *12th Post-Graduate Research Conference 2015*, Media City UK, 10-12 June 2015, pp. 262-276.

Kuo, E.W. and Thompson, L.F. (2014), "The influence of disposition and social ties on trust in new virtual teammates", *Computers in Human Behavior*, Vol. 37, pp. 41-48.

Lee, H., Ahn, H., Kim, H. and Lee, J. (2014), "Comparative analysis of trust in online communities", *Procedia Computer Science*, ITQM 2014, Vol. 31, pp. 1140-1149.

Lilian, S.C. (2014), "Virtual teams: opportunities and challenges for e-leaders", *Procedia-Social and Behavioral Sciences*, Vol. 110, pp. 1251-1261.

Lingard, H. and Rowlinson, S. (2006), "Letter to the editor", *Construction Management and Economics*, Vol. 24 No. 11, pp. 1107-1109.

Lu, L. (2015), "Building trust and cohesion in virtual teams: the developmental approach", *Journal of organisational Effectiveness: People and Performance*, Vol. 2 No. 1, pp. 55-72.

Mansor, N., Mirahsani, S. and Saidi, M. (2012), "Investigating possible contributors towards 'organizational trust' in effective 'virtual team' collaboration context", *Procedia-Social and Behavioral*, Vol. 57, pp. 283-289.

Mattessich, P.W. and Monsey, B.R. (1992), *Collaboration: What Makes it Work. A Review of Research Literature on Factors Influencing Successful Collaboration*, Amherst H. Wilder Foundation, St. Paul, MN.

Moore, D.R. and Abadi, M. (2005), "Virtual team working and associated technologies within the UK construction industry", *Architectural Engineering and Design Management*, Vol. 1 No. 1, pp. 21-32.

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

Mukherjee, D., Renn, R.W., Kedia, B.L. and Mukherjee, D. (2012), "Development of interorganizational trust in virtual organisations: an Integrative Framework", *European Business Review*, Vol. 24 No. 3, pp. 255-271.

Norusis, M.J. (1993), *SPSS for Windows Professional Statistics Release 6.0*, SPSS, Chicago.

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

Odubiyi, T.B. and Oke, A.E. (2016), "Strengths, weaknesses, opportunities and threats of virtual team in Nigerian construction industry", *Organisation, Technology and Management in Construction: An International Journal*, Vol. 8 No. 1, pp. 1422-1428.

Oertig, M. and Buergi, T. (2006), "The challenges of managing cross-cultural virtual project teams", *Team Performance Management*, Vol. 12 Nos 1/2, pp. 23-30.

Patel, H., Pettitt, M. and Wilson, J.R. (2012), "Factors of collaborative working: a framework for a collaboration model", *Applied Ergonomics*, Vol. 43 No. 1, pp. 1-26.

Paul, D.L. and McDaniel, R.R. Jr (2004), "A field study of the effect of interpersonal trust on virtual collaborative relationship performance", *MIS Quarterly*, pp. 183-227.

Paul, S., Seetharaman, P., Samarah, I. and Mykytyn, P.P. (2004), "Impact of heterogeneity and collaborative conflict management style on the performance of synchronous global virtual teams", *Information and Management*, Vol. 41 No. 3, pp. 303-321.

Pett, M.A., Lackey, N.R. and Sullivan, J.J. (2003), *Making Sense of Factor Analysis: The Use of Factor Analysis for Instrument Development in Health Care Research*, Sage, Thousand Oaks, California.

Powell, A., Piccoli, G. and Ives, B. (2004), "Virtual teams : a review of current literature and directions for future", *The Database for Advances in Information Systems*, Vol. 35 No. 1.

Ramalingam, S., Lobo, S., Mahalingam, A. and Whyte, J. (2014), "Achieving reliability in transnational work on complex projects: new directions for research", *Engineering Project Organization Journal*, Vol. 4 No. 4, pp. 193-208.

Santos, J.R.A. (1999), "Cronbach's alpha: a tool for assessing the reliability of scales", *Journal of Extension*, Vol. 37 No. 2, pp. 1-5.

Shaikh, I. (2018), "Virtual team management in construction projects and the role of BIM: a study of challenges faced by construction projects in managing virtual teams distributed globally", Master thesis submitted to Royal Institute of Technology (KTH).

Stevens, J.P. (2002), *Applied Multivariate Statistics for the Social Sciences*, 4th ed., Erlbaum, Hillsdale, NS.

Tabachnick, B.G. and Fidell, L.S. (2007), *Using Multivariate Statistics*, 5th ed., Allyn & Bacon, Boston, MA.

Tan, C.K., T, R., Teoh, A.P. and Cheah, J.-H. (2019), "Factors influencing virtual team performance in Malaysia", *Kybernetes*, Vol. 48 No. 9, pp. 2065-2092.

Vakola, M. and Wilson, I. (2004), "The challenge of virtual organisation: critical success factors in dealing with constant change", *Team Performance Management*, Vol. 10 Nos 5/6, pp. 112-120.

Vinaja, R. (2003), "Major challenges in multicultural virtual teams", *33rd Annual Conference of the Decision Sciences Institute Southwest Region*, Houston, TX, Vol. 78541 No. 956, pp. 341-346.

Yen, D., Chou, D.C., Chen, T. and Chen, H.-G. (2002), "Becoming a virtual organisation: a strategic approach", *International Journal of Networking and Virtual Organisations*, Vol. 1 No. 2, pp. 184-198.

Zuofa, T. and Ochieng, E.G. (2017), "Working separately but together: appraising virtual project team challenges", *Team Performance Management: An International Journal*, Vol. 23 No. 5, pp. 227-242.

Zuofa, T. and Ochieng, E.G. (2021), "Investigating barriers to project delivery using virtual teams", *Procedia Computer Science*, Vol. 181, pp. 1083-1088.

Further reading

Cramton, C.D. (2001), "The mutual knowledge problem and its consequences for dispersed collaboration", *Organisation Science*, Vol. 12, pp. 356-371.

Nathaniel, A. and Anthony, C.I. (2012), "Barriers to the uptake of concurrent engineering in the Nigerian construction industry", *International Journal of Engineering Business Management*, Vol. 4, pp. 1-8.

Norušis, M.J. (1993), *SPSS for Windows TM, Professional Statistics, Release 6.0*, SPSS, Chicago.

Peters, L.M. and Manz, C.C. (2007), "Identifying antecedents of virtual team collaboration", *Team Performance Management: An International Journal*, Vol. 13, pp. 117-129.

Wayne, F.C. (2000), "Managing a virtual workplace", *Academy of Management Executive*, Vol. 14 No. 3, pp. 81-90.

Corresponding author
Olugbenga Timo Oladinrin can be contacted at: o.oladinrin@wlv.ac.uk