

CHAPTER 7: DISCUSSION

The chapter discusses the results of the current study. The research findings are discussed in the context of achieving the aim and objectives of this research. The results presented in Chapter 4 (Data Analysis) are discussed in more detail in this chapter. The hypotheses were developed based on the relationships between independent and dependent variables. These hypotheses were reviewed and compared with prior researches. The evaluation of the research hypotheses and their significance are summarized. Finally, the security culture framework is refinement.

7.1 Achievement of Research Aim and Objectives

The primary aim of this research was to propose security culture framework to top management or providers of e-government services in developing countries, practically in Malaysian context to improve the implementation and management of information security. The objectives of research posed in Chapter 1 are as below:

1. **To identify the socio-technical factors that affects the information security of e-government.** To achieve this objective, the first question in this research was addressed *RQ 1: What are the socio-technical factors that affect the information security of e-government?*

A comprehensive review was conducted of information security current literature from socio-technical perspective. The purpose was to identify a set of candidates for building the framework. To answering this question, the study also explored and identified successful social-technical factors related to the information security in different organizations.

It explored these factors based on literature review, documents, and expert's perspective, and was grounded on the Socio-Technical approach, Security By Consensus (SBC) model, and adapting earlier work (Kankanhalli et al., 2003; Straub Jr, 1990) to address concerns about security effectiveness. The findings, factors influencing security culture were found to be: Legal & law, Compliance, Ethical Conduct, Security Policy, Security Awareness, Security Training, Top Management Support, IS structure. The importance of these factors on security culture creation and improving the effectiveness of information security was discussed in various literatures.

2. To develop information security culture framework for e-government

To achieve this objective, the second question in this research was addressed *RQ2. How significant are the various factors in influencing information security of e-government?*

Quantitative analysis of the organizations' employees' experiences were analyzed and discussed to examine the influence of these factors on the organization security. After identifying and investigating the factors, the framework was developed for improving the effectiveness of e-government security. Taking the results presented in Chapter 4 into account, this research reveals that the main socio-technical factors that affect the information security were as following:

- **Legal & law**

The legal factor could affect the information security in organization. Therefore, this issue needs to be properly addressed (Mwakalinga, 2011), Olusegun and Ithnin (2013) argue that legal issue is one of the important factors which need to be considered in information security management.

According to the results of analysis, all items relating to this construct were observed to have high means. The mean score were between 3.49 and 3.55. The mean score of these items was higher than 3 (the neutral scale), which suggested that the respondents were agreeable to the three measurement variables. The Cronbach's alpha reliability estimates for legal construct was (0.954) which suggested good internal consistency and had strong

reliability of the measurement item. Moreover, the output analysis of the CFA exhibits that these items loaded on (legal) with acceptable values of 0.883, 0.927, 0.946 and 0.909 respectively. Thus, it supported convergent validity of the construct. All the correlation coefficients between each pair of factors were less than 0.850, thus supporting the discriminant validity of the construct.

- **Compliance**

The literature review chapter has illustrated the importance of security compliance to the management of information security and more particularly to the creation of a security culture (M. A. Alnatheer, 2015). Eloff and Eloff (2005) stated that complying with information security policy will improve the security culture of the organizations.

According to the analysis result all items relating to this construct were observed to have high means. The mean score were between 3.35 and 3.39. The mean score of these items was higher than 3 (the neutral scale) which suggested that the respondents were agreeable to the measurement variables. The Cronbach's alpha reliability estimates for compliance construct was (0.907), which suggested good internal consistency and had strong reliability of the measurement item. Moreover, the output analysis of CFA exhibits that these items loaded on (compliance) with acceptable values of 0.921, 0.923 and 0.884, respectively, thus supporting convergent validity of the construct. All the correlation coefficients between each pair of factors were less than 0.850, thus supporting the discriminant validity of the construct.

- **Ethical Conduct**

One of the factors that influence security culture is ethical conduct. In fact, the importance of ethical conduct for security culture creation was well supported by several studies (Chaula, 2006; Da Veiga & Eloff, 2010; Dojkovski et al., 2007). Ethical conduct could assist users to understand and be aware of their security responsibilities to reduce any risk associated with their security behavior. This would also help users to adhere to the security policy.

According to the result of analysis, all items relating to this construct were observed to have high means. The mean score were between 3.55 and 3.67. The mean score of these items was higher than 3 (the neutral scale) which suggested that the respondents were agreeable to the three measurement variables. The Cronbach's alpha reliability estimates for ethical construct was (0.944) which suggested good internal consistency and had strong reliability of the measurement item. Moreover, the output analysis of CFA exhibits that these items were loaded on (ethical) with acceptable values of 0.928, 0.920 and 0.916 respectively, thus supporting convergent validity of the construct. All the correlation coefficients between each pair of factors were less than 0.850 thus supporting the discriminant validity of the construct.

- **Security Policy**

Information security policy was also considered one of the important factors for creating a security culture according to many studies (Da Veiga, 2015; Knapp et al., 2009; Paulsen & Coulson, 2014). M. A. Alnatheer (2014) argued that the security policies are extremely important not only for information security management effectiveness, but also to cultivate information security culture in an organization.

According to the result of analysis, all items relating to this construct were observed to have high means. The mean score were between 3.46 and 3.52. The mean score of these items was higher than 3 (the neutral scale which suggested that the respondents were agreeable to the three measurement variables). The Cronbach's alpha reliability estimates for Policy construct was 0.934 which suggested good internal consistency and had strong reliability of the measurement item. Moreover, the output analysis of CFA exhibits that these items were loaded on Policy with acceptable values of 0.913, 0.932 and 0.880 respectively thus supporting convergent validity of the construct. All the correlation coefficients between each pair of factors were less than 0.850 thus supporting the discriminant validity of the construct.

- **Security Awareness**

Security awareness is important elements of security culture. In order to create an environment that promotes security culture creation, security awareness must be established. The lack of security awareness itself has been repeatedly considered as a major problem for ensuring the security of organizations in many studies (Brodie, 2008; Chan & Mubarak, 2012; El-Haddadeh et al., 2012; Kim & Jeoung, 2015; Knapp & Ferrante, 2014; Shahri et al., 2013).

According to the results of analysis, all items relating to this construct were observed to have high means. The mean score were between 3.70 and 3.72. The mean score of these items was higher than 3 (the neutral scale) which suggested that the respondents were agreeable to the measurement variables. The Cronbach's alpha reliability estimates for Awareness construct was (0.925) which suggested good internal consistency and had strong reliability of the measurement item. Moreover, the output analysis of CFA exhibits that these items were loaded on (Awareness) with acceptable values of 0.857, 0.947 and 0.886 respectively thus supporting convergent validity of the construct. All the correlation coefficients between each pair of factors were less than 0.850 thus supporting the discriminant validity of the construct.

- **Security Training**

Information security training was also considered as an important factor that influences and assists in the creation of security culture. The security culture cannot be achieved without security training for all users (Tarimo et al., 2006). Da Veiga et al. (2007) argued that organizations need to ensure that "training will improve the information security culture, and minimize risks to information assets".

According to the results of the analysis, all items relating to this construct were observed to have high means. The mean score were between 3.30 and 3.33. The mean score of these items was higher than 3 (the neutral scale) which suggested that the respondents were agreeable to the three measurement variables. The Cronbach's alpha reliability estimates for Training construct was (0.958) which suggested good internal consistency

and had strong reliability of the measurement item. Moreover, the output analysis of CFA exhibits that these items were loaded on (Training) with acceptable values of 0.936, 0.947 and 0.939 respectively thus supporting convergent validity of the construct. All the correlation coefficients between each pair of factors were less than 0.850 thus supporting the discriminant validity of the construct.

- **Top Management Support**

Top management support was considered as an important driver of security culture creation (Dojkovski et al., 2007; Greene & D'Arcy, 2010; Kraemer et al., 2009; Veiga & Eloff, 2007). As discussed earlier in the literature review chapter, top management support can assist in the improvement of security awareness by providing extensive training and enforcing and maintaining adherence to the security policy by the organization's staff. This will help develop a positive staff attitude to the organization's security policy. It should be noted that top management involvement here is concerned with whether senior management are committed to information security, and with ensuring the appropriate responsible individual is assigned to specific information security activities. Additionally, the involvement of top management can ensure staff members are accountable for their security actions and decisions.

According to the results of analysis, all items relating to this construct were observed to have high means. The mean score were between 3.49 and 3.57. The mean score of these items was higher than 3 (the neutral scale) which suggested that the respondents were agreeable to the three measurement variables. The Cronbach's alpha reliability estimates for Top Management Support construct was (0.940) which suggested good internal consistency and had strong reliability of the measurement item. Moreover, the output analysis of CFA exhibits that these items were loaded on (Top Management Support) with acceptable values of 0.879, 0.913, 0.912 and 0.871 respectively. Thus, it supported convergent validity of the construct. All the correlation coefficients between each pair of factors were less than 0.850; thus supporting the discriminant validity of the construct.

- **Security culture**

The importance of creating a security culture within organization settings arises from the fact that the human dimension in information security is always considered to be the weakest link. Many studies have shown that the establishment of an information security culture is necessary for effective information security (S. M. Alfawaz, 2011; Brady, 2011; Da Veiga & Eloff, 2010).

According to the results of analysis, all items relating to this construct were observed to have high means. The mean score were between 3.59 and 3.63. The mean score of these items was higher than 3 (the neutral scale) which suggested that the respondents were agreeable to the three measurement variables. The Cronbach's alpha reliability estimates for cultureconstruct was (0.910) which suggested good internal consistency and had strong reliability of the measurement item. Moreover, the output analysis of CFA exhibits that these items were loaded on (security effectiveness) with acceptable values of 0.736, 0.906, 0.870 and 0.856 respectively. Thus, it supported convergent validity of the construct. All the correlation coefficients between each pair of factors were less than 0.850; thus supporting the discriminant validity of the construct.

- **IS structure**

Information security systems defined as systems that protect information assets from harm or misuse. Technical infrastructure that is capable of handling the required volume and type of transactions in a secure manner is a necessity in achieving the information assurance objectives. IS structure was considered as an important driver of security culture creation (S. M. Alfawaz, 2011).

According to the results of analysis, all items relating to this construct were observed to have high means. The mean score were between 3.68 and 3.73. The mean score of these items was higher than 3 (the neutral scale) which suggested that the respondents were agreeable to the three measurement variables. The Cronbach's alpha reliability estimates

for IS structure construct was (0.942) which suggested good internal consistency and had strong reliability of the measurement item. Moreover, the output analysis of CFA exhibits that these items were loaded on (IS structure) with acceptable values of 0.911, 0.935 and 0.910 respectively. Thus, it supported convergent validity of the construct. All the correlation coefficients between each pair of factors were less than 0.850; thus supporting the discriminant validity of the construct.

- **Security Effectiveness**

The effectiveness of security measures in reducing the overall risk to information in organizations had been studied extensively over the years (S. Alfawaz et al., 2008). Radack (2008) argued that the security controls such as the management, operational, and technical safeguards or countermeasures that protect the confidentiality, integrity, and availability of an information system and its information, effective information security in organizations depend on these controls (Aliti & Akkaya, 2011).

According to the results of analysis, all items relating to this construct were observed to have high means. The mean score were between 3.57 and 3.63. The mean score of these items was higher than 3 (the neutral scale) which suggested that the respondents were agreeable to the three measurement variables. The Cronbach's alpha reliability estimates for security effectiveness construct was (0.939) which suggested good internal consistency and had strong reliability of the measurement item. Moreover, the output analysis of the structural equation model (Figure 5.6) exhibits that these items were loaded on (security effectiveness) with acceptable values of 0.890, 0.880, 0.897 and 0.898 respectively. Thus, it supported convergent validity of the construct. All the correlation coefficients between each pair of factors were less than 0.850; thus supporting the discriminant.

3. To validate the proposed framework.

To achieve this objective, the last question in this research was addressed

RQ 3: How the proposed framework could be validated?

This research question was aimed to assess and validates the security culture framework. Structural Equation Modeling (SEM) employed as the technique for evaluating and validating the relationships between the framework constructs which presented SEM components of a measurement framework. In addition, to gain an initial understanding of the relationship between socio-technical factors that influenced security culture to improve the effectiveness of information security in e-government.

The proposed framework was developed based on the outcome of the review of literature and data analysis. Afterwards, the proposed framework was tested using SEM technique throughout chapter 6. The research data in this study offered a nomological validity to the conceptualization of a security culture measurement framework. To evaluate the proposed framework, the coefficient parameter estimates were examined along with the goodness-of-fit indices to assess if the hypothesized structural model fits the data. The results are discussed in the following section

Hypothesis 1(H1): Legal & law, Compliance, Ethical Conduct, Information Security Policy, Security Awareness, Information Security Training, Top Management Support and IS structure, are factors that have positive influence on security culture

It needs to be highlighted that the analysis on the output of the structural equation Model, outlined in chapter 6 (Figure 6.3) proved that the Legal & law has a Positive effect on security culture. The related Standard Regression Weight value was $b=.162$ and $P\text{-value}=0.00<0.05$. The results tend to agree with the findings of previous research (S. M. Alfawaz, 2011; M. A. Alnatheer, 2014), based on this result, it can be said that the Legal & law have an effects on security culture. It is accordingly concluded that the hypothesis is significant.

The Compliance has positive effect on security culture. The related Standard Regression Weight value is $b=.236$ and $P\text{-value}=0.00<0.05$ confirmed that Compliance have effects on security culture. The conclusion is that the hypothesis is significant. The results tend to

agree with the findings of previous research (M. A. Alnatheer, 2015; D'Arcy & Greene, 2009; Adele Da Veiga & Nico Martins, 2015).

The Ethical Conduct has positive effect on security culture. The related Standard Regression Weight value was $b=.120$ and $P\text{-value} = 0.007 < 0.05$. This confirmed that causes of Ethical issues have effects on security culture. The conclusion is that the hypothesis is significant. The results tend to agree with the findings of previous research (M. A. Alnatheer, 2015; C. C. Chen et al., 2008).

The Information Security Policy has positive effect on security culture. The related Standard Regression Weight value was $b=.263$ and $P\text{-value} = 0.00 < 0.05$. This confirmed that Policy issues have effects on security culture. The conclusion is that the hypothesis is significant. The results tend to agree with the findings of previous research (Da Veiga, 2015; Lim et al., 2010; Paulsen & Coulson, 2014).

The Security Awareness has positive effect on security culture. The related Standard Regression Weight value is $b=.113$ and $P\text{-value} = 0.011 < 0.05$. This confirmed that Awareness has effects on security culture. The conclusion is that hypothesizes significant. The results tend to agree with the findings of previous research (Akhgar & Arabnia, 2013; M. Alnatheer & Nelson, 2009; Chan & Mubarak, 2012; Tarimo et al., 2006).

The Information Security Training has positive effect on security culture. The related Standard Regression Weight value was $b=.180$ and $P\text{-value} = 0.00 < 0.05$. Because of this, Hanna (2002) confirmed that Training has effects on security culture. The conclusion is that the hypothesis is significant. Results tend to agree with the findings of previous research, (Crossler et al., 2013; Adèle Da Veiga & Nico Martins, 2015; Paulsen & Coulson, 2014).

The Top Management Support has positive effect on security culture. The related Standard Regression Weight value was $b=.256$ and $P\text{-value} = 0.00 < 0.05$. This confirmed that Top Management Support have effects on security culture. The conclusion is that the hypothesis is significant. The results tend to agree with the findings of previous research

(AlHogail & Mirza, 2014; Adele Da Veiga & Nico Martins, 2015; Greene & D'Arcy, 2010).

The IS structure has positive effect on security culture. The related Standard Regression Weight value was $b=.156$ and $P\text{-value} = 0.00 < 0.05$. This confirmed that IS structure has effects on security culture. The conclusion is that the hypothesis h1a is significant. The (S. M. Alfawaz, 2011; Hussein et al., 2007).

Hypothesis 2 (H2): Security culture has positive influence on security effectiveness.

In this study, the analysis done on the output of the structural equation Model exhibited that the security culture has positive effect on security effectiveness. The related Standard Regression Weight value was $b=.492$ and $P\text{-value} = 0.00 < 0.05$. This confirmed that security culture has positive effect on security effectiveness. The conclusion is that the hypothesis h1a is significant. The results tend to agree with the findings of previous research (S. M. Alfawaz, 2011; Brady, 2011; Chang & Lin, 2007; Da Veiga & Eloff, 2010; Rotvold, 2008).

Hypothesis 3 (H3): Legal & law, Compliance, Ethical Conduct, Information Security Policy, Security Awareness, Information Security Training, Top Management Support and IS structure influence on security effectiveness and mediated by security culture.

The results of the analysis performed on the output of the structural equation Model followed the mediation test procedure proposed by (Awang, 2015) indicate that the independent factors such as (Ethical Conduct, Legal & law, Compliance, Top Management Support, Information Security Policy, Information Security Training, Security Awareness, IS structure) have influence on security effectiveness and is mediated by security culture. In addition, all of these factors are fully mediated by security culture since the direct effect is no longer significant after the mediator enters the framework except the Compliance which is partially mediated by security culture since the direct effect is still significant after the mediator enters the framework. That supports H3. In addition, Bootstrapping technique was used to re-confirm the mediation tests result

using. Through bootstrapping, multiple samples (with the same N as the original sample) are randomly drawn from the original sample with replacement. That is, a given case may be randomly selected more than once in any given bootstrapping data set (Byrne, 2013), the number of re-sampling could be between 500 to 1000 times (Awang, 2015).

The result shows that the path from Compliance to security culture is significant. Path from Compliance to security effectiveness is significant ($p < .05$). This means mediation effect of security culture between Compliance and security effectiveness is partial. Further, path from (Ethical Conduct, Legal & law, Top Management Support, Information Security Policy, Information Security Training, Security Awareness, IS structure) to security culture is significant. However, paths from (Ethical Conduct, Organizational culture, Legal & law, Compliance, Top Management Support, Information Security Policy, Information Security Training, Security Awareness, IS structure) to security effectiveness are not significant ($p - \text{value} > .05$). This means mediation effect of security culture between (Ethical Conduct, Legal & law, Top Management Support, Information Security Policy, Information Security Training, Security Awareness, IS structure) and security effectiveness is Full. These confirm the previous results from conventional procedure, H3 supported.

7.2 Discussion of Results of Objectives

Based on the analysis of quantitative data and comprehensive review of the literature, the findings in this study support the assertion that factors influencing the effectiveness of the information security consist of eight factors: Legal & law, Compliance, Ethical Conduct, Security Policy, Security Awareness, Security Training, Top Management Support, IS structure, mediated by security culture.

The security culture measurement framework instruments that were demonstrated produced excellent reliability estimates and evidence also supported their content validity, discriminant validity, convergent validity, and nomological validity. The findings indicate that factors influence security culture are positively associated with Legal & law,

Compliance, Ethical Conduct, Security Policy, Security Awareness, Security Training, Top Management Support, IS structure. All of these factors have positive influence on security effectiveness and are mediated by Security culture. In addition, positive correlations, consistent with theoretical predictions, were obtained between factors influencing security to improve the effectiveness of information security for e-government. These correlations provide further support to the nomological validity of the socio-technical security measurement framework. The framework development consolidated with the socio-technical factors influencing information security (refer to chapter 5, page 104, Figure 5.1). The two dimensions of candidate factors set that influence information security effectiveness based on the literature review analysis are:

- **Socio-technical dimension: which includes** (Legal & law, Compliance, Ethical Conduct, Security culture, Security Policy, Security Awareness, Security Training, Top Management Support)
- **Technical dimension: which include** (IS structure).

7.3 Chapter Summary

This chapter compared the achievement of this research from the research aim and its objectives point of views. All hypotheses developed in the framework were discussed with previous literature and found inferences for the future. All hypotheses were supported. The findings showed that creating security culture is important for implementing an effective information security for e-government. The results of the data analysis showed that the factors influencing security culture are positively associated with Legal & law, Compliance, Ethical Conduct, Security Policy, Security Awareness, Security Training, Top Management Support, IS structure. All these factors have positive influence on security effectiveness and are mediated by Security culture.

Overview of the research, research limitations, conclusion, contributions, and suggestion for future work will be discussed in more detail in the next chapter.