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Employing Fuzzy Delphi Technique to Validate the Component and Contents of Software Security Readiness for Remote Working Employee in Public Organization

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ABSTRACT

The primary objective of this study is to require the experts' unanimous agreement on the factor influencing software security readiness for remote working employees. This study used the Fuzzy Delphi Method (FDM) to collect responses and feedback using a 7-point Likert scale. The survey (items) was reviewed and approved by eight (8) experts panel members. Data analysis was performed using Fuzzy Delphi Logic (FUDELO 1.0) software. The data were evaluated using triangular fuzzy numbering and defuzzification was employed to determine the rank of each variable. The findings revealed that all the items received high levels of to comply with the overall percentage of percent consensus, which must be greater than 75%. All 81 recommended items were retained adequately and acceptable for a large-scale survey in this study. Finally, each item was prioritized (ranked) based on its defuzzification value, and additional items were incorporated based on expert recommendations.

Keywords:
Software security factor; remote working employee; Fuzzy Delphi technique

1. Introduction

According to World Health Organization [1], COVID-19, or coronavirus disease 2019, is a worldwide pandemic brought on by a type of infectious virus that causes respiratory infections in humans. The virus was still unknown before December 2019, until a sudden outbreak related to pneumonia with an unidentified cause happened in Wuhan, China. This pandemic rapidly spread across countries around the whole globe. Unexempted from the spread, the virus outbreak indeed reached even our own country, Malaysia, on 24 January 2020 when the first case was discovered. The outbreak caused a nationwide Movement Control Order (MCO) to be issued by the Ministry of Health.

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The spread of Covid-19 around the world has affected everyone in many different aspects, education is not excluded. Covid-19 has brought a huge impact on various industries around the world. Although education is a relatively independent industry, it has also been affected to a certain extent. In Malaysia, the MCO was implemented on 18th March 2020. Due to MCO, schools and universities were forced to close, and classes were all halted. This caused a delay in the progress for students of all levels from primary school to doctorates. Many efforts are made to reduce the impact of the lack of progress, such as starting online classes but for research that requires work to be done in a laboratory, it cannot be helped.

To make sure that the education process is not disrupted, lecturers, are conducting online classes for students. This shift into virtual classrooms has left educators and students flocking to online learning platforms such as Google Classroom, Google Meet, and Zoom, and instant messaging apps such as WhatsApp, and Telegram to resume learning. For example, educators are using platforms such as Google Meet, Microsoft Teams, or Google Classroom to conduct online video meetings so that they could easily interact with students. The lecture was mostly exposed to cyber-attack and a lack the knowledge on managing software security in the university.

Software security refers to the protection of programs that are either bought from an outside vendor or created in-house by users. It concerns the methods used for controlling software used to run the operating system or utility software [2]. The focus of software security is to proactively protect assets from attacks that will result in losses. Organizations that lack awareness of software security may suffer from cyber threats which may affect the performance of the organizations and lead to losses. Hence, operating in a vulnerable cyber environment, organizations must be equipped with software security. Unlike most of the studies on software security that focus on addressing security at the beginning of the software process, built into the design, implementing it in the coding, and verifying it during testing [3], this research aims to develop the capability of software security among end-users.

The increasing development of IoT devices and the existence of sophisticated attackers have resulted in the emergence of cyber risks. Cyber risks refer to the operational risks to information and technology assets that have consequences affecting the confidentiality, availability, or integrity of information or information systems, and they can be classified according to the activity (e.g., criminal and non-criminal), the type of attack (e.g., malware, insider attack, spam, distributed denial of service), and the source (e.g., terrorists, criminals, government) [4]. Therefore, workers working from home should have some knowledge about cyber privacy and cybersecurity, in which failing to do so may damage the reputation of the organization.

When working remotely, employees are no longer working directly under the security of the organization. Communication is mainly conducted via mobile applications or other channels, which increases the possible sources of security threats [5]. Possible issues related to the heavily dependent on technology are the cyber threats that may happen when working remotely phishing scams that result in numerous data breaches, virtual private networks that could not handle everyone working from home, issues of security and data privacy, and many others [6]. Hazari *et al.,* [5] claim that enhancing security depends on changing the beliefs, attitudes, and behaviors of individuals and groups. According to Chan *et al.,* [7], a breach in security does not generally result from a flaw in the technical system but it can be a result of non-compliant employee behavior. Based on their study of non-compliant behavior, they identified two main factors of non- compliance which are individual perception climate and self-efficacy. Therefore, a study of software security readiness among workers working from home is necessary to address the threats of cyber risks faced by organizations. An analysis of selected studies from 2015 indicates that there are four main security aspects related to organizational securities which are information security [8-11], security policy [8-12], security

training [10-13] and security awareness [8,10-13]. For the purpose of this study, these factors will be considered as the antecedents for software security readiness.

Therefore, this study intends to verify the components and contents of software security factor towards remote working employee embarking on extensive research through the Fuzzy Delphi techniques. This is to ensure lecture are confident in managing software security among lecturers.

2. Literature Review

In this study, the development of proposed research model was adapted from Technology-Organization-Environment framework and Readiness model proposed by Kirlappos *et al.,* [8]. This study adopt TOE framework because of it is a holistic, robust and flexible framework used at the organizational level. The TOE framework covers almost all aspects of an organization internally (technology and organization) and externally (environment) and has strong empirical support in previous information systems research. Furthermore, the TOE framework allows new variable to be added to the model and enables inclusion multiple theories in single study. In order to achieve this, there are many theories and model including in TOE framework which are often utilized to study and synthesized used to examine different factors in previous studies are discussed, and the factors identified by previous studies are explained based on the TOE classification to further support the proposed model. The theories used in this study are: theory of planned behaviour (TPB) [14], TOE framework, Institutional theory, deterrence theory and Technology Acceptance Model (TAM) [15].

Based on TOE framework, this study proposes a comprehensive framework to systematically synthesize the factors affecting software security readiness derived from the literature. While Eilts *et al.,* [16] mentioned that assessed cyber security readiness in small business, no study has investigated on the factor of software security readiness for remote working employee in public organization.

Therefore, we proposed new software security readiness model for remote working employee in public organization extender from TOE framework and Readiness Model. The overall proposed new model in shown in Figure 1 drawn from a systematic analysis of literature review their dimension of readiness namely, individual, organization and technology together with their related security attributes were identified which are IT knowledge, security training, security policy, information security and infrastructure. this It was also found there is a one-to-many relationship between dimension aspect and security attributes. This model, named as Software Security Readiness (SSREM) model that can be used as guideline for organization to measure the readiness level for software security for remote working employee. Based on the literature review conducted, we found that each of dimension is associated with at least one security attributed that is related to the measurement readiness index.

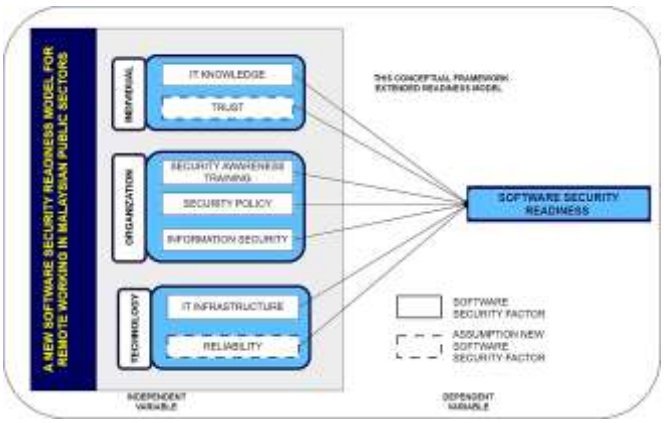

Fig. 1. Proposed research model

Furthermore, a new construct, trust and reliability has incorporated into this study. In the context of software security, trust and reliability are more likely to have favourable opinions of the benefits and utility of software security which influence the readiness in remote working employee. All constructs were examined simultaneously for construct validation, and refinement purposes for the whole measurement model fit via path analysis in Covariance Based-Structural Equation Modelling (CB-SEM) to apply the model in a software security context.

3. Methodology

The primary purpose of this investigation is to verify the components and contents of software security of remoted working employee using the Fuzzy Delphi Method (FDM) via expert feedback. In order to determine a definite choice, this approach was taken to acquire the agreement of relevant experts [17]. FDM provides several benefits, such as the capacity to acquire expert opinion, arrive at a consensus, ascertain whether or not it is feasible to adopt instructional interventions, forecast future trends, and establish connections with research subjects without being constrained by the constraints of time or location [18]. Basically, FDM was used to determine the extent to which experts or lay people agree about a particular problem and with each other and to achieve a consensus opinion in areas where they disagree with one another. FDM was often conducted through survey questionnaires [19]. When compared to the Delphi method, the FDM is preferable because it reduces the time and money spent on the management of surveys while simultaneously facilitating the experts' provision of consistent feedback [20].

In this study, there are two stages in this method for developing the concrete questionnaire. In the first stage, the researcher adapted and modified the questionnaire based on previously validated studies [22-28], as demonstrated in appendix section. Then, the researcher used previously validated questionnaires to support the contents and measurement items of the questionnaire into a formatted survey within a seven-point Likert scale. In the second stage, after obtaining all the contents and measurement items, the researcher designed a survey and distributed it to eight experts with specific expertise. The findings were analyzed using the FDM technique through Fuzzy Delphi Logic (FUDELO 1.0) software.

3.1 Sample Expert Criteria and Sampling

In order to synchronize with the expert criteria, this study has employed purposive sampling techniques to select the experts by taking into account both their level of experience and their level of knowledge in the research. In FDM, purposive sampling was the most appropriate techniques to carry out the sampling [29]. To evaluate the model, this researcher was used eight experts to evaluate the usability of the model. The experts had to have at least five years of experience and above, in addition to the need to be exact with their field of expertise and continually have experience teaching and managing [29]. The Fuzzy Delphi Method (FDM) requires agreement and expert opinion, which entails building a model, as stated by Ismail *et al.,* [30]. In expert selection, Yusoff *et al.,* [20] have stated that seven is the minimum number of experts required. This finding is supported by Mustapha *et al.,* [31] which reported that seven samples are adequate in the Fuzzy Delphi Method (FDM), if the experts are quite similar to one another (highly homogeneous). Thus, eight experts are sufficient to obtain information and expert consensus. The experts involved are summarized in Table 1.

Table 1
Experts list using Fuzzy Delphi Method (FDM)

Expert	Designation	Area expertise	Year of experience
1	Senior lecturer	Software engineering, mobile security.	10
2	Senior lecturer	Software engineering, information security, software requirements.	11
3	Senior lecturer	Software engineering, data analytic, software analysis and design.	8
4	Senior lecturer	Software engineering, requirement engineering.	6
5	Senior software engineer	Software Engineering, software development.	8
6	Chief executive officer	Software engineering, software verification and validation.	20
7	Senior software engineer	Software development, software engineer, software design.	5
8	Senior software engineer	Software development, software engineer, software design.	6

3.2 Fuzzy Scale in Instrument

The research instrument for Fuzzy Delphi was developed by the researcher based on the study literature. Based on Recker *et al.,* [32], the formation of questionnaire elements by researchers can be formed based on literature, pilot studies and experience. Meanwhile, according to Mustapha and Darusalam [33], in formulating questions for the Fuzzy Delphi technique based on research highlights, expert interviews and also through focus group techniques. In addition, according to Okoli *et al.,* [34], the formation of items and content elements of a study should be done through a literature review related to the scope of study. Therefore, researcher use literature in obtaining the elements of software security. After thoroughly reviewing the relevant literature and in-depth consultations with the experts, a series of expert questions are formulated using a seven-point Likert respond to the questionnaire, the researcher substituted a scale ranging from one to seven for the fuzzy value, as shown in Table 2, for each of the seven linguistic scales that follow, while Table 3 depicts the data collection and formulation steps utilized in this study's Fuzzy Delphi Method (FDM).

Table 2
Level of agreement and fuzzy scale

Item	Fuzzy number
Strongly disagree	0.0. 0.0, 0.1
Disagree	0.0, 0.1, 0.3
Somewhat disagree	0.0, 0.3, 0.5
Neither agree nor disagree	0.3, 0.5, 0.7
Somewhat agree	0.5, 0.7, 0.9
Agree	0.7, 0.9, 1.0
Strongly agree	0.9, 1.0, 1.0

Table 3
Data collection and formulation step utilized in FDM

Step	Formulation
Step 1: Expert selection.	For this investigation, eight experts were consulted to ascertain the significance of the evaluative criteria in connection to the variables that would be measured by linguistic variables.
Step 2: Determining linguistic scale.	The first step in this process is to transform all linguistic variables into a numerical system for fuzzy triangles (triangular fuzzy numbers). In this stage, linguistic variables were converted in conjunction with the incorporation of fuzzy numbers [35,36]. The Triangular Fuzzy Number represented the values m1, m2, and m3 and was written as follows (m1, m2, m3). The value of m1 represents the smallest value feasible, and the value of m2

Table 3
Data collection and formulation step utilized in FDM

Step	Formulation
	represents a value considered appropriate. The value of m3 represents the highest value that is possible. As can be seen in Figure 2, each response was given one of three fuzzy values that indicated expert opinion (fuzziness expert opinion).

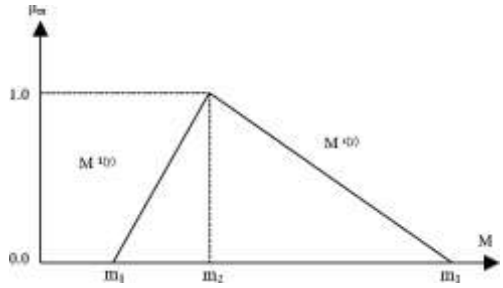

Fig. 2. Triangular fuzzy number

	Note: (M1=smallest value; M2=reasonable value; M3=maximum value)
Step 3: Determination of linguistic variables and average responses.	Once the researcher has obtained a response from the designated expert, the researcher must transform the entire Likert scale into the Fuzzy scale. In some circles, this is also called calculating each fuzzy number's average reaction [37]. This procedure is based on the equation Eq. (1): $$M = \frac{\sum_t^n 1mi}{n} \quad (1)$$
Step 4: The determination of threshold value "d".	The threshold value is an essential factor in assessing the degree of consensus among the experts [38]. For example, to determine how far apart any fuzzy number m = (m1, m2, m3) and n = (n1, n2, n3) are from one another, the distance may be calculated with the help of the following formula based on the Eq. (2): $$d(\bar{m}\bar{n}) = \sqrt{[(m_1 - n_1)^2 + (m_2 - n_2)^2 + (m_3 - n_3)^2]} \quad (2)$$
Step 5: Identify the alpha cut aggregate level of fuzzy assessment.	When the experts have reached a consensus, a hazy score will be assigned to each item [39]. The following formula is used for both the calculation and determination of fuzzy values: Amax = (1)/4 (m1 + 2m2 + m3).
Step 6: Defuzzification process.	The defuzzification procedure was also carried out during the Fuzzy Delphi method devoted to data analysis. The process of identifying the position or rank of each item and the position of each variable or sub-variable is referred to as position analysis. In this process, Mansour and Osama [39] have formulated three potential formulas that can be utilized in this procedure. Therefore, the researchers have the option of selecting one of these formulas, which are as follows Eq. (3): 1) A = 1/3* (m1 + m2 + m3) or; 2) A = 1/4* (m1 + 2m2 + m3) or; 3) A = 1/6* (m1 + 4m2 + m3). (3) Following that, the α-cut value = the median value for "0" and "1," where α-cut = (0+1)/2 = (0.5). If the value of A yielded is less than the α-cut value = (0.5), the item will be rejected because the experts agree to reject the item; however, if the value of A exceeds the α-cut value = (0.5), the item will be accepted because the experts agree to accept the item [40]. The data were then tabulated to obtain the Fuzzy value (n1, n2, n3). The average Fuzzy value (m1, m2, m3) calculated the threshold value, the percentage of expert consensus, the defuzzification value, and the item ranking.

Table 3
Data collection and formulation step utilized in FDM

Step	Formulation
Step 7: Ranking process.	Lastly, the ranking process. Saido *et al.,* [41] explain the model's ranking process or sub-phases process. The method of placement involves selecting the model element to be placed based on the defuzzification value according to the general agreement of the experts, and the position within the model is what determines the highest possible value that is considered to be the most important.

4. Results

In this section, the results of this research are based on the experts' general agreement regarding the guidelines for formulating steps involved in the Fuzzy Delphi Method (FDM). The information that was gathered was derived from the responses that were given to eight different experts in the relevant field. The following is a rundown of the findings from the study as shown in Table 4 until Table 24.

Table 4
Finding of expert consensus of organization regulation

Statistics	Item 1	Item 2	Item 3	Item 4	Item 5
Value of the item	0	0.0595	0.0433	0.0541	0.0685
Value of the construct					0.0451
Item < 0.2	8	8	8	8	7
% of item < 0.2	100%	100%	100%	100%	87%
Average of % consensus					97
Defuzzification	0.9	0.8375	0.85	0.775	0.7125
Ranking	1	3	2	4	5
Status	Accept	Accept	Accept	Accept	Accept

Table 5
Finding of expert consensus of personal norms

Statistics	Item 1	Item 2	Item 3	Item 4
Value of the item	0.05413	0.0433	0.0505	0.0505
Value of the construct				0.0496
Item < 0.2	8	8	7	7
% of item < 0.2	100%	100%	87%	87%
Average of % consensus				93
Defuzzification	0.775	0.75	0.65	0.65
Ranking	1	2	3	3
Status	Accept	Accept	Accept	Accept

Table 6
Finding of expert consensus of attachment

Statistics	Item1	Item 2	Item 3	Item 4
Value of the item	0	0.0433	0.0252	0
Value of the construct				0.01714
Item < 0.2	8	8	8	8
% of item < 0.2	100%	100%	100%	100%
Average of % consensus				100
Defuzzification	0.7	0.65	0.675	0.7
Ranking	1	3	2	1
Status	Accept	Accept	Accept	Accept

Table 7
Finding of expert consensus of commitment

Statistics	Item 1	Item 2	Item 3	Item 4
Value of the item	0.05774	0.05774	0.05774	0.0866
Value of the construct				0.0649
Item < 0.2	8	8	8	7
% of item < 0.2	100%	100%	100%	87%
Average of % consensus				96
Defuzzification	0.8	0.8	0.8	0.7
Ranking	1	1	1	2
Status	Accept	Accept	Accept	Accept

Table 8
Finding of expert consensus of integrity

Statistics	Item 1	Item 2	Item 3	Item 4
Value of the item	0.01263	0	0.0126	0
Value of the construct				0.00632
Item < 0.2	8	8	8	8
% of item < 0.2	100%	100%	100%	100%
Average of % consensus				100
Defuzzification	0.9875	1	0.9875	1
Ranking	2	1	2	1
Status	Accept	Accept	Accept	Accept

Table 9
Finding of expert consensus of benevolence

Statistics	Item 1	Item 2	Item 3	Item 4	Item 5
Value of the item	0.01263	0	0.0216	0	0
Value of the construct					
Item < 0.2	8	8	8	8	8
% of item < 0.2	100%	100%	100%	100%	100%
Average of % consensus					
Defuzzification	0.9875	1	0.975	0.9	1
Ranking	2	1	2	3	1
Status	Accept	Accept	Accept	Accept	Accept

Table 10
Finding of expert consensus of ability

Statistics	Item 1	Item 2	Item 3	Item 4
Value of the item	0	0	0.05774	0.01263
Value of the construct				0.01759
Item < 0.2	8	8	8	8
% of item < 0.2	100%	100%	100%	100%
Average of % consensus				100
Defuzzification	0.9	0.9	0.6	0.9875
Ranking	2	2	3	1
Status	Accept	Accept	Accept	Accept

Table 11
Finding of expert consensus of confidentially

Statistics	Item 1	Item 2	Item 3	Item 4	Item 5
Value of the item	0.01263	0	0.0216	0	0
Value of the construct					
Item < 0.2	8	8	8	8	8
% of item < 0.2	100%	100%	100%	100%	100%
Average of % consensus					
Defuzzification	0.9875	1	0.975	0.9	1
Ranking	2	1	2	3	1
Status	Accept	Accept	Accept	Accept	Accept

Table 12
Finding of expert consensus of integrity

Statistics	Item 1	Item 2	Item 3	Item 4
Value of the item	0	0	0.0577	0.01263
Value of the construct				0.01759
Item < 0.2	8	8	8	8
% of item < 0.2	100%	100%	100%	100%
Average of % consensus				100
Defuzzification	0.9	0.9	0.6	0.9875
Ranking	2	2	3	1
Status	Accept	Accept	Accept	Accept

Table 13
Finding of expert consensus of availability

Statistics	Item 1	Item 2	Item 3	Item 4
Value of the item	0	0	0	0
Value of the construct				0
Item < 0.2	8	8	8	8
% of item < 0.2	100%	100%	100%	100%
Average of % consensus				100
Defuzzification	0.9	0.9	0.7	0.7
Ranking	1	1	2	2
Status	Accept	Accept	Accept	Accept

Table 14
Finding of expert consensus of knowledge

Statistics	Item 1	Item 2	Item 3	Item 4	Item 5
Value of the item	0	0	0	0	0.0378
Value of the construct					0.0075
Item < 0.2	8	8	8	8	8
% of item < 0.2	100%	100%	100%	100%	100%
Average of % consensus					100
Defuzzification	1	0.7	0.9	1	0.9625
Ranking	1	4	3	1	2
Status	Accept	Accept	Accept	Accept	Accept

Table 15
Finding of expert consensus of attitude

Statistics	Item 1	Item 2	Item 3	Item 4	Item 5
Value of the item	0	0	0	0	0
Value of the construct					0
Item < 0.2	8	8	8	8	8
% of item < 0.2	100%	100%	100%	100%	100%
Average of % consensus					100
Defuzzification	0.7	0.7	0.9	1	0.7
Ranking	3	3	2	1	3
Status	Accept	Accept	Accept	Accept	Accept

Table 16
Finding of expert consensus of management support

Statistics	Item 1	Item 2	Item 3	Item 4	Item 5
Value of the item	0	0.05413	0.01263	0	0
Value of the construct					0.01335
Item < 0.2	8	8	8	8	8
% of item < 0.2	100%	100%	100%	100%	100%
Average of % consensus					100
Defuzzification	0.7	0.825	0.9125	1	0.7
Ranking	4	3	2	1	4
Status	Accept	Accept	Accept	Accept	Accept

Table 17
Finding of expert consensus of culture

Statistics	Item 1	Item 2	Item 3	Item 4	Item 5
Value of the item	0	0.05413	0.01263	0.07578	0.02526
Value of the construct					0.03356
Item < 0.2	8	8	8	8	8
% of item < 0.2	100%	100%	100%	100%	100%
Average of % consensus					100
Defuzzification	0.7	0.825	0.9125	0.675	0.675
Ranking	3	2	1	4	4
Status	Accept	Accept	Accept	Accept	Accept

Table 18
Finding of expert consensus of work location

Statistics	Item 1	Item 2	Item 3	Item 4
Value of the item	0.02526	0	0.0577	0.02526
Value of the construct				0.02706
Item < 0.2	8	8	8	8
% of item < 0.2	100%	100%	100%	100%
Average of % consensus				100
Defuzzification	0.875	0.9	0.6	0.675
Ranking	2	1	4	3
Status	Accept	Accept	Accept	Accept

Table 19
Finding of expert consensus of IT flexibility

Statistics	Item 1	Item 2	Item 3	Item 4	Item 5
Value of the item	0.02526	0	0	0.01263	0
Value of the construct					
Item < 0.2	8	8	8	8	8
% of item < 0.2	100%	100%	100%	100%	100%
Average of % consensus					
Defuzzification	0.875	0.7	0.9	0.9125	0.7
Ranking	2	3	2	1	3
Status	Accept	Accept	Accept	Accept	Accept

Table 20
Finding of expert consensus of integration

Statistics	Item 1	Item 2	Item 3	Item 4	Item 5
Value of the item	0	0	0	0	0
Value of the construct					0
Item < 0.2	8	8	8	8	8
% of item < 0.2	100%	100%	100%	100%	100%
Average of % consensus					100
Defuzzification	0.7	0.9	0.9	1	1
Ranking	3	2	2	1	1
Status	Accept	Accept	Accept	Accept	Accept

Table 21
Finding of expert consensus of modularity

Statistics	Item 1	Item 2	Item 3	Item 4	Item 5
Value of the item	0	0	0	0	0
Value of the construct				0	
Item < 0.2	8	8	8	8	8
% of item < 0.2	100%	100%	100%	100%	100%
Average of % consensus				100	
Defuzzification	1	0.9	0.9	0.7	1
Ranking	1	2	2	3	1
Status	Accept	Accept	Accept	Accept	Accept

Table 22
Finding of expert consensus of connectivity

Statistics	Item 1	Item 2	Item 3	Item 4
Value of the item	0	0.16238	0	0
Value of the construct				0.04059
Item < 0.2	8	5	8	8
% of item < 0.2	100%	62%	100%	100%
Average of % consensus				90
Defuzzification	1	0.675	0.9	0.7
Ranking	1	4	2	3
Status	Accept	Accept	Accept	Accept

Table 23
Finding of expert consensus of compatibility

Statistics	Item 1	Item 2	Item 3	Item 4
Value of the item	0	0	0	0
Value of the construct				0
Item < 0.2	8	8	8	8
% of item < 0.2	100%	100%	100%	100%
Average of % consensus				100
Defuzzification	1	1	0.9	0.7
Ranking	1	1	2	3
Status	Accept	Accept	Accept	Accept

Table 24
Finding of expert consensus of hardware reliability

Statistics	Item 1	Item 2	Item 3	Item 4
Value of the item	0	0	0	0
Value of the construct				0
Item < 0.2	8	8	8	8
% of item < 0.2	100%	100%	100%	100%
Average of % consensus				100
Defuzzification	1	1	0.9	0.7
Ranking	1	1	2	3
Status	Accept	Accept	Accept	Accept

As a consequence of the investigation of the analyses as shown in Table 4 until Table 24, the darkened threshold value is higher than 2, which shows that it is above the threshold value. It indicated that expert opinions differed or did not reach a consensus on certain issues. Although expert opinions differed, the average value of all items (Table 6 until Table 24), reveals that the threshold value (d) is lower than 0.2, which shows that each of the components reached an adequate level of consensus among the experts [17,35,42]. In addition, it posted evidence that the total percentage of percent consensus is higher than 75%, showing that the requirements for the existence of an expert consensus on these issues have been met [20-49]. On a similar note, it was discovered that every single of the Alpha-Cut defuzzification value, also known as the average of fuzzy response, is higher than 0.5 for the α-cut threshold. In the circumstance that if the value of defuzzification is lower than α-cut => 0.5, then the item in this study would be rejected because it demonstrates that the experts agreed on rejecting the utilized items [30,48]. In this study, all alpha cut values are greater than 0.5. All the items utilized are reliable and appropriate to use in other settings. Lastly, the findings of this analysis show that all the items received high levels of expert agreement and have been categorized and ordered according to the priority (ranking), which can be found in Table 6 until Table 25, respectively.

In conducting the analysis via the Fuzzy Delphi Method (FDM), this study also considers all of the feedback and recommendations for advancement that field experts provided. The sentences were revised one more time after the components were reorganized according to their level of importance, and this research incorporated some new elements recommended by experts (solidified items). It has been concluded that all the constructs are reliable and appropriate to use based on the consensus of experts. As a result, this study has successfully established the validated research instruments and enhanced the research design for the substantive investigation has been improved. It demonstrates that all the constructs from the literature review are validated to be drivers of software security contexts. The purposes of the study were successfully attained, which was to

address questions about areas of agreement among experts. As a result, the described items can be implemented successfully and are suitable for use in various environments.

Table 25
Finding of expert software security readiness

Statistics	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10
Value of the item	0	0	0	0	0	0	0.10	0	0	0
Value of the construct										0.01
Item < 0.2	8	8	8	8	8	8	7	8	8	8
% of item < 0.2	100%	100%	100%	100%	100%	100%	87%	100%	100%	100%
Average of % consensus										98
Defuzzification	0.9	0.9	1	0.7	0.9	1	0.725	0.7	0.9	1
Ranking	2	2	1	4	2	1	3	4	2	1
Status	Accept	Accept	Accept	Accept	Accept	Accept	Accept	Accept	Accept	Accept

5. Discussion

In this study, TOE framework and readiness model have been incorporated in order to develop a comprehensive framework model for examining the software security, readiness of software security among remote working employee. This study has been accomplished by examining the relationship between the two theories. While the existing software security are widely used in different contexts and with various other variables, this study has empirically examined and validated the present questionnaire to fit in the study context via the feedback of subject matter experts throughout the Fuzzy Delphi Method (FDM). This approach was taken to ascertain knowledgeable individuals' agreement before making a final choice [17,50]. The outcomes of the current study demonstrated that the items received high levels of expert agreement, significantly greater α-cut defuzzification values of >.5 [30,51] and complied with the overall percentage of percent consensus, which must be greater than 75% [20,52]. In this study, all 81 recommended items were retained adequately and acceptable for a large-scale survey to be utilized, which was conducive for data collection. Similarly, it also emphasizes the significance of a Fuzzy Delphi Method (FDM), which contributes to validating and comparing the expert consensus while handling the questionnaires. During the process, the experts can provide their views and understanding of the items utilized. Finally, all the comments and suggestions were considered for improvements.

6. Conclusions

In conducting the analysis via the Fuzzy Delphi Method (FDM), this study also considers all of the feedback and recommendations for advancement that field experts provided. The sentences were revised one more time after the components were reorganized according to their level of importance, and this research incorporated some new elements recommended by experts (solidified items). It has been concluded that all the constructs are reliable and appropriate to use based on the consensus of experts. As a result, this study has successfully established the validated research instruments and enhanced the research design for the substantive investigation has been improved. It demonstrates that all the constructs from the literature review are validated to be drivers of software security contexts. The purposes of the study were successfully attained, which was to

address questions about areas of agreement among experts. As a result, the described items can be implemented successfully and are suitable for use in various environments.

The findings clearly show that Fuzzy Delphi Method (FDM) can be utilized to ascertain the consensus of experts on the elements used to develop or validate the questionnaires. Furthermore, it can be said that the FDM may be utilized once for screening purposes. A clear solution was also given for ending the rounds of FDM formulation steps. The validation of these items contributes to the expansion of the body of knowledge, which in turn contributes to the development of knowledge (literature) and practice in software engineering. This study was primarily based on highlights from the literature and expert consensus. As a result, future researchers might be able to conduct in-depth interviews with industry experts, which would allow them to evaluate and investigate the topic in greater detail, so that the components and contents of software security factor [43-47]. Hence, FDM is indispensable for future work.

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