INFORMATION SECURITY POLICY COMPLIANCE BEHAVIOUR MODEL FOR MALAYSIAN FEDERAL PUBLIC SECTOR AGENCIES

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DEDICATION

This thesis is dedicated to my husband (Mr.Sivabalan) and kids (Vihaan &Vidhyan)

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ABSTRACT

Organizations leverage information security policies (ISP) to prevent information security incidents, but employees often fail to comply with them. As such, the Malaysian public sector has a comprehensive ISP in the form of circulars, policies, procedures, frameworks, and strategic plans. However, ISP compliance among Malaysian public sector employees remains low, with limited studies found in extant research. Hence, this research aims to develop and validate a new model of factors that influence ISP compliance behaviour among Malaysian federal public sector agency employees. The research started with the identification of problems through conducting interviews with the relevant agencies and knowledge gaps by reviewing existing ISP literature. Then, a systematic literature review (SLR) was performed and analysed to identify the influencing factors of ISP compliance behaviour. A conceptual model was developed using factors from the theory of planned behaviour, social bond theory, protection motivation theory, and several other factors from literatures. Next, the survey instrument items were developed, their content validated by nine experts, and a pilot test was conducted with 30 respondents. Subsequently, data collection was conducted through email among 27 federal agency employees in Putrajaya and Kuala Lumpur, Malaysia. As a result, 360 valid responses were analysed to validate the conceptual model using ‘partial least square-structured equation modelling’ analysis. The model validation revealed that ‘attitude’, ‘perceived behavioural control’, ‘perceived response efficacy’, ‘perceived punishment severity’, ‘attachment’, ‘commitment’, ‘belief’, and ‘perceived benefit’ have positive effects on ISP compliance intention with p-value < 0.05. However, five factors, namely ‘subjective norm’, ‘threat severity’, ‘threat vulnerability’, ‘awareness training’ and ‘involvement’ were found to be non-significant towards ISP compliance intention with p-value > 0.05. These research findings were used to develop ISP compliance guidelines for the Malaysian public sector. The ISP compliance guidelines were reviewed by three ISP practitioners. Overall, this research contributes theoretically, contextually, and practically towards ISP compliance, especially in the context of the Malaysian federal public sector agencies.

ABSTRAK

Organisasi memanfaatkan dasar keselamatan maklumat (ISP) untuk mencegah insiden keselamatan maklumat, tetapi pekerja sering gagal mematuhinya. Oleh yang demikian, sektor awam Malaysia mempunyai ISP yang komprehensif dalam bentuk pekeliling, dasar, prosedur, rangka kerja dan pelan strategik. Walau bagaimanapun, pematuhan ISP dalam kalangan kakitangan sektor awam Malaysia kekal rendah, dan kajian lepas dalam penyelidikan ini adalah terhad. Oleh itu, kajian ini bertujuan untuk membangunkan dan mengesahkan model baharu bagi faktor-faktor yang mempengaruhi tingkah laku pematuhan ISP dalam kalangan kakitangan agensi sektor awam persekutuan Malaysia. Kajian dimulakan dengan mengenal pasti masalah melalui temu bual dengan agensi berkaitan dan jurang pengetahuan dengan mengkaji kajian lepas yang sedia ada. Kemudian, kajian literatur sistematik (SLR) dilakukan dan dianalisis untuk mengenal pasti faktor-faktor yang mempengaruhi tingkah laku pematuhan ISP. Model konseptual dibangunkan menggunakan faktor-faktor daripada teori tingkah laku terancang, teori ikatan sosial, teori motivasi perlindungan dan beberapa faktor lain daripada kajian lepas. Seterusnya, item instrumen soal selidik telah dibangunkan, kandungannya disahkan oleh sembilan pakar, serta ujian rintis telah dijalankan dengan 30 responden. Selepas itu, pengumpulan data telah dijalankan menerusi e-mel dalam kalangan kakitangan di 27 agensi persekutuan di Putrajaya dan Kuala Lumpur, Malaysia. Sebanyak 360 respons yang sah telah dianalisis untuk mengesahkan model konseptual menggunakan analisis ‘pemodelan persamaan berstruktur separa terkecil’. Pengesahan model mendedahkan bahawa ‘sikap’, ‘kawalan tingkah laku yang dirasakan’, ‘keberkesanan tindak balas’, ‘keterukan hukuman’, ‘keterikatan’, ‘komitmen’, ‘kepercayaan’, dan ‘faedah yang dirasakan’ mempunyai kesan positif terhadap niat pematuhan ISP dengan nilai-p < 0.05. Bagaimanapun, lima faktor iaitu ‘norma subjektif’, ‘keterukan ancaman’, ‘kelemahan ancaman’, ‘latihan kesedaran’ dan ‘penglibatan’ didapati tidak signifikan terhadap niat pematuhan ISP dengan nilai-p > 0.05. Hasil kajian ini digunakan untuk membangunkan garis panduan pematuhan ISP untuk sektor awam Malaysia. Garis panduan pematuhan ISP telah disemak oleh tiga pengamal ISP. Secara keseluruhannya, kajian ini menyumbang secara teori, kontekstual dan praktikal ke arah pematuhan ISP, terutamanya dalam konteks agensi sektor awam persekutuan Malaysia.

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LIST OF ABBREVIATIONS

SDT	-	Self Determination Theory
DT	-	Deterrence Theory
PMT	-	Protection Motivation Theory
TPB	-	Theory of Planned behaviour
SBT	-	Social Bond Theory
RCT	-	Rational Choice Theory
HBM	-	Health Belief Model
ISC	-	Information Security Compliance
JD-R	-	Extended Job Demands-Resources
EPPM	-	Extended Parallel Processing Model
TIB	-	Theory of Interpersonal Behaviour
ISP	-	Information Security Policy
TRA	-	Theory of Reasoned Action
RAKKSSA	-	Public Sector Cyber Security Framework
ICT	-	Information Communication Technology
CERT	-	Computer Emergency Response Team
ISMS	-	Information Security Management System
BCM	-	Business Continuity Management
GCERT	-	Government Computer Emergency Response Team
PLS-SEM	-	Partial Least Squares Structural Equation Modelling
IPMA	-	Importance and Performance Matrix Analysis
CMV	-	Common Method Variance
CVI	-	Content Validity Index
CVR	-	Content Validity Ratio
VIF	-	Variance Inflation Factors
AVE	-	Average Variance Extracted

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CHAPTER 1

INTRODUCTION

1.1 Overview

Organisations reliance on information technology have increased tremendously and brought many advantages. The prevalent use of information technology has resulted in an exponential increase in information security threats and attacks (Humayun, Niazi, Jhanjhi, Alshayeb, & Mahmood, 2020). Therefore, information security becomes a necessity for organizations. Globally, information security becoming top priority as worldwide threat assessment of the United States intelligence community put cyber threat as the top priority ahead of other prominent threats including weapons of mass destruction and proliferation, terrorism, and counter intelligence (CIA, 2019). Meanwhile Malaysia's cybersecurity strategy for 2020-2024 recognizes information security as a vital national priority (National Security Council, 2019). According to the report, government now has to deal with cyber threats from state sponsored actors aimed at critical targets of national importance.

At the outset, a lot of initiatives taken to address information security threats in technological context but later discovered that it is not sufficient to guarantee overall information security in organisations (Ifinedo, 2014; Kim, Yang, & Park, 2014; Metalidou et al., 2014; Safa, Solms, & Futcher, 2016; Soomro, Shah, & Ahmed, 2016). Growing security threats despite advanced technological solutions in place have extended researchers attention to explore on the human aspect such as employees behaviour in an organisation (Ifinedo, 2014; Metalidou et al., 2014; Safa et al., 2016).

First, employees need guidance to prevent, face and manage information security threats. Therefore, information security policy is developed to provide relevant guide and support to the employees within an organization with regard to information security (Sommestad, Karlzén, & Hallberg, 2015). Information security policy is defined as guidelines, requirements, and rules developed by management to guide employee's behaviours (Ifinedo, 2014). Information security policy generally include acceptable use of computer resources, accountabilities concerning information security and sometimes the consequences of security policy violation (Sommestad et al., 2015). Information security policy is responsible to secure information security of an organization if the anticipated behaviour mandated in policy is achieved by observance or compliance of the policy by employees (Kim et al., 2014; Sohrabi Safa, Von Solms, & Furnell, 2016; Sommestad et al., 2015). Therefore, information security policy compliance is one of the key challenges being faced by organisation around the globe.

Typically, organizations around the globe especially public sector do have comprehensive information security policy such specific cybersecurity framework by national institute of standards and technology (NIST) United States and basic policies such as a disaster recovery policy, data backup policy, or risk assessment policy and so on. Relatively Malaysian public sector does have a list of policies, framework, circulars, best practises, standard requirements, guidelines, instruction letters and security procedures in place (Section 2.3.1). These lists of documents are generalised and referred as 'information security policy (ISP)' are applicable to all Malaysian public sector employees. Malaysian public sector employees must know, understand and comply to ISP (MAMPU, 2016).

According to Malaysian national cybersecurity strategy 2020-2025 report employees remain a significant information security risk to organisation (National Security Council, 2019). According to that report, there were also incidents where these insiders (employees), unknowingly become victims of elaborated cybercrime schemes such as watering hole attacks, social engineering ploys, malware and ransomware infections, propagation mechanism by inserting infected universal serial bus (USB) devices into the internal networks or arbitrarily clicking on links found in emails or while browsing the internet (National Security Council, 2019). The report also stated that numerous cases of intellectual property theft and the leaking of sensitive information have caused substantial financial and reputational damage (National Security Council, 2019).

This chapter gives introduction and overview of this thesis. First, the chapter provide background of problem (section 1.2), second, it describes problem statement of the research (section 1.3). Third, it describes the research questions (section 1.4) and research objectives (section 1.5). Then, it continues to describe research scope (section 1.6), significance of the research (Section 1.7) and finally, structure of the thesis content (Section 1.8).

1.2 Background of Problem

ISP which includes mandatory organisational rules, policies, frameworks, procedure, guidelines, requirements and best practices essential to control employees security behaviours in cyber environment (Bauer & Bernroider, 2017; Ifinedo, 2018). ISP compliance ensure adherence to safe practise by employees. Employees should comply to these policies to defend their organisation's resources and assets (Lowry & Moody, 2015; Yazdanmehr & Wang, 2016). Having ISP is in place does not guarantee that employees will comply to its specifications (Ifinedo, 2018). In reality, employees noncompliance to ISP, leads to greater information security complications such as information security incidents (Han, Kim, & Kim, 2017; Siponen, Adam Mahmood, & Pahnila, 2014).

Although various ISP have been developed and deployed, the employee's compliance to ISP remains low (D'Arcy & Lowry, 2017; Ifinedo, 2018; Chenhui Liu, Wang, & Liang, 2020). Employees tend to ignore ISP which leads to incidents of unsafe security activities, such as downloading unverified software from the internet, using simple and obvious passwords and sharing computer accounts (Pham, El-Den, & Richardson, 2016). Such unsafe security behaviour have the potential to compromise the organisation security system, despite having the best ISP (Pham et al., 2016). Hence, employees causes breaches to information resources and assets of organisations (Lowry & Moody, 2015).

Employees has been described as the critical factor and weakest link in an organisation (Ifinedo, 2014; Stewart & Jurjens, 2017). Employees does not comply to

ISP for many reasons including unawareness of ISP, carelessness, laziness, mischief, and conflict (Lowry & Moody, 2015; Siponen et al., 2014; Sohrabi Safa et al., 2016). Sometimes, employees may find complying to ISP is time consuming and inconvenient, as it has the potential to obstruct their daily routine work (Pham et al., 2016).

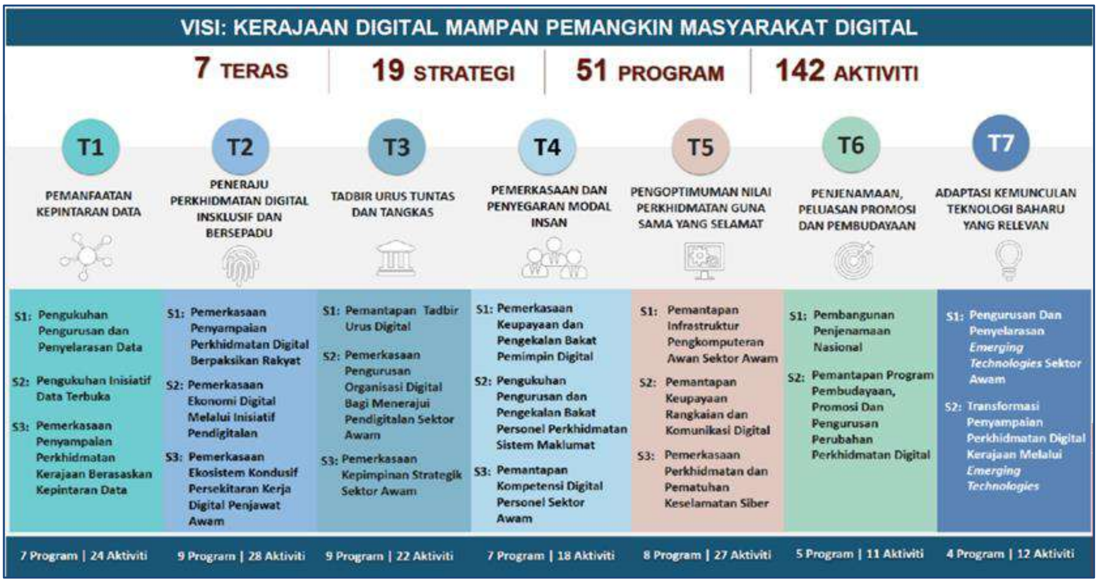
A number of 10,790 security incidents have been recorded in Malaysia involving spam, intrusion attempt, denial of service, fraud, malicious code, content related incidents, intrusion, cyber harassment and vulnerability report meanwhile malware infection and botnet drones accumulated to 5,508,357 devices in the year 2020 (MYCERT, 2020). As for year 2021, a number of 10,016 security incidents and 2,746,265 malware and botnet infected devices was reported (MyCERT, 2014). Meanwhile, Malaysian public sector security incidents statistics from year 2015 up until 31 July 2021 is shown in Table 1.1. It is important to note that most of Malaysian public sector employees was working from home (WFH) during 2020 and 2021 and any security incidents that happen in employees home network is not covered. Hence, the actual number of incidents are far more than the reported cases.

Table 1.1 Cyber security incidents of Malaysian public sector (Cybersecurity, 2021)

	2021*	**2020**	**2019**	**2018**	**2017**	**2016**	**2015**
Content related	2	5	14	8	2	0	0
Cyber harassment	0	2	1	1	0	1	0
DoS	1	1	0	1	0	0	2
Fraud	4	11	4	16	7	17	10
Intrusion	29	66	63	49	36	122	75
Intrusion attempt	0	0	0	0	0	1	4
Malicious codes	2	6	4	6	16	13	13
Spam	1	6	4	3	4	3	1
Vulnerabilities report	5	8	13	43	13	7	3
Total	**44**	**105**	**103**	**127**	**78**	**164**	**108**

***until 31st July 2021**

Every employee in Malaysian public sector is subject to complying with ISP, hence they should equip themselves with an understanding of information security risks and know the relevant preventive measures, take responsibility, and take steps to improve information security. Noncompliance among Malaysian public sector employees to ISP have huge impact where it erodes the public's trust in the governance of Malaysian public sector organizations to protect their information assets. Hence the urgency in identifying solution in improving the ISP compliance behaviour among Malaysian public sector employees expressed in Public Sector Digitization Strategic Plan (PSPSA) 2021-2025 (MAMPU, 2021). As of Figure 1.1, under strategic thrust 5 which is ‘optimization of equalized service value’, outlined the strategy 3 which is ‘strengthening service and cyber security compliance’. This is also in line with the sustainable development goals 2030 (SDG 2030) of United Nation, the 12th Malaysia plan (RMKe-12) and the aspirations of the vision for common prosperity 2030 (WKB 2030).



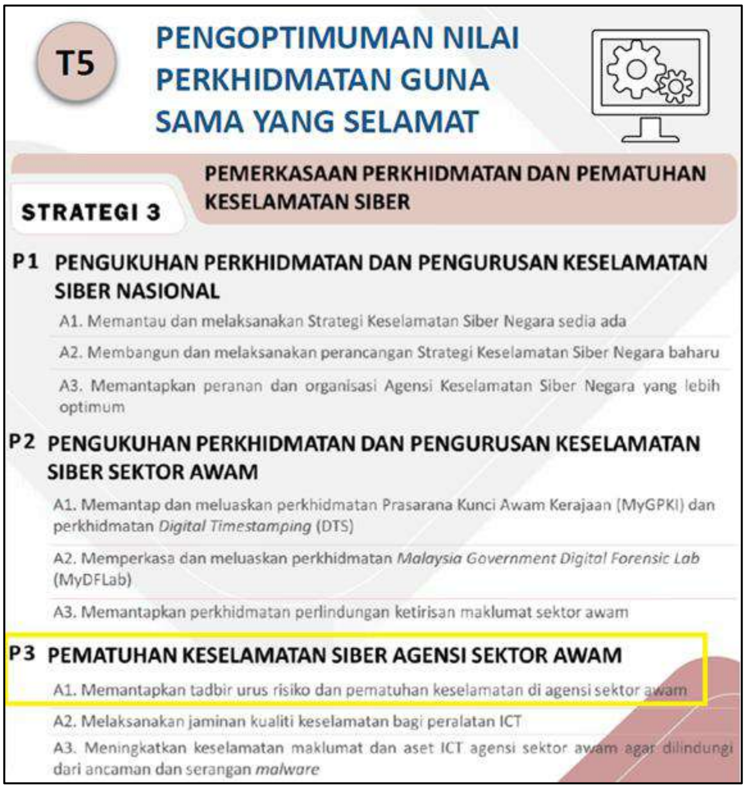
VISI: KERAJAAN DIGITAL MAMPAN PEMANGKIN MASYARAKAT DIGITAL

7 TERAS | 19 STRATEGI | 51 PROGRAM | 142 AKTIVITI

T1	T2	T3	T4	T5	T6	T7
PEMANFAATAN KEPINTARAN DATA	PENERAJU PERKHIDMATAN DIGITAL INSKLUSIF DAN BERSEPADU	TADBIR URUS TUNTAS DAN TANGKAS	PEMERKASAAN DAN PENYEGARAN MODAL INSAN	PENGOPTIMUMAN NILAI PERKHIDMATAN GUNA SAMA YANG SELAMAT	PENJENAMAAN, PELUASAN PROMOSI DAN PEMBUDAYAAN	ADAPTASI KEMUNCULAN TEKNOLOGI BAHARU YANG RELEVAN
S1: Pengukuhan Pengurusan dan Penyelarasan Data	S1: Pemerkasaan Penyampaian Perkhidmatan Digital Berpaksikan Rakyat	S1: Pemantapan Tadbir Urus Digital	S1: Pemerkasaan Keupayaan dan Pengekalan Bakat Pemimpin Digital	S1: Pemantapan Infrastruktur Pengkomputeran Awan Sektor Awam	S1: Pembangunan Penjenamaan Nasional	S1: Pengurusan Dan Penyelarasan *Emerging Technologies* Sektor Awam
S2: Pengukuhan Inisiatif Data Terbuka	S2: Pemerkasaan Ekonomi Digital Melalui Inisiatif Pendigitalan	S2: Pemerkasaan Pengurusan Organisasi Digital Bagi Menerajui Pendigitalan Sektor Awam	S2: Pengukuhan Pengurusan dan Pengekalan Bakat Personel Perkhidmatan Sistem Maklumat	S2: Pemantapan Keupayaan Rangkaian dan Komunikasi Digital	S2: Pemantapan Program Pembudayaan, Promosi Dan Pengurusan Perubahan Perkhidmatan Digital	S2: Transformasi Penyampaian Perkhidmatan Digital Kerajaan Melalui *Emerging Technologies*
S3: Pemerkasaan Penyampaian Perkhidmatan Kerajaan Berasaskan Kepintaran Data	S3: Pemerkasaan Ekosistem Kondusif Persekitaran Kerja Digital Penjawat Awam	S3: Pemerkasaan Kepimpinan Strategik Sektor Awam	S3: Pemantapan Kompetensi Digital Personel Sektor Awam	S3: Pemerkasaan Perkhidmatan dan Pematuhan Keselamatan Siber		
7 Program | 24 Aktiviti	9 Program | 28 Aktiviti	9 Program | 22 Aktiviti	7 Program | 18 Aktiviti	8 Program | 27 Aktiviti	5 Program | 11 Aktiviti	4 Program | 12 Aktiviti

Figure 1.1 Trust and strategy outlined in PSPSA 2021-2025 (MAMPU, 2021)

PSPSA have regarded ISP compliance as vital through implementation plan to strengthen cyber security compliance among public sector agencies as in Figure 1.2.



T5 PENGOPTIMUMAN NILAI PERKHIDMATAN GUNA SAMA YANG SELAMAT

STRATEGI 3 PEMERKASAAN PERKHIDMATAN DAN PEMATUHAN KESELAMATAN SIBER

P1 PENGUKUHAN PERKHIDMATAN DAN PENGURUSAN KESELAMATAN SIBER NASIONAL

A1. Memantau dan melaksanakan Strategi Keselamatan Siber Negara sedia ada

A2. Membangun dan melaksanakan perancangan Strategi Keselamatan Siber Negara baharu

A3. Memantapkan peranan dan organisasi Agensi Keselamatan Siber Negara yang lebih optimum

P2 PENGUKUHAN PERKHIDMATAN DAN PENGURUSAN KESELAMATAN SIBER SEKTOR AWAM

A1. Memantap dan meluaskan perkhidmatan Prasarana Kunci Awam Kerajaan (MyGPKI) dan perkhidmatan *Digital Timestamping* (DTS)

A2. Memperkasa dan meluaskan perkhidmatan *Malaysia Government Digital Forensic Lab* (MyDFLab)

A3. Memantapkan perkhidmatan perlindungan ketirisan maklumat sektor awam

P3 PEMATUHAN KESELAMATAN SIBER AGENSI SEKTOR AWAM

A1. Memantapkan tadbir urus risiko dan pematuhan keselamatan di agensi sektor awam

A2. Melaksanakan jaminan kualiti keselamatan bagi peralatan ICT

A3. Meningkatkan keselamatan maklumat dan aset ICT agensi sektor awam agar dilindungi dari ancaman dan serangan *malware*

Figure 1.2 Information security compliance of public sector agencies (under T5, Strategi 3 and P3) in PSPSA (MAMPU, 2021)

Numerous programs are in place to encourage ISP compliance behaviour among Malaysia public sector employees, but the full impact of the activities and programs under the strategy mentioned in Figure 1.2 has not been quantified. Therefore, the central problem researched by this study is the low ISP compliance behaviour among Malaysian public sector employees which resulted in security breaches. A preliminary interview involving three (3) main agencies coordinating cybersecurity in Malaysia, namely National Cyber Security Agency (NACSA), Cybersecurity Malaysia (CSM) and Malaysian Administrative Modernisation and Management Planning Unit (MAMPU) was conducted and found ISP compliance behaviour among Malaysian public sector employees is low (Section 3.3.1). This is an area of increasing concern as it impacts public trust, national sovereignty, national security and also public service delivery (Dzazali & Zolait, 2012; Teoh, Mahmood, & Dzazali, 2018). A case study conducted through qualitative approach using semi-structured interviews on cyber security challenges in Malaysian public sector organisations also revealed that, despite being weakest link, Malaysian public sector employees are not been able to address successfully in term of cybersecurity (Teoh et al., 2018). Further research in this area is needed to uncover what factor contribute to ISP compliance intention among Malaysian public sector employees since Malaysian public sector employee's compliance to ISP is relatively not examined before.

1.3 Problem Statement

A rationale to this research aim is based on the low ISP compliance behaviour among Malaysian public sector employees which was confirmed during the interview and knowledge gap analyses of the extant research as described in section 2.8. The gap analyses advocate the development of new ISP compliance behaviour model in sixfold problem which are 'lack of ISP compliance model for Malaysian public sector', 'lack of generalizability', 'lack of studies about social bonding perspective on attitude towards intention to comply to ISP', 'no study that explores the integration of theory of planned behaviour (TPB), social bond theory (SBT), protection motivation theory (PMT) and other significant factors to form ISP compliance model', 'lack of studies that examine the relationship between perceived benefit and attitude', and 'lack of ISP compliance guidelines for the public sector especially in Malaysia'. Hence, this research aims to develop, validate, and evaluate a new model of the behavioural factors that influence the ISP compliance intention among Malaysian public sector employees in the attempts to address the low ISP compliance problem and knowledge gaps.

1.4 Research Questions

The main questions of this research are as below: -

(a) What are the factors that influence information security policy compliance behaviour among Malaysian public sector employees?

(b) How to develop information security policy compliance behaviour model for Malaysian public sector employees?

(c) How to validate the information security policy compliance behaviour model for Malaysian public sector employees?

(d) What are the relevant guidelines can be proposed based on model findings for Malaysian public sector employees?

1.5 Research Objective

To answer the formulated research questions, four research objectives were constructed. Those research objectives were defined to achieve the aim of this research which to develop, validate a new model of factors that influence the ISP compliance intention among Malaysian public sector employees and help to increase their ISP compliance. The research objectives are as below: -

(a) To identify factors that influence information security policy compliance behaviour among Malaysian public sector employees.

(b) To develop a new information security policy compliance behaviour model for Malaysian public sector employees.

(c) To validate the new information security policy compliance behaviour model for Malaysian public sector employees.

(d) To propose appropriate ISP compliance guidelines for Malaysian public sector employees based on proposed model findings.

1.6 Scope of study

The scope of this research is categorised into five main perspectives which are ISP compliance stage, ISP compliance study, level of analysis, ISP cluster, and respondents. Table 1.2 indicates the perspectives, types and scope applied in this research.

Table 1.2 Scope of the research

Perspective	**Type**	**Scope of this research**
ISP compliance behaviour stage	i. Intention to comply ii. Actual compliance	Intention to comply
ISP compliance behaviour study	i. Relational ii. Descriptive iii. Comparative	Relational
Level of analysis	i. Individual ii. Organization	Individual (Employee)
Cluster	i. Telecommunication ii. Education iii. Health iv. Others (etc)	Public Sector of Malaysia
Respondents	Malaysian public sector employees	Employees of Malaysian federal public sector agencies

The dependant variable in this research is the 'intention to comply' measuring Malaysian public sector employee's intention to comply to ISP. Generally, ISP compliance stages can be categorised into two stages which are intention to comply (pre-compliance) and actual compliance (post-compliance). Intention to comply refers to the initial decision of the employee to comply to ISP. On the other hand, actual compliance refers to the willingness of the employee to continue complying to ISP. This research focuses on the intention to comply (pre-compliance) stage by Malaysian federal public sector employees. Studies can be classified into three main groups namely relational, descriptive, and comparative studies. This research applied relational study as it aims to investigate the relationship between the 14 independent factors obtained from the integration of TPB, SBT, PMT and past literatures, with dependant variable which is 'intention to comply' to ISP.

This research focuses on the ISP compliance intention from the perspective of Malaysian federal public sector employees at the individual level. Research conducted among employees from 27 federal agencies in Malaysian public sectors. The selection of agencies is based on suitability factors, involvement with the ISP and ease of obtaining feedback from respondents.

1.7 Significance of the study

This research is substantial from theoretical, contextual, and practical perspective. First, the development of a new ISP compliance behaviour model which consist of factors that influence ISP compliance intention among Malaysian federal Public sector employees has contributed to a new theoretical finding in ISP. It is done by incorporating the theory of TPB, SBT, PMT, and factors from prior studies to examine the influential factors of ISP compliance behaviour among Malaysian federal public sector employees. The findings implies that eight factors namely ‘attitude’, ‘perceived behavioural control’, ‘perceived response efficacy’, ‘perceived punishment severity’, ‘attachment’, ‘commitment’, ‘belief’ and ‘perceived benefit’ increase ISP compliance behaviour among Malaysian federal public sector employees. It is an effort to add new knowledge to the current research body by identifying factors that influence the ISP compliance behaviour, developing and proposing model to measure ISP compliance behaviour and propose strategic solutions for future improvement. The relationships between factors and ISP compliance behaviour intention are expected to contribute to the body of knowledge of ISP compliance.

As the TPB theory only defines the causal relationship between its own factors, this research extends the relationship by examining SBT factors into ‘attitude’ factor of TPB. This research reveals SBT factors such as ‘attachment’, ‘commitment’ and ‘belief’ has influenced ‘attitude’ factor towards ISP compliance intention. This relationship appears to be a new addition to knowledge by enriching the application of TPB. Moreover, the research also contributes to the knowledge by adding ‘perceived benefit’ from literature to influence ‘attitude’ besides SBT and the findings reveals it influence ‘attitude’ factor. Besides that, this research is strengthened with reduced bias because the data collection was conducted during movement control order (MCO) where most of the respondents works from home without direct pressure form top management and peer influence too.

Third, the findings of this research have valuable practical contribution. The involvement of cybersecurity practitioners in validating the survey instrument, and reviewing the proposed guidelines has made the research findings more reliable to be applied in real-world phenomena. In addition, this research also proposed ISP compliance guidelines for the Malaysian public sector based on proposed model findings (Appendix I) to increase the ISP compliance among Malaysian public sector employees. The proposed guidelines is timely since the intention of developing more ISP for Malaysian public sector has been established in Malaysian National Cybersecurity Strategy 2020-2025 and PSPSA 2021-2025.

In developing new ISP, the findings of this research would be beneficial for the ISP developer such as NACSA and MAMPU. ISP developers could understand the key constructs that must be considered for ISP compliance so that it can be widely accepted by public sector employees and other organizations too in the future. Findings can be used by the organisations to strategically plan to enhance their employee's ISP compliance behaviour to prevent security breaches. Overall, the model and guidelines developed from this research are expected to help in increasing Malaysian public sector employee's ISP compliance.

1.8 Structure of the thesis

This thesis is structured into six chapters. Chapter 1 is named introduction. This chapter discusses introduction, background, problem background, problem statement, research questions, research objectives, scope, and significance of the study. Chapter 2 is named literature review. Chapter 2 discusses the literature review, definition of key concepts by explaining the research key terms. Subsequently, review the related theories, describes systematic literature review that have been conducted in identifying related works within ISP compliance research area and influencing factor of ISP.

Chapter 2 also highlights knowledge gap in extant research to justify the rationale and novelty of this research.

Chapter 3 is named research methodology. This chapter discusses the research methodology which refers to the overall process involved in the research in fulfilling the research objectives and obtaining the expected deliverables. It starts with a discussion of research design, and research phases. Each phase of research design is explained in depth, and the outcomes are also presented. Chapter 4 is named conceptual model development. This chapter presents the process of the conceptual model development and content validation of the survey instruments.

Chapter 5 is named data analysis and findings and recommendation. This chapter presents the empirical data analysis and discussion in empirical findings of the research. First, initial preparation is described including response rate analysis, data cleaning, non-response bias test, common method bias test, and normality test. Second, descriptive analysis of the demographics is presented. Third, the measurement model analysis using Partial Least Squares Structural Equation Modelling (PLS-SEM) analysis is presented which includes internal consistency reliability, convergent validity, and discriminant validity. Fourth, the structural model analysis using PLS-SEM which includes collinearity, path coefficient, coefficient of determination, effect size, blindfolding and predictive relevance. Fifth, advanced PLS-SEM analysis such as importance and performance matrix analysis (IPMA) and PLSpredict was conducted and reported. Later, hypotheses testing was summarized and discussed in detail in Malaysian federal public sector employee's context. Eventually, this research proposes ISP compliance guidelines for Malaysian public sector. The guidelines development is also discussed in Chapter 5. Finally, Chapter 6 is named conclusion. It summarizes the research findings based on research objectives, research implications, limitations and recommended future work.

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LIST OF PUBLICATIONS

Indexed Journal

1. **Kuppusamy, P.,** Samy, G. N., Maarop, N., Shanmugam, B., & Perumal, S. (2022). Information Security Policy Compliance Behavior Models, Theories, And Influencing Factors: A Systematic Literature Review. *Journal Of Theoretical And Applied Information Technology*, *100*(5) (**Indexed by SCOPUS**)

Indexed Conference Proceedings

1. **Kuppusamy, P**., Samy, G. N., Maarop, N., Magalingam, P., Kamaruddin, N., Shanmugam, B., & Perumal, S. (2020, May). Systematic literature review of information security compliance behaviour theories. In *Journal of physics: conference series* (Vol. 1551, No. 1, p. 012005). IOP Publishing (**Indexed by SCOPUS**)