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Role of Information System Management during Emergencies: The COVID-19 Crisis in Malaysia

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ABSTRACT

The spike in the number of COVID-19 cases across the globe hased the World Health Organization to declare the virus as a pandemic. Many countries have institutionalized either complete or partial lockdowns in coping with COVID-19. Regardless of a partial of full-lockdown, most organizations, across different sectors, are focussing on business continuity through work from home and other initiatives—which require access to information systems remotely, coupled with other forms of short-term crisis management measures. Managing emergency situations forces organizations to rethink strategies, competencies, and processes to enhance resilience. The COVID-19 pandemic suggests that Information Systems play a vital role in crisis management efforts for majority of organisations. Nevertheless, these remedial measures may not necessarily be guided by well-defined emergency management frameworks and the role that information systems can play at the core of such efforts. At the organisational level, the developments in information communication systems as well as workforce technology have transformed the magnitudes of work culture to an unprecedented level. It has led to a diverse work atmosphere. The workforce consumes a 24/7 situation to provide stake holders around the world with necessary services. Many innovative practices have been adopted by companies around the world. The challenges of amalgamating work and family life is an evident fact due to technological advancement which enables remote working. In some companies abroad a well-balanced career and social obligations are enforced as part of the human resource initiatives to maintain a healthy and committed work force. This study aims to bridge the gap in the body of literature pertaining to the information system quality impact on emergency crisis management during the COVID-19 crisis in Malaysia.

Keywords: information systems; communication systems; emergency management process; crisis management; pandemic; COVID-19; Malaysia.

Introduction

Advanced computing technologies have led to new forms of working concepts such as telecommuting. The advent of mobile computing and increasing access to the Internet and its component technologies have also paved the way for working from a remote location instead of a traditional office environment, particularly during major crisis situations such as the COVID-19 pandemic. The COVID-19 pandemic has revealed to us that, the use of digital technology—or more broadly speaking, the use of Information Systems in an institutionalised context, offers temporal solutions to many organizations in remaining resilient during this crisis. Most have turned towards technology and digital applications to ensure business continuity. From zoom meetings, google hangouts/meet,

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skype to more simplified applications such as WhatsApp and YouTube, companies are trying their level best to ensure core operations run effectively. The COVID-19 pandemic has taught Malaysian corporations several key lessons. Firstly, the advancements in technology have made communication from a remote location possible., Thus, this leads to the ability to work from anywhere at any time with the aid of various tools and technical support systems—more so during a pandemic/other forms of emergencies. Secondly, the information system management may have a role to play in the emergency work processes, given the availability of modern technology. To ensure successful management of emergencies, it is vital for organisations to ensure that issues such as information system's quality and its amalgamation into core work processes are done properly.

As such, this study intends to examine the relationship between information system management and emergency work process management which posit to indirectly contribute to improved crisis management. Our proposed model is tested in a Malaysian context, based on data gathered during the first two phases of the movement control order (MCO—March 18th to April 14th, 2020).

Literature Review

Researchers in the Information Systems (IS) fields have suggested various models to describe what makes some IS as 'successful.' However, based on Davis's (1989) Technology Acceptance Model (TAM), it was derived from Ajzen and Fishbein's (1977) Theory of Reasoned Action and Theory of Planned Behaviour (Ajzen, 1985) to understand why some IS are readily accepted by users compared to others (Davis, Bagozzi, & Warshaw, 1989). However, acceptance is not equivalent to success, although the acceptance of an information system is a necessary prerequisite to determine its success. In addition to TAM, TAM 2 (Venkatesh & Davis, 2000) and the Unified Theory of Acceptance and Use of Technology (UTAUT) were developed (Venkatesh, Morris, Davis, & Davis, 2003). Information Systems Success theory explored in this study is mainly based on the DeLone and McLean's IS Success model. Its basis is in the mathematical model of communication derived in 1949 by Shannon and Weaver, whereby Norbert Wiener's theory of probability was the underlying theory used to produce their communication theory (Shannon & Weaver, 1949). Shannon and Weaver used tools in probability theory, developed by Wiener, which were applied to communication theory. Shannon and Weaver developed information entropy as a measure for the ambiguity in a message while basically creating what was identified as the main form of "information theory." Then the Shannon–Weaver model was comprehensively adopted into science researches in various fields such as education, management, information systems, organizational study, psychology, and several other areas. However, some reviewers have categorized this adoption as misleading and lacking representation in human's communications, citing its simplicity and inability to consider the context (Chandler, 1994). Shannon and Weaver's theory was used extensively in various fields of engineering and mathematical studies (Verdu, 2000). However, Mason (1978) improvised this model to meet the needs of information technology. The author presented a conceptual framework, with relevant examples to gauge the output of an information system. Mason drew on communication theory where four approaches to output measurement were developed. The measures were based on technical level output, semantic level output, functional output and pragmatic level output (Mason, 1978). Based on the sound foundation from Shannon and Weaver and Mason (1978) as well as empirical research analyzed from 1980–1987, DeLone and McLean (1992) and its updated version of their 2003 paper postulated a complete multidimensional model (hereinafter referred to as the D & M Model) to measure IS success. The technical level of communication was defined as accuracy and efficiency of the communication system to produce information (Shannon & Weaver, 1949). The semantic level and effectiveness level were determined as the success in delivering the message to the intended receiver and the impact of the message on the receiver respectively. However, the D & M model uses systems quality to measure technical success, information quality to measure semantic success and use, and user satisfaction, individual and organizational impacts to measure effectiveness success.

Information System during Emergency Crisis Management

Information Systems (IS) is the study of complimentary networks of hardware and software that people and organizations use to collect, filter, process, create and distribute data (Jessup & Valacich, 2009). In this study, IS refers to the application and devices used by employees from a remote location. Information quality can be divided into inherent and pragmatic information quality (Johnson & Johnson, 2009). Inherent information quality refers to the correctness of the data whilst pragmatic information quality refers to the value of the accurate data in supporting daily operations of the company

(Johnson & Johnson, 2009). Quality as defined by Philip Crosby (1979) is the "conformance to the requirement". In this study, information requirements by the users / employees under the construct of information quality, is tested to meet the functional requirements to perform their work. Software Quality is defined as the conformance to explicitly state functional and performance requirements, explicitly documented development standards and implicit characteristics that are expected by all professionally developed software (Johnson & Johnson, 2009). Quality in an organization is deemed as excellence and conformity to specifications and meeting customer's expectations (Reeves & Bednar, 1994). Information Systems (IS) can be best understood using the framework of quality designed by Reeves and Bednar (1994) as the usage of state of the art technology together with "best practice" software and hardware standards to deliver an effective customer oriented service and performance (Reeves & Bednar, 1994). The significance of IS can be comprehended by improving profit limitations for the organization to provide a user-friendly and valuable applications. IS quality is known as a conformance to certain requirements to design systems that match the end users' information needs and adhere to business standards (Reeves & Bednar, 1994; Gorla, Somers, & Wong, 2010). Offering an appealing, user friendly service or product and entertaining user needs for changes and satisfying them of their expectations towards IS quality in turn allows them to be at ease to perform work efficiently (Gorla, Somers, & Wong, 2010). Amplified dependence of employees on IS drives management's interest to improve information systems' quality (ISQ). A recent study by Gorla et al (2010) demonstrated that ''Improve IT quality" is one of the top issues facing ICT employees. While ISQ is a multidimensional measure, it is imperative to establish what phases of IT quality are significant to organizations to help the higher management authorities to devise efficient IS quality enhancement strategies (Gorla, Somers, & Wong, 2010). In their research, Gorla et al (2010) modelled the association between ISQ and organizational impact. They found that better organizational impact was contributed by higher system quality, information quality and service quality. They also found a positive relationship between system quality and information quality. A survey was used to collect the data in this study. A Structural Equation Model (SEM) exhibited a good fit with the experimental data. Hence, the results of their study portrayed that IS service quality is the most influential variable in this model which was followed by information quality and system quality, respectively, consequently high-lighting the importance of IS service quality for organizational performance (Gorla, Somers, & Wong, 2010). As such, there may be a contribution of these constructs towards the work-life balance of an employee, whereby a sound and well-defined information system and processes may ease an employee's strain and stress towards performing work from a remote location during an emergency crisis.

Hypotheses Development

Information System Quality during Emergency Crisis Management

For this study, information system quality (ISQ) is divided to three sub constructs i.e. information quality, system quality and service quality. Various researchers looked at work life balance and emergency work processes during crisis management in its organizational behavioural context as opposed to an information technology (IT) perspective. Thus, the need to examine the relationship between information system quality (ISQ) on emergency work processes and crisis management amongst remote workers in Malaysia during the COVID-19 pandemic movement control order. As such the following hypotheses were tested:

> Hypothesis 1 (H1): *There is a significant positive relationship between Information Quality and Emergency Management Process.*

> Hypothesis 2 (H2): *There is a significant positive relationship between System Quality and Emergency Management Process.*

> Hypothesis 3 (H3): *There is a significant positive relationship between Service Quality and Emergency Management Process.*

According to Stephens, K.K (2020) the relationship between job, location of work and the gadgets used to work is a vital part of the job itself. Neha and Pooja (2012) illustrate that the ways to capitalize on employee productivity centers around two main areas, namely the infrastructure of the worksite and individual motivation to utilize the infrastructure. Various literatures define different issues that control the performance of employees. Hayes (2009) elucidates the behavioural office setting and components of the workplace environment have the most impact on staff productivity. The mediating hypotheses between ISQ and Crisis Management are derived to test this relationship.

> Hypothesis 6 (H6): *Emergency Management Processes mediates the relationship between Information Quality and Crisis Management during COVID-19.*

Hypothesis 7 (H7): *Emergency Management Processes mediates the relationship between System Quality and Crisis Management during COVID-19.*

Hypothesis 8 (H8): *Emergency Management Processes mediates the relationship between Service Quality and Crisis Management during COVID-19.*

Communication during Emergency Crisis Management

Communication is an essential mode to disseminate information among employees in an organization during a movement control order and when employees are required to work from a remote location. Employees and employers can be well informed of the happenings and work progress with a sound communication layout in place during emergency crisis situations. (McManus et al., 2008). Furthermore, communication provides employees with the sense of responsibility to keep their colleagues and superiors informed of the task progress in hand. Consecutively, a well-structured communication plan leads to enhancing confidence. Thus, preparing employees with collective mind-set to face a crisis (Connor & Davidson, 2003). An organization is deemed to be able to communicate effectively and accurately during adverse situations (Wangnild, 2009). The organization that has a strong communication system enriches the employee's understanding of normal and crisis times, making it more resilient compared to the rest. Therefore, this doubt leads to the testing of the following hypothesis:

Hypothesis 4 (H4): *There is a significant positive relationship between Communication System and Emergency Management Process.*

Hypothesis 9 (H9): *Emergency Management Processes mediates the relationship between Communication System and Crisis Management during COVID-19.*

Emergency Management Process during COVID-19

Emergency management systems are used by organizations to assist in responding to a crisis situation. These systems support communications, data gathering and analysis, and decision-making. Emergency response systems are rarely used but when needed, they must function well and without fail. Designing and building these systems require designers to anticipate what will be needed, what resources will be available, and how conditions will differ from normal. A standard model for an Emergency management systems (EMS) is from Bellardo, Karwan, and Wallace (1984) and identifies the components as including a database, data analysis capability, normative models, and an interface.

This model is only somewhat useful as it fails to address issues such as how the Crisis Response System fits into the overall crisis response plan, EMS infrastructure, multiple organization spanning, knowledge from past emergencies, and integrating multiple systems. Additionally, many organizations do not address the need for an EMS until a crisis happens, and then, only for a few months until something more pressing comes up (Jennex, 2003). The result is that many organizations have an EMS that may not be adequate. Prior to the establishment of the Homeland Security Department, the task of managing information pertaining to crisis situations and crisis management in the United States was under the jurisdiction of the Office of Emergency response (OEP) (Turoff, 1972).

The information requirements for the OEP were largely handled by a group of consultants from both business and academia. Over time, the OEP recognized that a system that could provide timely and relevant information to crisis responders was needed (Turoff, 1972). In 1970, twenty-five people working on crisis response were able to collaborate via a computerized Delphi system (Turoff, 1972). Computerized Delphi techniques can be administered via the web today (see for example Turoff and Hiltz, 1995). In 1971, the OEP was assigned the task of monitoring a new form of crisis called the "Wage Price Freeze" (Turoff et al., 2004). This new role for the OEP included among others, to "monitor nationwide compliance, examine and determine requests for exemptions and prosecute violations" in relation to wage and price changes in the economy. This led to the advent of a flexible system called the Emergency Management Information System and Reference Index (EMISARI). EMISARI was a system designed to facilitate effective communication between people involved in monitoring the Wage Price Freeze situation.

The system was designed to integrate people and data into a common platform that could be updated regularly by people who were non-technical administrators (Turoff et al., 2004). The EMISARI system was flexible and enabled several hundreds of people to collaborate in responding to a crisis. Jennex (2003, 2004, 2005) classifies crisis management information systems as Emergency Information Systems (EIS). He defines an EIS as any system that is used "by organizations to assist in responding to a crisis or disaster situation" (p. 2148).

Jennex further adds that an EIS should be designed to: support communication during crisis response; enable data and gathering analysis; and support decision-making. Lee and Bui (2000) documented vital observation with the use of EIS during the massive earthquake that hit Kobe, Japan, several years ago. Key lessons for EMS designers based on Lee and Bui's work are as follows. Relevant information should be included in the crisis response system prior to the actual crisis situation. This is to ensure that crisis responders have sufficient information to guide the decision-making processes in responding to a crisis. Lee and Bui (2000) imply that the task of gathering relevant information to support crisis response should be incorporated into part of the crisis response strategic initiative. Information from prior experiences should become part of the crisis management system. The system should somehow be able to capture both tacit and explicit knowledge about how prior crisis situations were dealt with. Similar findings were shown by Dorasamy et al. (2017) and Raman et al. (2014).

Lessons learned can guide future action. Lee and Bui (2000) in this regard imply that the design of any crisis response system should support some form of organizational memory component. In addition to designing relevant systems features to support crisis planning and response, researchers suggest that successful implementation of any crisis management system is contingent on how well people are trained to use such systems (Patton & Flin, 1999; Turoff, 1972; Lee & Bui, 2000, Dorasamy et al. 2017). Patton and Flin, for instance, suggest that CMS systems can be incorporated into crisis response related activities such as training, simulations, drills, and evacuation exercises. Turoff (1992) states that crisis management systems that are not normally used will not be used when an actual crisis situation occurs. The majority of post 9/11 literature on crisis management is confined within the realm of commercial entities (Braveman, 2003, Dorasamy et al. 2017).

Given the above, we therefore tested the following Hypothesis:

(H5): *There is a significant positive relationship between Emergency Management Process and Crisis Management.*

Thus, based on the above theories and proposed hypotheses, the following framework shown in Figure 1 was derived to be tested.

Methodology

This study employs a quantitative cross-sectional design to discover the role between information system quality and communication system and emergency crisis management. The data for this study was collected from various organizations and work sectors in Malaysia. The subjects for this study were the employees of the organizations who were affected by the movement control order due to the COVID-19 pandemic. These employees were required to work from home during this movement control order stipulated by the Malaysian Government.

Sample Selection

The sample size for this study was estimated with the GPower version 3.1. Based on the power of 0.95 with the effect size of 0.15, the effective sample size required for this study was 129 with the 4 predictors. Questionnaires were sent to a large population of employees in Malaysia

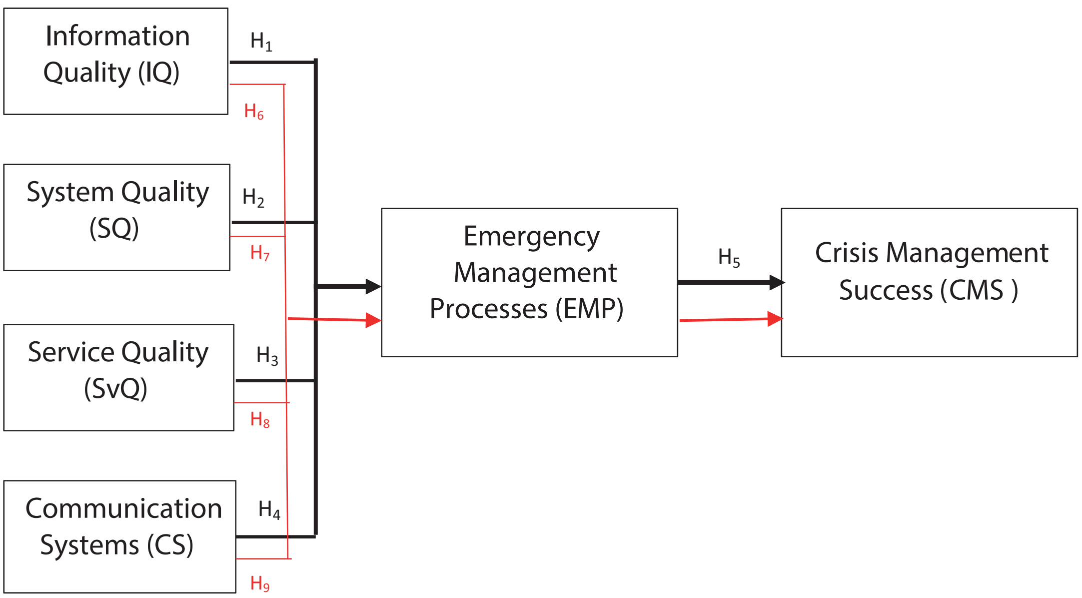

Figure 1: Proposed Theoretical Framework

and received a total of 156 sets. The total usable questionnaire was only 147 sets of the completed questionnaires.

Research instrument

Upon completion of the survey instrument development process, a pre-test process was conducted to validate the accuracy and aptness of the questionnaire. This pre-test procedure vetted the teething problems and content validity in the survey questionnaire, scale, and rectify them appropriately before the actual data collection takes place. This is to ensure the teething problems and survey questionnaire's language. Professional scrutiny and explanations on the precision and the correctness of a questionnaire will be considered. Zikmund et al. (2010) elaborate that these experts' opinion and advice from both industries as well as academic perspectives aid the researcher to be more precise in terms of the scale and understanding of the way these questions are phrased. In this pre-test, the initial questionnaire was distributed to and discussed with five industry specialists like team leads, operations managers (OPM), shift leads and technical leads, with extensive experience in remote working, as well as academicians, who are proficient and experienced in research methodology with a basic understanding of the research area undertaken. This process has been through two cycles to ensure rigorous tests have been conducted on the correctness and aptness of the instrument.

Common Method Variance (CMV)

Data cleaning was performed to detect and correct errors pertaining to data entry and any inconsistencies in the data obtained. Since data was obtained from a single source, it was checked for common method bias by using Harman's Single Factor Analysis in SPSS (see Table 1). The variance attributable to measurement method rather than to the construct or constructs purportedly represented by the measures is called common method variance (CMV). The total variance extracted shows that the extractions sums of loadings on the first factor is 22.125% which is less than 50%.herefore we can conclude that this data set does not suffer from common method bias (Podsakoff, 2003).

Data Analysis Method

As this study is explorative and due to the non-normality of the data this study utilized the PLS-SEM. The results of this study are reported as per the recommendations of Hair, Ringle and Sarstedt (2014) for the PLS-SEM. The recommendation for the indicators reliability at the item level is to have a standardized indicator loading of 0.70 and as for explorative studies the item loading is at 0.40. The internal consistency was tested with Cronbach's alpha and composite reliability. The suggested values for both are 0.70 and above. The average variance extracted value must be 0.50 or above for each construct. The path coefficient represents the value of the effect of the input variable for the output relationship. The r^2 is the measure of the explanation of the outcome variables with the input variables. The effect size (f^2) and Q^2 are the measurements of the model. The model effect size (f^2) is the measure of the effect of each input variables on the outcome variable. Cohen's (1988) study provides the guidelines for the understanding of the (f^2). The effect sizes of 0.32, 0.15 and 0.02 presents the large, medium and small effect respectively. The Q^2 represents the predictive relevance of the model that how much is the accuracy of the input variables in predicting the outcome variables. The Q^2 value of 0.02, 0.15 and 0.35 indicates the small, medium and large predictive relevancy of the model respectively (Hair et al., 2014). The current sample fulfilled the indicator figures for both reliability and validity, thus proves that the sample is reliable and valid for further analysis.

Table 1: Harman's Single Factor Analysis in SPSS

	Total Variance Explained					
	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	**Total**	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**
1	13.717	22.125	22.125	13.717	22.125	22.125
2	5.282	8.520	30.645	5.282	8.520	30.645
3	3.142	5.067	35.712	3.142	5.067	35.712
4	2.737	4.415	40.127	2.737	4.415	40.127
5	2.517	4.060	44.187	2.517	4.060	44.187

Extraction Method: Principal Component Analysis.

Data Analysis

Descriptive Statistics

The 147 samples were taken from various segments of industries in Malaysia. The respondents were largely male (51.7%). They are of 26 years old who, made up to 84.4% of the total samples. The samples were mostly married (53.1%) and hold a . college degree (94.6%).

Validity and Reliability

Indicator reliability is described as "the degree to which a set of variables or a single variable is consistent to that it proposes to measure" (Urbach & Ahlemann, 2010, p. 5). In PLS, indicator reliability is assessed by looking at the factor loadings. This has been utilized in more than 75 frameworks published in the MIS Quarterly between the years 1991 to 2012 (Ringle et al., 2012). "The rule of thumb is to accept items with a factor loading of 0.7 or higher" (p. 779) (Hair et. al., 2012). Nevertheless, for exploratory research designs, the factor loading for each item in a lower threshold between 0.5 – 0.6 is satisfactory (Chin & Dibbern, 2010; Ghozali, 2008; Henseler et al. 2009; Urbach & Ahlemann, 2010; Vinzi, Trincherra, & Amanto, 2010). Initial evaluation found that Average Variance Extracted (AVE) values for some of the constructs were found to be below 0.5. Therefore, the factor loading values were examined to determine the possibility for deletion of low factor loading items to increase the AVE ratings (p. 779, Hair et. al., 2006). Based on this, some of the factor loadings below the threshold of 0.6 was removed to increase the AVE rating (Hair, Ringle & Sarstedt, 2011). As a result, some items which had low ratings were eliminated from the scale. Table 2 illustrates the final measurements after running the PLS algorithm. The final measurement model after the removal of the items is shown in Figure 2. It showed that the items had

Table 2: Profile of the Respondents

	n	%
Gender		
Male	76	51.7
Female	71	48.3
Total	147	
Age		
Below 25 years of age	23	15.6
26 - 35 years of age	30	20.4
36 - 45 years of age	56	38.1
Above 46 years of age	38	25.9
Total	147	
Education		
High School	6	4.1
Diploma	45	30.6
Degree	62	42.2
Post Graduate Degree	32	21.8
Professional Cert	2	1.4
Total	147	
Marital Status		
Single	66	44.9
Married	78	53.1
Divorced	3	2.0
Total	147	

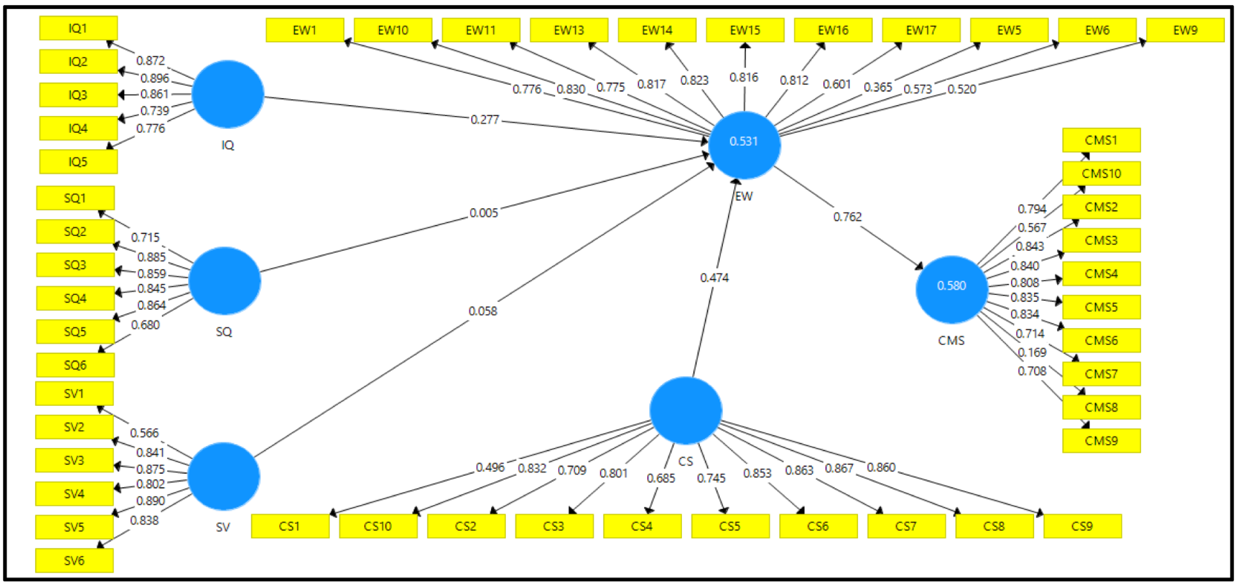

Figure 2: Measurement Model

sufficient convergent validity. The indicators of a formative measurement model represent the latent variable's independent drivers and should not correlate highly with one another. Therefore it is necessary to check for possible multicollinearity (Diamantopoulos and Winklhofer 2001), which is measured by the variance inflation factor (VIF). According to Hair et. al (2012) "the evaluation of multi-collinearity prior to assessment of the structural model is important to ensure that the predicament of multi-collinearity is not present". Multi-collinearity can be detected using variance-inflation factor (VIF) and tolerance value, as applied by nine models published in the MISQ from 1992 to 2011 (Ringle et al., 2012). In the present study, the collinearity diagnostic test was carried out using SmartPLS 3. It indicated that the VIF values are all less than 5. Higher degrees of multi-collinearity are reflected in lower tolerance values and higher VIF (Hair et al., 2010, pp. 201). As a general rule, values of tolerance less than 0.20 and a VIF above 5 indicate the existence of multi-collinearity (Leahy, 2000; Garson, 2012). This is illustrated in Table 2a, there is no multi collinearity present.

"The correlations between each construct and other constructs in the model (in the lower left off-diagonal elements) and the square roots of the average variance (AVE) values (with the diagonals)" is illustrated in Table 3 according to several prominent researchers like Hair et al. (2010). Table 4 gives an idea about the off-diagonal values of the indictor's cross loadings which are lesser than the outer loading values as per the rule of thumb (Hair et. al., 2014).

The test for the discriminant validity is to check the Fornell-Larcker criterion. Table 5 shows the results.

Another suggested test for discriminant validity is the HTMT ratio. The HTMT values must be at 0.90 or less to proof that the study has discriminant validity. The results depicted in Table 6 shows that the study has no evidence on the lack of discriminant validity.

Table 2a: Reliability Analysis

	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)	VIF
CMS	0.895	0.918	0.545	—
CS	0.925	0.938	0.607	2.214
EW	0.899	0.918	0.514	1.000
IQ	0.887	0.917	0.691	2.931
SQ	0.896	0.920	0.659	3.573
SV	0.894	0.918	0.655	2.558

Note: CMS: Crisis Management Success; CS: Communication System; IQ: Information Quality; SQ: System Quality; SVQ: Service Quality; EW: Emergency Work Management Process; AVE: Average Variance extracted; VIF: Variance Inflation Factor

Table 3: Latent Variable Correlations

	CMS	CS	EW	IQ	SQ	SV
CMS	1.00	0.72	0.76	0.47	0.48	0.60
CS	0.72	1.00	0.69	0.63	0.61	0.68
EW	0.76	0.69	1.00	0.61	0.56	0.55
IQ	0.47	0.63	0.61	1.00	0.79	0.58
SQ	0.48	0.61	0.56	0.79	1.00	0.71
SV	0.60	0.68	0.55	0.58	0.71	1.00

Note: CMS: Crisis Management Success; CS: Communication System; IQ: Information Quality; SQ: System Quality; SVQ: Service Quality; EW: Emergency Work Management Process

Table 4: Latent Variable Cross Loadings

	CMS	CS	EW	IQ	SQ	SV
CMS	1.00	0.72	0.76	0.47	0.48	0.60
CS	0.72	1.00	0.69	0.63	0.61	0.68
EW	0.76	0.69	1.00	0.61	0.56	0.55
IQ	0.47	0.63	0.61	1.00	0.79	0.58
SQ	0.48	0.61	0.56	0.79	1.00	0.71
SV	0.60	0.68	0.55	0.58	0.71	1.00

Note: CMS: Crisis Management Success; CS: Communication System; IQ: Information Quality; SQ: System Quality; SVQ: Service Quality; EW: Emergency Work Management Process

Table 5: Fornell – Larcker Criterion – Discriminant Validity

	CMS	CS	EW	IQ	SQ	SV
CMS	0.738					
CS	0.716	0.779				
EW	0.762	0.691	0.717			
IQ	0.467	0.628	0.612	0.831		
SQ	0.482	0.613	0.555	0.788	0.812	
SV	0.599	0.683	0.546	0.578	0.712	0.809

Note: CMS: Crisis Management Success; CS: Communication System; IQ: Information Quality; SQ: System Quality; SVQ: Service Quality; EW: Emergency Work Management Process

Path Analysis

The R^2 significant factor measures a construct's proportional difference that is described by the model or the tiny proportion of the total variation in the dependent variable explained by the independent variables jointly (Moran, 2006; Gujarati & Porter, 2010; Urbach & Ahlemann, 2010). The R^2 value ought to be amply high for the model to have a lowest level of descriptive power.

According to Ringle (2006) and several other studies conducted "values above 0.5, approximately between 0.3 – 0.5, and values lower than 0.19 are deemed substantial, average and weak, respectively" (Urbach & Ahlemann, 2010; Hock & Ringle, 2006). The R^2 value for the model indicated that the 57.7 percent in the crisis management was explained by emergency work management processes. However, another 51.8 percent in the emergency work management process was explained by the information system quality and communication system that existed. This was perceived by the organizations' employees. The R^2 for the information system quality of previous studies that used various IS and philosophical models ranged from 0.3 to 0.6 (Niehaves & Plattfaut, 2010).

The standardized path coefficients, t-values and significance level are presented in the Table 7. The path coefficient for the information quality on emergency work management was (β = 0.277, p = 0.023), which supports the H_1. The results showed that the effect of information quality on emergency work management process is positive and significant. The path coefficient for system quality on organizational resilience was (β = 0.005, p = 0.968), indicating a negative and insignificant effect of the system quality on emergency work management process. The results showed that the H_2 was not supported. The path coefficient for the service quality on emergency work management process was (β = 0.058, p = 0.677). Thus, the effect of the service quality on emergency work management process was negative and insignificant. Thus, not supporting H_3. The path coefficient for the communication systems on the emergency work management process was (β = 0.474, p = 0.000), indicating the positive effect of the communication systems on the emergency work management process and provided the evidence to support H_4.

The path coefficient for emergency work management process to the crisis management success was (β = 0.762, p = 0.000), showing that the effect of the emergency work management process on the crisis management success was positive and significant. This supported the H_5. Path coefficients results are shown in Table 7.

Table 6. Heterotrait-Monotrait Ratio (HTMT) – Discriminant Validity

	CMS	CS	EW	IQ	SQ	SV
CMS						
CS	0.769					
EW	0.801	0.725				
IQ	0.516	0.682	0.667			
SQ	0.548	0.677	0.604	0.877		
SV	0.653	0.737	0.564	0.633	0.809	

Note: CMS: Crisis Management Success; CS: Communication System; IQ: Information Quality; SQ: System Quality; SVQ: Service Quality; EW: Emergency Work Management Process

Bootstrapping

According to Hair et. al. (2009), PLS-SEM does not assume that data analyzed are normally distributed. Consequently, there is an implication that parametric significant tests used in regression analysis cannot be useful to test whether coefficients such as outer weights, outer loadings and path coefficients which are said to be significant. As an alternative, PLS-SEM heavily relies on a non-parametric bootstrapping procedure to test the coefficients for their significance (Davidson & Hinkley, 1997; Efron & Tibshirani, 1986). In this study, mediation was tested to see if emergency work management process mediates the relationship between information quality, system quality, service quality, communication systems and crisis management success. The results showed that the emergency work management process

Table 7. Hypothesis testing (resize table to fit nicely?)

	Relationship	Standard Beta (β)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics	P Values	Decision
H1	Information Quality-> Emergency Work Management Process	0.277	0.252	0.122	**2.269**	0.023	**Supported**
H2	System Quality -> Emergency Work Management Process	0.005	0.011	0.117	0.040	0.968	Not Supported
H3	Service Quality -> Emergency Work Management Process	0.058	0.079	0.140	0.417	0.677	Not Supported
H4	Communication Systems -> Emergency Work Management Process	0.474	0.478	0.112	**4.220**	0.000	**Supported**
H5	Emergency Work Management Process -> Crisis Management Success	0.762	0.769	0.053	**14.406**	0.000	**Supported**

only mediates the relationship between information quality, communication systems and crisis management success. Nevertheless, emergency work management process showed no mediation relationships between system quality, service quality and crisis management success. The results are illustrated in Table 8.

The final model is illustrated in Figure 3, conclusive to the hypotheses and mediation analysis.

Discussion

This study was motivated by the increasing pressure and stress amongst employees in Malaysia who were suddenly encouraged to work from various geographical locations and at various time due to the current COVID-19 pandemic. The study aimed to reveal the role of information system quality (ISQ) in handling emergency work management processes to enable effective crisis management success. The variables of ISQ i.e. information quality (IQ), system quality (SQ), service quality (SVQ), and communication systems (CS) were examined as independent variables in contributing towards better Emergency Work Management Process (EW) that leads to Crisis Management Success (CMS).

System Quality is defined as the performance of the information systems used by employees. It is measured in terms of reliability, convenience, ease of use, functionality, and other system metrics. System Quality (SQ) was found to be not significant in this study. Due to the emergence of COVID-19 and the movement control order by the Government of Malaysia has temporarily shift

Table 8. Mediation Analysis

	Relationship (Mediation)	Beta (β)	Sample Mean (M)	Standard Deviation (STDEV)	T Stats	P Values	Lower Limit 2.5%	Upper Limit 97.5%	Decision
H6	Information Quality -> Emergency Work Management Process -> Crisis Management Success	0.211	0.191	0.089	**2.365**	0.018	0	0.351	**Supported**
H7	System Quality -> Emergency Work Management Process -> Crisis Management Success	0.004	0.007	0.09	0.04	0.968	−0.183	0.175	Not Supported
H8	Service Quality -> Emergency Work Management Process -> Crisis Management Success	0.044	0.063	0.111	0.401	0.689	−0.14	0.3	Not Supported
H9	Communication System -> Emergency Work Management Process -> Crisis Management Success	0.361	0.369	0.097	**3.721**	0	0.178	0.552	**Supported**

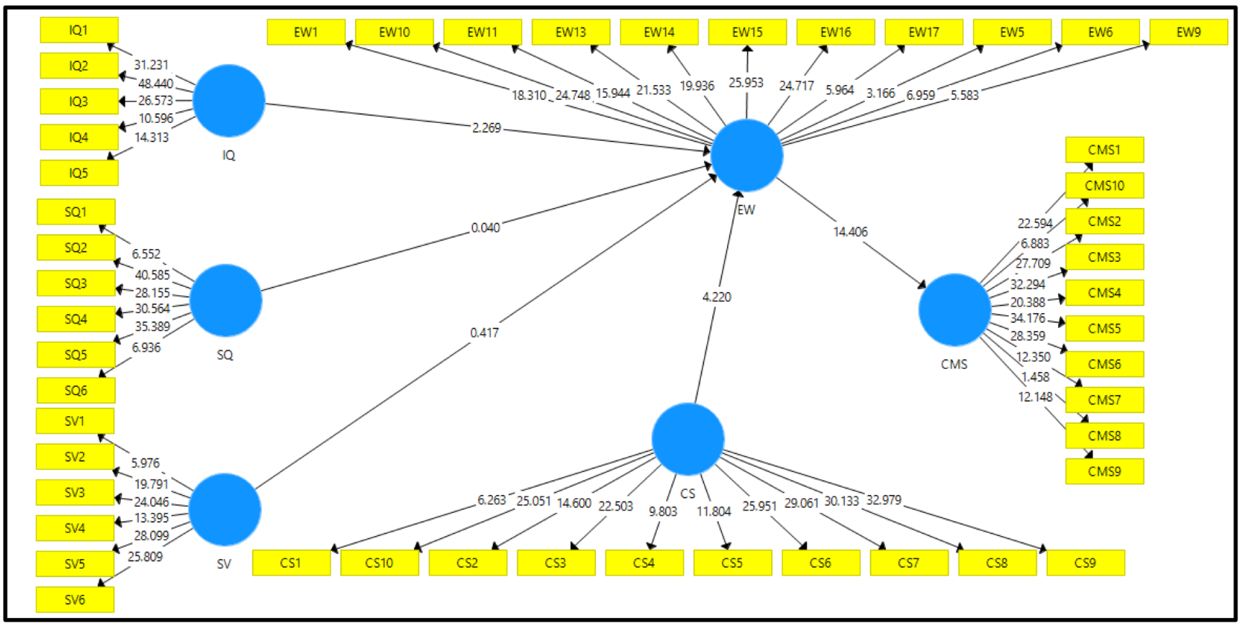

Figure 3: Final Structural Model

working patterns. Employees of non – essential services are forced to grip remote working lifestyle due to the pandemic. The sudden increase in work from home culture has presented issues as well as opportunities: one situation is start-ups such as Slack and Zoom and reputable titans including Microsoft and Google have opted to allow people to use their tools free of charge. These tools are far more accessible than companies' regular VPN services and systems which may be slow and insufficient to address the sudden surge in remote working culture among the employees. This could be because Corporate networks are not used to consuming a majority of their connections over virtual private networks (VPNs), thus experiencing rare quirks, despite the fact that internet service providers (ISPs) have come under duress to boost bandwidth limits so that the employees working remotely do not get cut off from their employers halfway through a meeting or work hour session.

Service Quality is defined as the Support for users by the organization's internal Information Technology Support Department (ITSD). Service Quality was measured in terms of responsiveness, reliability, and empathy of the support organization. The use of free tools and software means of communication and a standard set of manuals to perform self-maintenance in situations where system has issues have put the employees at a point that they are not fully dependant on external remote IT support. In addition, if there is a problem with connecting to the free software this can be solved independently by the employee itself using the standard FAQs and manuals available online. Thus, Service Quality of internal ITSD is not significant in this study due to the independence provided to employees to solve their issues.

Conclusion

This study recommends to possible practical and societal implications due to to IS quality and crisis management success. It contributes to possible tools and methods to empower remote working amongst employees in Malaysia. The COVID-19 pandemic has revealed that the use of digital technology—or Information Systems in an institutionalised context, offers temporal solutions to many organizations in remaining resilient during this crisis. Most companies across the globe have turned towards technology and digital applications to ensure business continuity. From zoom meetings, google hangouts/meet, skype to more simplified applications such as WhatsApp and YouTube, companies are trying their level best to ensure core learning run effectively. Nevertheless, the COVID-19 pandemic lessons suggest that, in Malaysia, there is an urgent need for companies to identify and prioritize possible crisis scenarios and conduct relevant risk assessment and mitigation plans, in light of using relevant Information Systems to support crisis situations. Corporations also need to ensure that the crisis management plans mirror closely to the overall communication protocols for example . alignment between crisis management operations and communication plans by using appropriate technology. Besides, to identify relevant Information Systems that will be used to manage the crisis in meeting stakeholder requirements for example. customers, employees, and shareholders.. Moving forward to ensure overall effectiveness of emergency management processes, companies need to ensure that appropriate information technology is well embedded and tested within the overarching Information System architecture, even before a crisis occurs.

Competing Interest Statement

All authors have read and approved the manuscript and take full responsibility for its contents. The authors have declared that no competing interest exists.

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