

CHAPTER III : RESEARCH METHODOLOGY

3.1 Introduction

This chapter is the discussion of methodology used in this study which is specify on the approaches selected to develop the research design with the aim of achieving its research objectives and answer the research questions. The process of selecting research design is very important in determining the suitability of research procedures and methodology in line with improving the validity of research results. Research design addresses methods and strategies for each phase.

This chapter begins with an explanation of the research paradigm and research methods. The following sections provide information on research design that emphasize the techniques and procedures used in this research. Then, the following sections describe about data collection, respondent sampling, data analysis strategy, pilot study and ethics consideration.

3.2 Research Paradigm

Research paradigm is about differentiate between the set of beliefs, conventions and assumptions that guide the direction and philosophy of the researcher in reaching the knowledge needed to get conclusions for the study (Teddlie & Tashakkori, 2009). It mean that, the research paradigm influences the research design with the intention of providing quality research outcomes (Cresswel & Clark, 2007). In according to this study, pragmatism for research paradigm was used in which application of mix method.

Pragmatism is well equipped than any other paradigm because of its power of

complementary whereby the weakness of one technology is accompanied by the strengths of the other methodology (Kalolo, 2015). Furthermore, it can be readily accepted for usage in answering research questions and producing better study results.

Teddlie and Tashakkori (2009) have listed out the characteristics of pragmatic paradigm research which are suitable to the study, encourage the efficient use of both quantitative and qualitative approaches, the methods match the purpose of the research questions and the approach is practical and applicable to the type of research presented. Agree with that, this study presents the appropriate instruments of a quantitative survey questionnaire and in-depth semi structure interviews for data collections. This pragmatic approach results in the application of content analysis strategies to get new insights into the study, particularly for collecting answers to research questions in order to meet the study's objectives.

The components of the IT security maintenance framework can be developed by direct measurement and assessment for verification of the framework when creating it. With that, in ensuring and conforming the proposed framework has been constructed according to the real organization requirement, the validation was performed. An interview was accompanied to support the quantitative data by validating the framework developed from quantitative phase. After the validation process took place, qualitative phase was continued to provide a synthesis of IT security maintenance framework's parameters. Then, experts were invited to give holistic opinions explaining their perceptions of reality and its usefulness against the framework. All this research process flow can be review in the following Figure 3.1 of research procedure.

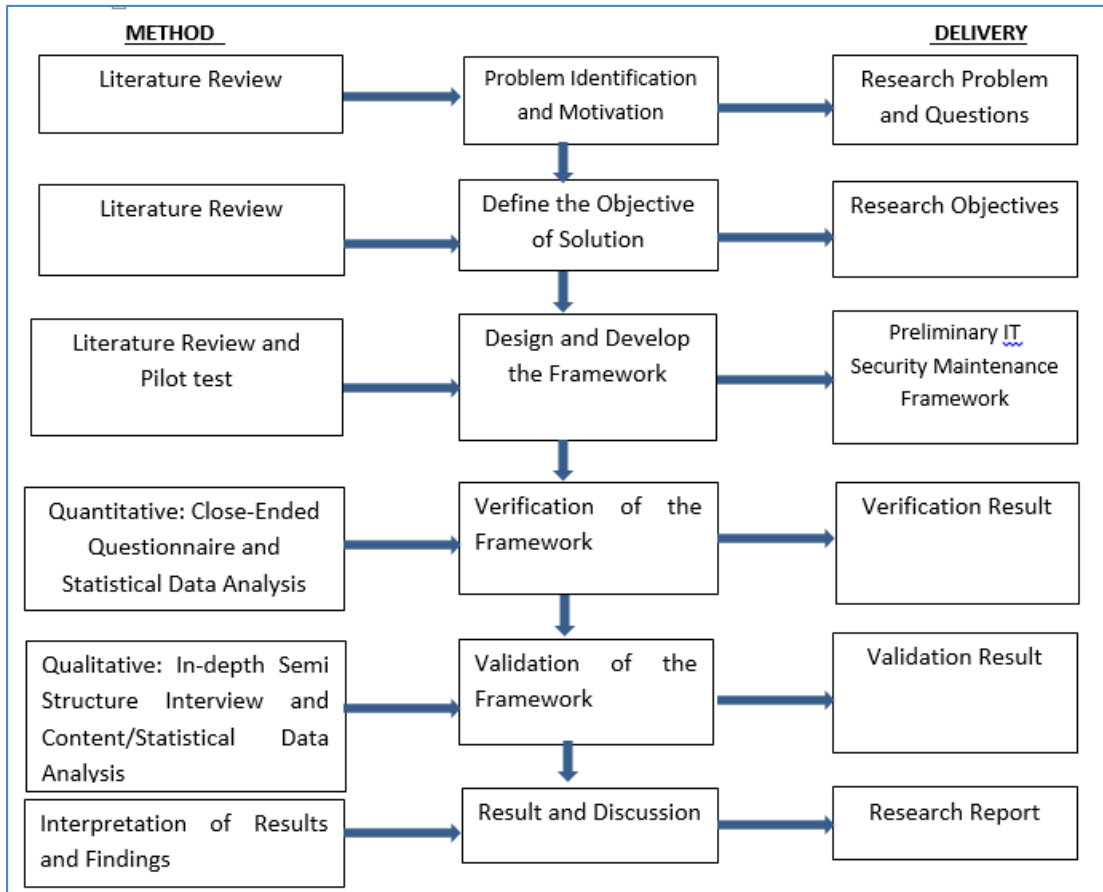


Figure 3.1: Research Procedure

3.3 The Rationale of Mix-Methods Approach

The mixed-methods design in this research aims to integrate the benefits of both quantitative and qualitative approaches to increase the accuracy of research findings and maximize reliability of the data (Kothari, 2005). However, the quantitative and qualitative approaches have good advantages that counterbalance possible weaknesses by provide more comprehensive evidence and help to answer the questions that cannot be answer by either quantitative or qualitative methods alone (Cresswell, 2003).

The quantitative method was utilized in this study to verify the components of the IT security maintenance framework, which were derived from a literature review in chapter two. Within the running of survey, numeric data made available would be

useful to understand the absolute real requirements in the industry. An in-depth semi-structured interview was conducted to validate the analytical results obtained from the quantitative data support in developing a realistic and valid framework as required in the real requirement situations.

Then, in validating the quantitative results, the qualitative approach was applied in evaluate the the IT security maintenance framework's components. The synthesis of findings on determining IT security maintenance framework's components from experts will guide practitioners properly on understanding the basic tasks to be done for achieving each of the IT security maintenance's components. In addition, the qualitative approach can be helpful in explaining the verification and validation of IT security maintenance framework in reality and its usefulness.

Thus, this research has considered to adopt the pragmatic paradigm which combines the quantitative and qualitative method to understand the research problems and answer the research questions which will be discussed further in the following sections.

3.4 Research Design

Research design essentially refers to the plan or strategy of shaping the research (Henn, Weinstein & Foard, 2016), that might include the entire process of research from conceptualizing a problem to writing research questions, and on to data collection, analysis, interpretation and report writing (Creswell, 2017). It provided the framework for the collection and analysis of data and subsequently indicated which research methods were appropriate (Walliman, 2016). The most common, useful purposes and

main aims of research were exploration, description and rational explanation based on data (Richardson, 2015; Babbie, 2017).

The research design delivers a framework to perform a research by depicting how the data will be collected and analyzed in order to answer the research questions (Bryman & Bell, 2003). A research design is compulsory for a framework of data collection and observations including for linking the topics. The research design is designed to structure the flow of research, display the functions of the major parts of the research activities, and explain the contribution of each part in addressing the research questions (Trochim, 2000). Therefore, the research design is needed to reflect on the research questions and clarify what data are concerned, and how the data are to be analyzed in order to achieve its research objectives.

The study used mixed method research approach for best outcome and mixed method approaches research do collects and analyses data using both quantitative and qualitative methods. Combining these methods may give with more in-depth answers to the research queries than using them alone. However, quantitative data is better able to answer queries like "What is the impact of your digital product?" and qualitative data can illustrate how and why you have obtained these outcomes.

This research design consists of four phases, which are background research, development and verification of the framework, validation of the framework and reporting of results. Background research in phase one, literature review and analysis activity were performed to gather research questions and study planning. In phase two, framework development and verification, it also about doing literature review and analysis at the beginning of the phase to fulfilled objective number one. Then, research

activities such as literature review and analysis, expert opinion and pilot study had been done to fulfilled requirement of objective number two. Next in this phase, quantitative approach implementation by distribute a questionnaire and doing data analysis on the result is done to fulfilled the objective number three.

Then in phase three, validation of the framework, qualitative approach implementation had done by doing in-depth semi structure interview with the experts. Result of this interview is gather and analysis to fulfilled objective number four. In last phase, research report is prepared for all findings based on research objectives. Figure 3.2 is about the research design of this study.

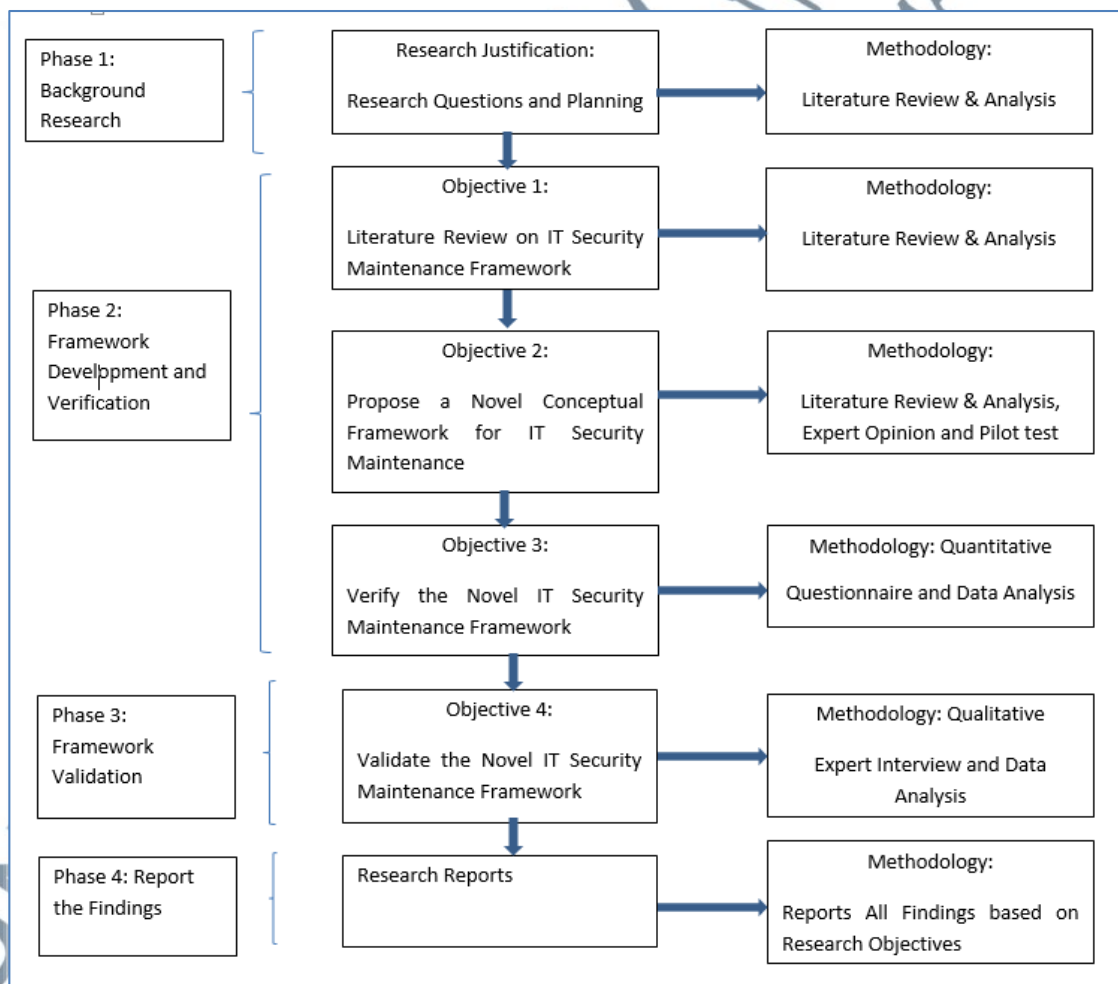


Figure 3.2: Research Design

For the purpose of this research which is evaluating a novel conceptual security maintenance framework for IT infrastructure by enhancing IT security management, an **exploratory descriptive research design** had been chosen, because it would conclusively describe the characteristics and state-of-the-art of the population under study. Exploratory descriptive research would suit best because according to Sekaran (2010) an exploratory study research was performed when a researcher had little knowledge about the situation or had no information on how similar problems or research issues had been solved in the past. It embarks on investigating and finding the real nature of the problem.

In addition, solutions and new ideas could surface from this type of research (Richardson, 2015). A descriptive research on the other hand was a research that described a phenomenon (Salkind, 2010), to document and describe the phenomenon of interest (Marshall & Rossman, 2016), providing a clear answer of who, what, when, where, why, and way (6 Ws) of the research problem and data were typically collected through a questionnaire survey. Prior to the development of questionnaires, the researcher had access, formulate the appropriate IT security model, aspects, processes and metrics for novel conceptual framework security maintenance in IT infrastructure.

The main focus of this study in the mix-method approach will be on quantitative data. Quantitative research methods focus on objective measurements and statistical, mathematical, or numerical analysis of data acquired via polls, questionnaires, and surveys, as well as modifying pre-existing statistical data using computing tools. Quantitative research is concerned with collecting numerical data and generalizing it across groups of individuals or explaining a phenomenon.

Whereby, in quantitative research the data were collected through questionnaire and analyze using Statistical Package for Social Sciences (SPSS) in order to gain measurable objective. The setting of this study is **non-contrived settings** whereby it can be done in the natural environment where events proceed normally which is preferred to analyze the organization's IT infrastructure security. Data is collected only once so the study is based on statistical analysis. The extent of researcher interference will be minimal interference as the respondent only will be asked to answer the close ended questionnaire.

According to Uma Sekaran and Bougie (2013), unit of analysis refers to the level of aggregation of the data collected during the subsequent data analysis stage. In this study the unit of analysis is individuals. The time horizon of this study is cross-sectional studies whereby the study can be undertaken in which data are collected just once.

3.5 Population

Population refers to the entire group of people of interest that the researcher wishes to investigate based on Uma Sekaran and Bougie (2013). The population of this study involves about 600 IT practitioners in Malaysian public universities from different background. The reason for the selection of this IT practitioners was their capability and knowledge for IT security which can be represent their population.

3.6 Sampling technique

In this study, the technique used is probability sampling which is simple random sampling. This is because the determination of who will end up in the sample is determined by nonsystematic and random rules, the chance that the sample will truly represent the population is great. According to Salkind (2013), this technique allows

each member of the population to have an equal and independent chance of being selected as part of the sample. Here, the selection of participants is determined by chance. It is equal because there is no bias that one person will be chosen rather than another and independent because the choice of one person does not bias the researcher for or against the choice of another (Salkind, 2013).

3.7 Sample size

It is not always possible to collect data from every unit of the population; thus a sampling technique is frequently required. As a result, choosing a suitable sample size is critical for drawing reliable conclusions from research findings. It is, nevertheless, frequently seen as a tough stage in empirical research design.

Despite the fact that there are numerous tables and rules of thumb for calculating sample size in social science research, many researchers are unsure which one to use when determining the right sample size for their studies, particularly when survey research is used to collect data.

Sample size was the number of respondents that researcher choose from the population. The sample size to be surveyed is chosen among IT practitioners in Malaysian public universities. In determining the sample size in descriptive surveys, it is followed Krejcie and Morgan table as stated in Table 3.1 (Krejcie & Morgan, 1970). The number of sample in this study is 272 respondents from the population in this research.

Table 3.1: Determining Sample Size

TABLE 1
Table for Determining Sample Size from a Given Population

<i>N</i>	<i>S</i>	<i>N</i>	<i>S</i>	<i>N</i>	<i>S</i>
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	100000	384

Note.—*N* is population size.
S is sample size.

3.8 Data Collection

The data set for this research will be collected from the selected IT practitioners in Malaysian public universities in mix method approach. Questionnaires for developing and verifying the framework, on-site interviews to validate the framework, and document reviews for the preliminary study make up the data.

This study uses a quantitative method to demonstrate the verification of the proposed conceptual framework in ensuring information technology security compliance in IT security maintenance for small medium and mid-size IT infrastructure especially in public university (Bojanc, 2012). It explores the questions of how information security management model, theories and concepts can be ensured in IT security maintenance and how the existing practices of IT security maintenance can be improved in small medium and mid-size IT infrastructure. This approach is deemed most suitable to attain the research purpose which is to gain in-depth understanding on IT and information security.

The questionnaire's items develop based on a comprehensive review of the related literature and are divided into three parts. The first part focuses on the demographic information of the interviewees. The second part comprises general questions on the practices for ensuring information security management in the organizations. The third part contains specific questions on factors influencing information technology security compliance in IT security maintenance for small medium and mid-size IT infrastructure. The questionnaire's questions will pretest with the help of academics, higher degree research scholars and information security practitioners

Six in-depth semi-structured interviews was conduct with IT and IT security managers and experts from the selected public university to confirm the validity of the

proposed conceptual framework. Interviewees will select based on their knowledge, experience and roles in information technology security.

This study uses a qualitative method to demonstrate the validity of the proposed conceptual framework in ensuring information technology security compliance in IT security maintenance for mid-size IT infrastructure. It explores the questions of how information security management can be ensured in IT security maintenance and how the existing practices of IT security maintenance can be improved in small medium and mid-size IT infrastructure.

Content analysis technique was used to analyse the interview data. Specifically, this study employed the theory-driven content analysis by deriving themes based on pre-existing theoretical concerns (Howitt, 2010). Following (Howitt 2010), underlying dominant themes such as information technology which repeatedly appears within the data set, were identified to generate insights and reveal similarities and differences between the responses of the interviewees.

3.9 Development of Research Instruments

The questionnaire survey was used as the instrument for data collection for this quantitative phase. The questionnaire consists of three sections. This survey is developed to achieve objective number three. The survey is written in English and contains the following parts:

- a. Section 1: Demographic Profile
- b. Section 2: IT Security Environment
- c. Section 3: IT Security Maintenance Framework (variables)

Questions in Section 1 are divided into two (2) subsections which are known as (a) company profile and (b) interviewee profile. Questions in Section 2 are about the IT security environment exist in the company or organization which is more into information security management and practices involved. Questions in Section 3 are about the components involved in developing IT Security maintenance framework. All the components chosen were based on high frequency of more than half percentage agreed responses from respondents in reliability test of the pilot study. Then, it strengthens from feedback of the expert opinion and descriptive study.

For demographic profile and information security environment of the respondents, nominal scales are used for labelling the variables without any quantitative value. It simply be called labels.

The Likert scale is widely used in questionnaires for its easy construction, high reliability, and successful adaption to measure many types of affective characteristic (Lee, 2006). As such, the Likert scale was used in this questionnaire for IT Security maintenance framework's components. Even though Likert scaling has been criticized for being subjective in nature, it is still one of the most frequently used measurement instruments in social sciences (Wu, 2007).

Generally, in the Likert scale survey, a respondent indicates agreement or disagreement with a variety of statements on an intensity scale. For questionnaire in IT Security maintenance framework's components, five levels of answer used through data collection as follow (Likert, 1932): (1) strongly disagree (2) disagree (3) neutral (4) agree (5) strongly agree. The Likert scale is bipolar, measuring a positive or negative response to a statement.

3.10 Participating respondents

The respondents who involved in this study are IT practitioners and experts in Malaysian public universities. The responds from the respondents were taken into account for further action in developing novel conceptual security maintenance framework for IT infrastructure by enhanced IT security management.

3.11 Validity of instruments

Factor analysis is part of a test to determine the validity of the constructs (Conway & Huffcut, 2003). It was also carried out to test the construct validity of questionnaire (Segar & Grover, 1993). Even though questionnaire of this study developed by researcher had been verify by the experts in related field which is established measurement but also need to perform validity test. This matter is required because the questionnaire has made some minor changes by discard unrelated question and add several question from advice by the experts in order to suit objective of the study (Paino et al., 2010; Lestari, 2010). In terms of question structure and layout, each panel included a detailed list of updates, deletions and additions. All the proposed improvements were addressed and incorporated into the news questionnaire.

Factor analysis procedures were performed using SPSS 25.0. This study has identified several conditions that must be met before conducting factor analysis test such as factorability which includes tests such as Test Kaiser-Meyer-Olkin and Barlett's test of sphericity test. When the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) value is 0.6 or above the all variables is significant and correlated between the item and the study was high enough for this analysis (Brown, 2006).

3.12 Data analysis (reliability and validity)

Statistical Package for Social Science Software (SPSS) version 25.0 was used to analyze data after the entire questionnaires had been collected from the respondents. The data were analyzed using descriptive and inferential statistics, whereby mean, median, mode, percentage, and frequencies and supported by illustration of tables and graphs were listed.

The transformation of raw data into a form that will make them easy to understand and interpret, rearranging, ordering, and manipulating data to generate descriptive information.

In this research, descriptive method is used to gather information about the present existing condition. The statistical descriptive analysis was used to analyze all the variables. The purpose of employing this method is to describe the nature of a situation, as it exists at the time of the study and to explore the cause of particular phenomena. The researcher opted to use this kind of research considering the desire of the researcher to obtain first hand data from the respondents so as to formulate rational and sound conclusions and recommendations for the study.

Frequency analysis is a descriptive statistical method that shows the number of occurrences of each response chosen by the respondents. When using frequency analysis, SPSS Statistics can also calculate the mean and standard deviation to help researchers analyze the results and draw conclusions.

Normality test is a statistical process which is conducted to know whether the data is distributed normally or not (Ghozali, 2013). Since that, the data can be determined as a normal distribution when the significance value of the data is >0.05 .

Term of reliability analysis is measure indicate the extent to which without bias (error free) and to ensure the consistent measurement across time and across the various items in the instruments. In other words, stability and consistency can be measure an indication the reliability. Cronbach's alpha is a reliability coefficient that indicates how well the items in a set are positively correlated to one another. The higher the degree of reliability of the instrument, the more accurate the data will be obtained to produce good-quality studies. Cronbach's alpha is the tool to investigate the internal consistency (i.e. reliability) of the measures, and Cronbach's alpha reliability coefficient normally ranges between 0 and 1 (Cortina, 1993). Table 3.2 shows the classification range for reliability.

Table 3.2: Reliability Range of Items

Reliability Range	Description
>0.90	Excellent
0.80-0.89	Good
0.70-0.79	Acceptable
0.60-0.69	Questionable
0.50-0.59	Poor

3.13 Qualitative Method: In-depth Semi-Structured Interview

This is a phase where result of survey questionnaire is validated through the process of interview with the experts. In-depth semi-structured interview on qualitative approach is drawn for explaining the quantitative result. In-depth semi-structured interview is chosen because of to increase understanding and strengthen the findings on framework. Qualitative data collected to answer the research question 4 were used to synthesize and list the parameters for determining components of information security maintenance framework which were obtained from quantitative analysis.

Interviewing the IT expertise provides the benefit of gathering richer primary data that provide synthesis results of components of information security maintenance framework in order to ensure the quality of information gathering and to validate the framework. Interview questions were designed in order to get information from IT expertise about their view on components of information security maintenance in order to enhance the quality of the framework. In qualitative approach, **purposive sampling technique** was chosen. It was chosen based on three characteristics: 1) IT practitioners, 2) have experience in manage IT and information security, 3) have experience in IT and information security for more than 5 years at organization. All the interviews were conducted face-to-face. The interview form can be seen in Appendix C.

3.13.1 Participating Respondents

The following Table 3.3 show the details of the five respondents that participate in the interview session for validating the framework.

Table 3.3: Respondent's Profiles

Label	Principal Activity	Location	Position	Working Experience	Interview Date	Remarks
R1	Quality Audit Unit, IPTA	Batu Pahat, Johor	Senior IT Officer	8 years	23/5/2019	45 mins
R2	Centre of IT, IPTA	Batu Pahat, Johor	Director	10 years	30/5/2019	30 mins
R3	Centre of IT, IPTA	Nilai, N.Sembilan	Director	10 years	19/7/2019	45 mins
R4	Centre of IT, IPTA	Nilai, N.Sembilan	Senior IT Officer	7 years	19/7/2019	45 mins
R5	Centre of IT, IPTA	Batu Pahat, Johor	Assistant Manager	10 years	24/7/2019	50 mins
R6	Centre of IT, IPTA	Batu Pahat, Johor	Assistant Manager	10 years	24/7/2019	1 hour

3.13.2 Framework Validation

Normally, this step is undertaken as the final stage of the study. The important of the validation process is to ensure the quality of the framework as an outcome in this research. Validation of the framework is obtaining by the getting opinion from the experts and practitioners regarding its components. According to Esther (2009), validations will make confirmation on certain value of the data or meet specific requirements. So, the framework in this research was validate by conduct questionnaire survey and interview with the experts and practitioners. With that, there are five (5) validation aspects which are appropriateness, objectivity, practicability, reliability and suitability that need to access to validate the framework (Yeung, 2007).

3.14 Pilot Study

This is a phase where content of survey questionnaire are validated through the process of validity and reliability. The researcher is able to recognize the consistency of the questions and understanding of the respondents performing to the survey questionnaire. Before a survey questionnaire can be used to collect data, it is advised to validate the instrument in order to confirm its competence to measure what is intended to be measured (Zikmund et al., 2012).

On doing sampling of the pilot test, respondents were selected randomly among the staff of the Data Centre Unit in the selected public university which not mentioned here because of private and confidential. Julious (2008) and Hertzog (2008) have argued that 10 respondents are minimum sample size of pilot study and precise enough to meet variety of possible aims. The pilot study was a pre-test of the redesigned survey

questionnaire, and 20 sets of questionnaires were delivered, with 10 respondents filling them out and returning them to the researcher.

This pilot study focuses on reliability and validity of the developed survey questionnaire. With that, reliability test is conducted to assess quality of the questionnaire (Chua, 2006). Reliability of the instrument happens when it is used repeatedly that produce consistent results (Skinner et al., 2007). Consistency is about when the same items are tested many times to the same subject at different time intervals will get the result nearly the same answer (Drost, 2011).

Reliability test had three (3) types which are test-retest reliability, split-half reliability and internal consistency reliability. With that, internal consistency reliability test was used in this study to measure the reliability of questionnaire. It was the common approach used in researches (Pallant, 2010).

Reliability in this test means that about the number of coefficient which is known as alpha Cronbach's coefficient. According to Chua (2006), the number of coefficient higher shows more reliability. The most reliable alpha value is more than 0.7 (Hair et al., 2007; Pallant, 2010; Tavakol & Dennick, 2011). Then, the question scores of alpha value more than 0.7, should be retained because it is considered reliable (Maiyaki and Sani, 2011). So, reliability test in this pilot study had all questions score more than 0.7 of Cronbach's alpha coefficient (Table 3.4). With that, there is no question that was removed.

Table 3.4: The Result of Reliability Test for Pilot Study

Main Variables	Number of Questions	Cronbach's Alpha
IT Assets Identification	4	0.878
IT Security Breach Identification	3	1.0
IT Security Offensive Protection	3	0.884
IT Security Defensive Protection	7	0.907
IT Security Objectives	3	0.944

3.15 Conceptual Framework

Development of conceptual framework is based on the end result combining many relevant concepts from various theories to explain, provide a better understanding or predict a particular research event, phenomenon or problem (Imenda, 2014). Therefore, several concepts of IT Security originate from the literature review are combined to develop a conceptual framework.

Model Input-process-output used in economics, system analysis and decision analysis (Raghunathan, 1999; Cooper, 1983). In this model, the quality of the output depends on the input and the quality of the process that converts the input into output (Raghunathan, 1999; Cooper, 1983). By adapt these model of theory, the conceptual framework for this study is proposed as shown in Figure 3.3.

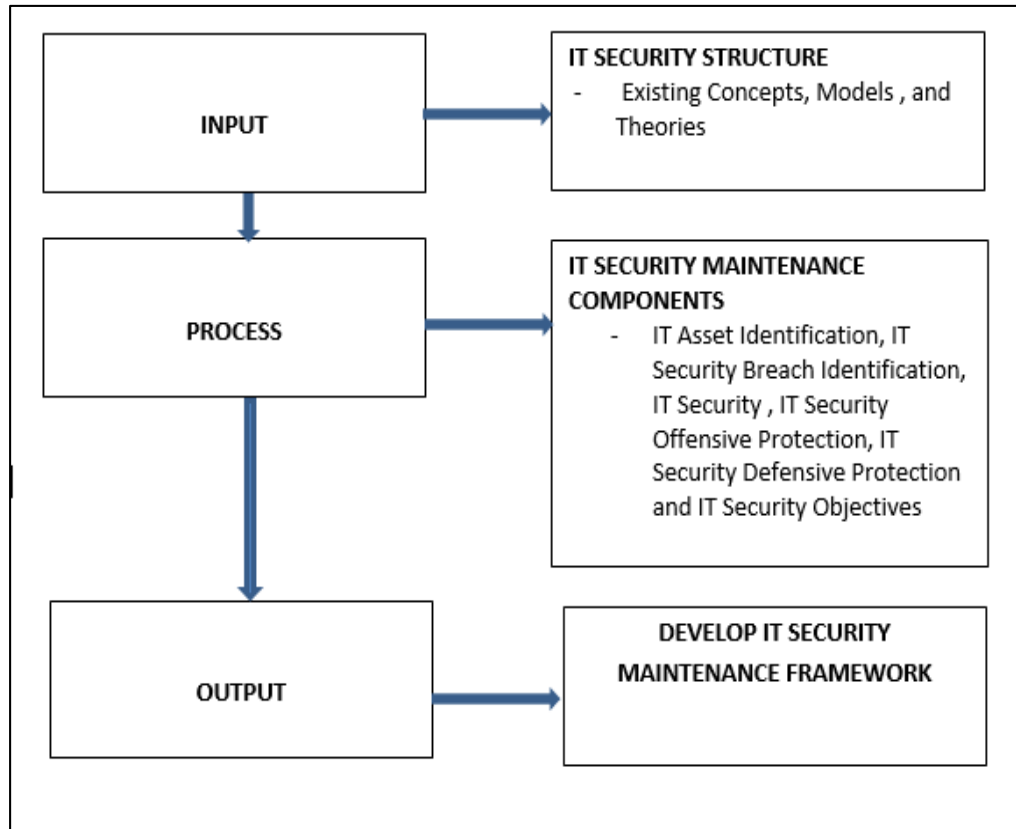


Figure 3.3: Input-Process-Output Model of Proposed Framework

In making the framework more systematic, practitioners need to determine the detailed steps in planning the framework development properly. Therefore, determining the components of framework is important as a basic guide for practitioners to identify and gather information, and determine the necessary steps.

There is an important to get agreement among participants of researchers and practitioners that IT security maintenance framework use a multiple concept in which each components represents an aspect or construct of IT security items and is explained by a set of features. Organizations need to develop comprehensive measures of the security of their IT infrastructure and to benchmark their efforts towards other organizations. Therefore, by examining the components of IT security maintenance framework in IT infrastructure can be formed. As state in Figure 3.3, the researcher presents five main components of IT security maintenance which is IT Asset

Identification, IT Security Breach Identification, IT Security Offensive Protection, IT Security Defensive Protection and IT Security Objectives which these five component are later influential to influence the IT security maintenance for IT infrastructure. Five (5) proposed main hypotheses are:

H1: IT Asset Identification influences the IT security maintenance for IT infrastructure.

H2: IT Security Breach Identification influences the IT security maintenance for IT infrastructure.

H3: IT Security Offensive Protection influences the IT security maintenance for IT infrastructure.

H4: IT Security Defensive Protection influences the IT security maintenance for IT infrastructure.

H5: IT Security Objectives influences the IT security maintenance for IT infrastructure.

The following Figure 3.4 is presents the proposed structural framework. With that, these structural framework has highlighted the five main hypotheses which are relevant to this research.

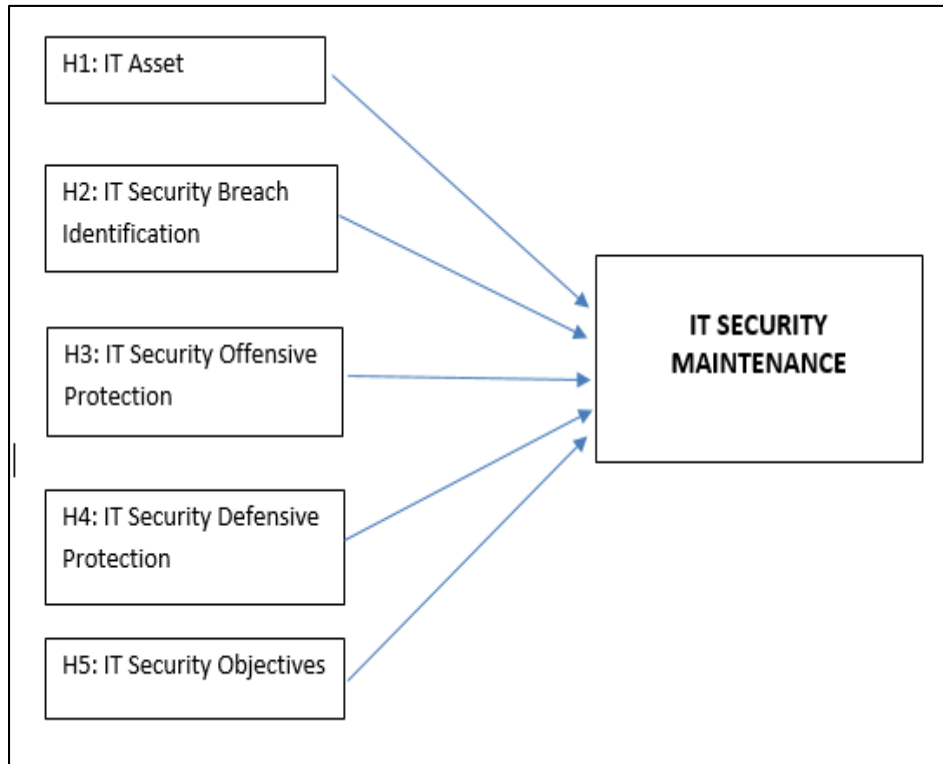


Figure 3.4: Main Hypotheses of Research Framework

3.16 Ethical Assurance

This study performed with higher observance to research ethics and code of conduct. This study does not have sponsor from any individual, group or organization. The study conducted mainly for academic purposes. The objectives of this research and their choice to participate were first notified by the researcher in this study. Otherwise, the researcher considered proper considerations for collecting the data accurately and objectively. Then, about the information gathered is strictly confidential and the result used only for research purposes had informed by researcher to the respondents.

3.17 Chapter Summary

This chapter described the research methodology and design along with the research philosophy and paradigm. Pragmatic paradigm research occupies the mixed-

method approach by using quantitative and qualitative methods. By that, it employs to answer the research questions and achieve the research objectives. The research consists of three phases which are involved, literature review and framework development, framework verification and framework validation.

Literature review in the first phase guided researcher to identify the lacking in the study and encouraged to develop a conceptual framework by using the literature review's findings. Mixed methods approach was applied to collect data at each level in the conceptual framework. During this phase, components of IT security maintenance framework were determined using findings of the study.

A survey questionnaire, Likert scale type was developed and distributed among information technology practitioners in order to collect quantitative data. Collected data were analysed using statistical data analysis. Statistical data analysis was used to determine and verify reliability of the components for IT security maintenance framework in the real requirements. Then, semi-structured interview with the IT experts and managers was applied again to validate the components of IT security maintenance framework.

In order to conform and ensure that the developed IT security maintenance framework through the quantitative method is properly designed and meets the requirements of information security management practice, the qualitative method was used. Within that, semi-structured interview was performed to validate in terms of the components' suitability and adequacy to be in the framework.

Again, in conforming the quantitative results, the qualitative approach was used. In order to determine the synthesis of IT security maintenance framework parameters, semi-structure interview questions were developed among five information security manager and experts.

Besides that, the qualitative approach also was used in order to identify its usefulness in the real situation of the organization.

