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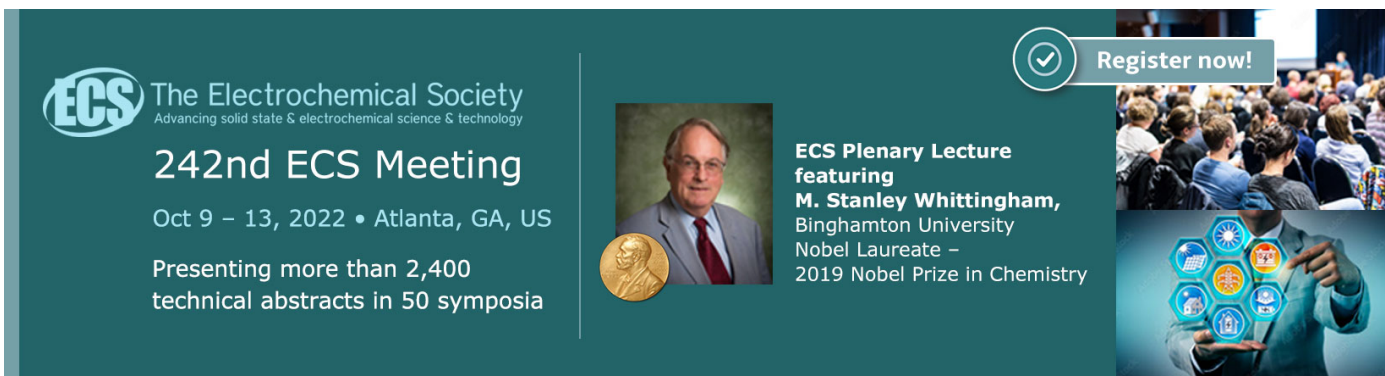
Strategies for virtual teams in construction: Easiness-effectiveness analysis

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Strategies for virtual teams in construction: Easiness-effectiveness analysis

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Abstract. Technology has contributed to the development of the construction sector. Scientific discoveries have resulted in the cooperation of a group of people from different geographic locations who depend on communication technologies (i.e., a virtual team). Virtual teams use advanced technology to fix communication issues and are considered as a practical, productive, and creative team concept. Thus, it is evident that the virtual team also needs to concern about improving construction efficiency. This study aims to define the strategies that maximize the effectiveness of virtual teams in the construction industry in Malaysia. To achieve the objective, a questionnaire survey was conducted with industry practitioners from the Malaysian construction industry. Data of 112 respondents were collected and analyzed. The results reveal that seven strategies are perceived by industry practitioners to be both the most effective and easiest in enhancing virtual teams. Conversely, ten strategies are either the most effective or easiest to be implemented. This research adds to the body of knowledge in expanding the understanding of virtual teams in the construction industry in Malaysia, which could support industry practitioners in the decision-making process for improving virtual teams. The findings of this research would help increase the efficiency of the project teams in the construction industry.

1. Introduction

For the last years, the construction industry in Malaysia has experienced critical issues and faced enormous challenges from surrounding communities to improve the productivity and quality of work. Some of these obstacles are high-cost payment, late in completing the job, low production quality, intensive labor, and the use of conventional methods and old technology [30]. For instance, the average percentage of time overrun for construction projects is 49.71% [29]. Effective collaboration has become essential to organizations due to its significance in the performance [28]. In other words, the ability of workers to work as a team contributes directly to the success of an organization. Collaboration also makes workers more accountable, which goes a long way towards increasing their motivation levels. Therefore,



organizations are seeking to gain competitive advantages through effective collaboration, which can be achieved by approaching new technologies.

One of the most effective strategies nowadays widely used by large firms is the use of technological aspects, such as virtual teams [32]. Virtual teams, also known as a geographically spread group of colleagues who participate in work from different geographic locations and rely on communicational technologies such as email, FAX, and video or voice conferencing callings to collaborate [33]. Unlike a traditional team, a virtual team works through space, time, and organizational boundaries, with links supported by communication technologies. Through the past years, we realized that the organizations used some techniques such as conference calls and telecommuting as a way to help people for doing their works more efficiently and effectively. Motivated by globalization, companies often resort to using virtual teams in higher numbers, which increases the communications strategies and their efficiency [34]. The virtual teams ease a firm's path in continuously producing a change in environments [31]. In today's competitive global economy, companies capable of rapidly building virtual teams of talented people will respond quickly to evolving business environments [26]. This kind of capability strengthens the position of an organization in the market. Therefore, every construction company should improve the efficiency of virtual team members, including how to use leadership expertise as a way to minimize obstacles and enhance team outcomes.

This paper aims to explore the level of easiness and effectiveness of strategies that targets the enhancements of virtual teams in the construction industry. To achieve that objective, survey data from construction companies across Malaysia are analyzed. The findings of this study will expand the understanding of the virtual team in the construction industry. In which it will significantly support the decision-making process. Also, the findings will help industry practitioners in allocating resources such as human resources and technologies strategically. Moreover, this study will increase the efficiency of virtual teams in the construction industry.

2. Literature Review

2.1 Virtual Teams

Virtual-team researches showed a lack of depth in the definitions. Although virtual communication is a current topic in global organizational-based researches, defining what "virtual" means across multiple institutional contexts has been problematic [38]. One of the most widely accepted definitions of the virtual team is "virtual teams as groups of geographically, organizationally and/or time dispersed workers brought together by information technologies to accomplish one or more organization tasks" [48]. A study found that virtual teamwork is an effective way for projects to create flexibility or superior value in solving problems [34]. Also, virtual teams are seen as a viable way to provide an effective team to improve communication and collaboration to solve decentralized problems [34]. In addition, group collaboration had a significant yield of improvement in their performances compares to individuals with a remarkable performance on each collaborative test that had a higher score compared to that of the individuals [41]. The success of virtual teams depends on the use of technological methods because it is the main approach to virtualization and operation in the virtual environment [42]. Technology in construction generally includes digital devices, spatial analysis systems, hand tools, and excavation equipment and any combination of resources from design to building and demolition used in the construction process [43]. A study proposed that virtual team members should learn and endure training on ways to communicate differently [26]. Also, due to virtual team members are located in different areas, virtual team leaders must reach daily with other members to develop trust and understanding that is critical to improving the quality of communication [26]. Virtual teams provide new approaches that are creative and innovative through diversity, but cultural differences can be affected by different perspectives

and differences [40]. Thus, identifying suitable strategies could maximize the efficiency of the virtual teams.

2.2 Effective Virtual Teams

In the last decades, with the rapid development of electronic information and communication media, communication has become much quicker, easier, and more efficient [44]. In response to the growing development of the work processes, many organizations have responded to the development by incorporating virtual teams that interact across geographical, cultural, and organizational boundaries through communication technologies to achieve common goals in their organizational productions [46]. One of the main benefits of virtual teams is the availability of a flexible and configurable base infrastructure [44]. The use of effective communication, particularly during the early stages of team development, can play an equally important role in building trust and retaining trust [33]. Virtual teams are essential platforms for companies that aim to maximize resources across geographic boundaries and elsewhere. Complex projects are constructed much more in collaboration with the parties involved in the construction process [47]. The innovations of virtual teams provide the infrastructure needed to support the development of new organization methods. Virtual teams offer an extraordinary level of flexibility for organizations and responsiveness [48]. Based on studies of virtual team simulation meetings, [28] discovered that effective communication strategies could play a role as a team and play a key role in building confidence within the work area. Finally, organizational and cultural barriers are the most significant barrier to the effectiveness of virtual teams. Most managers are uncomfortable with the idea of a virtual team, since effective virtual team management may require new strategies of supervision [47]. Therefore, to have effective virtual communication between the team members, the organization needs to select strategies that will enhance the performance of the team and the efficiency of the organization.

2.3 Positioning this study

Research on virtual teams is still in its beginnings, and many areas of research have not yet been studied due to the relative recency of virtual teams [37]. Building up the infrastructure of the virtual teams needs a great effort, which will face many challenges for implementing this new technology [39]. Effective collaboration between team members becomes vital to the success of engineering projects. Therefore, the studies suggest that more research needs to be done to explore ways to improve the efficiency of virtual teams [40]. In this research, seventeen strategies that target the enhancement of virtual teams have been identified from previous studies and distributed to construction industry practitioners using an online questionnaire survey. The authors aim to explore the effectiveness and easiness of strategies that target the enhancement of virtual teams in the construction industry. The findings will support the idea of having efficient common communication strategies for virtual teams.

3. Methodology

3.1 Introduction

Data collection will include primary statistics collection from the project managers of construction companies. Questionnaire forms have been distributed to the respondent to gain better background about the strategies that maximize the effectiveness of the virtual team in the Malaysian construction industry. For the collected data, the normalization method was used to analyze it.

3.2 Developing the Survey

The questionnaire is designed according to the objective of this research. Hence, a systematic review of the literature on virtual team strategies was first conducted. Then, a list of 17 strategies for maximizing the

effectiveness of virtual teams was identified. Table 1 lists those strategies together with their respective references.

The questionnaire has three main sections: It begins with questions about general information in section A, and rating the effectiveness of the strategies in section B, and rating the easiness of implementing the strategies section C. Section B and C use a six-point Likert scale because it is highly reliable and accurate [35]. The descriptors used in the six-point scale in section B are: ‘not at all effective,’ ‘slightly effective,’ ‘moderately effective,’ ‘effective,’ ‘extremely effective,’ and ‘no opinion;’ and for section C are: ‘extremely difficult,’ ‘difficult,’ ‘average,’ ‘easy,’ ‘extremely easy,’ and ‘no opinion.’

Before the actual data being recorded, a pilot test had been conducted first. Four participants were involved in the pilot test to ensure the respondent understand the question, the objectives of the research and to determine either the questionnaires are acceptable and reliable by the respondent to make sure the data obtained are valid. The results of the pilot survey provide an overall satisfactory picture of the questionnaire items, scales, and measures. Most of the participants found the questionnaire to be understandable and easy to respond. In addition, the questionnaire can be easily completed within 5-7 minutes. After the pilot study, the significance and completeness of the variables are verified and finalized.

Table 1. List of the strategies for maximizing the effectiveness of virtual teams.

Code	Strategies	References
S01	Using synchronous online communication platform	[1], [17], [18], [24]
S02	Using digital information modeling	[2], [3], [5], [6], [9], [12], [22]
S03	Using virtual information modeling	[6], [7], [8]
S04	Using Strategy that known for a high rate of respond	[1], [8], [11] [13], [14], [18], [22]
S05	Using augmented reality (AR)-based 4D CAD system	[6], [7], [8]
S06	Using modern communication tools between team members	[1], [2], [3], [5], [6], [8], [11] [13], [14], [22]
S07	Using collaborative virtual reality (CoVR)	[6], [7], [8]
S08	Using communication platforms that are easily accessible	[1], [17], [18], [24]
S09	Using cyber-physical systems that allow bidirectional coordination between virtual models and the physical construction	[2], [5], [7] [15], [19]
S10	Establishing communication platforms based on the situation	[7], [14], [17], [20], [21]
S11	Using virtual design team (VDT)	[3], [5], [14], [16]
S12	Using platforms that provide instant communication	[17], [18], [24], [25]
S13	Defining communication platforms that are agreed as best in reaching each other	[6], [8], [17], [18], [20]
S14	Using tools that are known for smoothing communication among team members	[1], [18], [21], [24], [25]

S15	Establishing communication platforms based on the speed of project delivery	[3], [9], [10] [13], [14], [18]
S16	Adopting communication platforms that are agreed as best in reaching each other	[6], [18], [20]
S17	Using communication platforms that are readily available	[1], [18], [25]

3.3 Data Collection

In this research, mail surveys, and social media such as WhatsApp and LinkedIn have been used because this method is capable of accumulating information in a short time with lower cost [27]. Also, this approach allows the researcher to target a specific group of individuals while allowing participants to respond according to their availability. It also benefits the need to ask non-public questions about the research study.

The targeted population for this study is project managers with deep experience in the implementation of virtual teams in the Malaysian construction industry. This research used a random sampling because it is more reliable for studying a large sample size. The intended samples are a heterogeneous combination of participants from various levels of public and private firms of virtual teams. Firms that fall within the population sample are rated by grade G-7 level under CIDB. G-7 rated companies have been chosen because they are subjected to more complex projects and therefore have more experience with the implementation of virtual teams. Table 2 summarizes the respondents' background for this study.

Table 2. Respondents background.

Profiles	Categories	Number of respondents	Percentage
Types of organization	Owners (e.g., government, developers)	15	14.0%
	Contractors	53	47.0%
	Consultants	35	31.0%
	Others	9	8.0%
Highest academic qualification	High School Certification	4	3.6%
	Diploma	8	7.0%
	Bachelor's Degree	75	67.0%
	Master's Degree	25	22.4%
Years of experience in the construction industry	Less than 2 years	17	15.2%
	2 - 5 years	36	32.0%
	6 - 9 years	20	18.0%
	More than 10 years	39	34.8%
Types of projects	Private	44	39.3%
	Government	16	14.3%
	Both government and privates	52	46.4%
Location of the company	Northern Region	13	11.6%
	Central Region	76	67.9%
	Southern Region	13	11.6%

East Region	6	5.4%
East Malaysia	4	3.5%

3.4 Data Analysis

The collected data were analyzed from the respondents using Statistical Package for Social Sciences (SPSS) software, version 20. Statistical analyses, such as descriptive statistics and normalization analysis, were employed for data analysis. The mean scores were first determined and then used to calculate their respective normalized values. Equation (1) shows the mathematical expression to compute the normalized values.

$$\text{Normalized value} = (\text{mean} - \text{minimum mean}) / (\text{maximum mean} - \text{minimum mean}) \quad (1)$$

The normalization value ranges from 0 to 1, with 0 not inclusive. It shows that the higher the normalization value, the more important of the sustainable criteria and vice versa. Only strategies with a normalized value > 0.50 will be considered most effective or easiest to be implemented.

4. Results and Discussion

Table 2 shows the ranking of effectiveness and easiness of the strategies that target the enhancement of virtual teams in the construction industry. The results are obtained after analyzing the questionnaire survey data from 112 respondents. The results illustrate that there are strategies that are both easy and effective and also strategies that are either effective but not easy or easy but not effective. Therefore, this study identifies the overlapping strategies, which, in other words, represent strategies that are both easy and effective.

Table 3. Ranking of the effectiveness and easiness level of the strategies.

Code	Effectiveness				Easiness			
	Mean	Std. Deviation	Normalization value	Rank	Mean	Std. Deviation	Normalization value	Rank
S05	4.14	1.154	1.00 ^a	1	3.37	1.259	0.03	16
S08	4.13	0.881	0.95 ^a	2	3.83	0.909	0.84 ^b	5
S14	4.13	0.912	0.95 ^a	3	3.85	0.862	0.87 ^b	4
S04	4.11	0.924	0.89 ^a	4	3.79	0.988	0.78 ^b	7
S06	4.1	0.816	0.86 ^a	5	3.88	0.881	0.92 ^b	2
S12	4.1	0.880	0.86 ^a	6	3.92	0.840	1.00 ^b	1
S15	4.08	0.950	0.80 ^a	7	3.67	0.953	0.56 ^b	11
S11	4.07	1.198	0.77 ^a	8	3.6	1.298	0.44	12
S13	4.04	0.920	0.65 ^a	9	3.75	0.905	0.70 ^b	8
S07	4.03	1.248	0.62 ^a	10	3.55	1.374	0.36	13
S03	4.02	0.890	0.59 ^a	11	3.39	1.118	0.08	15

S09	3.99	1.197	0.50	12	3.35	1.285	0,00	17
S16	3.96	0.869	0.41	13	3.81	0.865	0.81 ^b	6
S10	3.95	0.899	0.35	14	3.87	0.875	0.91 ^b	3
S17	3.9	0.849	0.21	15	3.74	0.825	0.69 ^b	9
S02	3.88	1.055	0.15	16	3.46	1.048	0.20	14
S01	3.84	0.896	0.00	17	3.67	0.943	0.56 ^b	10

^a The normalized value indicates that the strategy is effective (normalized level of effectiveness > 0.50).

^b The normalized value indicates that the strategy is easy (normalized level of easiness > 0.50).

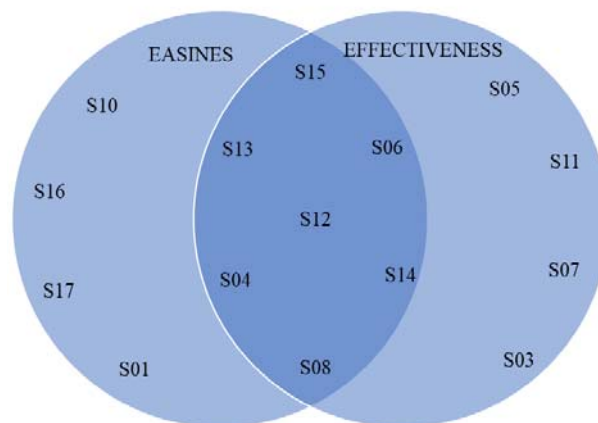


Figure 1. Illustrating the relationship between the most effective and easiest strategies.

According to Figure 1, strategies that are both effective and easy are: (S04) Using strategy that known for a high rate of respond; (S06) Using modern communication tools between team members; (S08) Using communication platforms that are easily accessible; (S12) Using platforms that provide instant communication; (S13) Defining communication platforms that are agreed as best in reaching each other; (S14) Using tools that are known for smoothing communication among team members; and (S15) Establishing communication platforms based on the speed of project delivery. The following subsections detail those strategies.

4.1 S04: Strategies with high response rates

An example of this strategy includes Skype. This strategy is ranked both effective and easiest implemented strategy for many reasons. For example, the strategy can be used for online meetings and transferring files. Team members need to install the application and register accounts which are free of charge.

4.2 S06: Strategies that use modern communication tools

Using Building Information Modelling (BIM) is one of the examples of this strategy. It is ranked with a high level of effectiveness because it can provide a stable platform for 3D models. This strategy enables clients to engage with projects before construction, and it improves team collaboration and workflow efficiency.

4.3 S08 Strategies that are easily accessible

The use of the WebEx Meeting Center is an example of this strategy. Due to many reasons, this strategy is ranked as both an effective and easiest implemented strategy. For example, it provides the team with an online meeting, fast decision making, sharing documents, simple to connect with other team members, and it also saves money and time.

4.4 S12 Strategies that provide instant communication

For the reasons for providing virtual communication, which is always online, always ready to respond, always in communication with each other, and with almost no cost, this strategy was considered as both an effective strategy and easiest to be implemented. WhatsApp is one of the examples of this strategy.

4.5 S13: Strategies that are agreed as best in reaching each other

Using ezTalks Cloud Meeting is an example of this strategy. The reasons for ranking this strategy as both effective and easiest strategy include, it supports a high number of members to collaborate during the same time without any charges, and it works with Windows, iOS, Android, and MAC.

4.6 S14: Strategies that use smoothing communication tools among team members

The reasons behind ranking this strategy as both effective and easiest strategy are because it supports online meetings and transferring files among team members who make everything go smoothly among the team members. Using TeamViewer is an example of this strategy.

4.7 S15: Strategies that established based on the speed of project delivery

Using Slack is an example of this strategy. Due to many reasons, this strategy was ranked as both the effective and easiest strategy. For example, it can support the team that is willing to keep in touch all the time virtually, which can increase the productivity of the team. Moreover, with the use of this strategy, teams will achieve a better and comprehensive of the project.

5. Conclusion

In response to the objectives of the study, the results identified the most effective and easiest strategies that target the enhancement of virtual teams in the construction industry by analyzing survey data from 112 respondents using the normalization method. The significant findings of this study are:

- Seventeen strategies that target the enhancement of virtual teams in the construction industry have been identified from the prior literature.
- Out of those seventeen strategies, seven strategies are perceived by industry practitioners to be both the most effective and easiest in enhancing virtual teams.
- Conversely, ten strategies are either the most effective or easiest to be implemented.

The authors believe that the identified strategies can help the construction industry make decisions in maximizing the efficiency of virtual team communication. The authors would suggest future studies to figure out more strategies and challenges through conducting interviews with industry practitioners who have deep experience in construction projects.

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