A POST-ADOPTION FRAMEWORK FOR MALAYSIA OPEN GOVERNMENT DATA

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FACULTY OF COMPUTER SCIENCE AND
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THESIS SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

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A POST-ADOPTION FRAMEWORK FOR MALAYSIA OPEN GOVERNMENT DATA

ABSTRACT

Today, the call for greater transparency from the public administration is progressively apparent. Publishing non-confidential government data to the public is one of the initiatives adopted by many governments today to embrace transparency practice. The initiative of publishing non-confidential government data and accessible by the public for limitless re-use is known as Open Government Data (OGD). The Malaysian government adopted OGD innovation in 2014 and since established a centralised government open data portal. However, after several years of adoption, OGD implementation among government agencies remains unclear. Furthermore, the extant literature on OGD adoption largely focused on the factors that influence OGD adopters' decisions, whereas the actual use of OGD is more critical. The underlying factors of keeping the adopter continuing or discontinuing OGD implementation in the post-adoption phase are unexplored. Moreover, taking from previous experience, many government innovations were hampered in an inertia state after the adoption phase. Driven from these issues, this study explored the OGD adoption phases and identified the OGD post-adoption factors in the Malaysian public sector. With the stance that the phenomenon can be measured, the positivism philosophy is also applied for this study. Anchored by the Diffusion of Innovation (DOI) theory, Technology-Organisation-Environment (TOE) framework, and innovation adoption process theory, the OGD post-adoption framework is developed and validated. The outcome of this study seeks to guide the OGD implementation in the post-adoption phase in the Malaysian public sector. This study adopted an exploratory sequential mixed-methods design in which the quantitative is the dominant method complement by the qualitative method. The data collection started with semi-structured interviews with four field experts in OGD implementation. Subsequently, combining interviews with government agencies and documents analysis, the initial post-adoption factors of OGD were obtained. The empirical data is collected from 266 government agencies in Malaysia's public sector using a survey questionnaire. This study employed the Partial Least Square-Structural Equation Modelling (PLS-SEM) as the factor analysis's primary statistical technique. The statistical analysis indicates that three factors from the organisational context (Culture, Top management support, IT competency), two factors from the technological context (Relative advantage, Complexity), and OGD principles significantly contribute to the OGD implementation in the post-adoption phase. While factors from the environmental context (Incentives, Data demand) and one factor from the technological context (Compatibility) have an insignificant contribution to the OGD implementation in the post-adoption phase. This study contribution is threefold in theoretical, conceptual, and practice. The study contributed theoretically by introducing the post-adoption framework of OGD innovation. Conceptually, this study introduces new factors from the environmental context for OGD post-adoption, namely incentives and data demand. In practicality, this study's outcome allows policymakers to strategize for sustainable OGD implementation from the data provider's perspective. The drawback of this research is shown by the survey method, which used a single point of time horizon for data collecting. A longitudinal or case study approach is suggested for future research to understand OGD assimilation in the public sector better.

Keywords: Open government data, open data, post-adoption, adoption process, public sector.

KERANGKA PASCA-ADOPSI UNTUK DATA TERBUKA KERAJAAN MALAYSIA

ABSTRAK

Hari ini, tuntutan ketelusan terhadap pentadbiran awam semakin ketara. Menerbitkan data kerajaan yang tidak sulit kepada orang ramai adalah salah satu inisiatif yang diterapkan oleh banyak kerajaan hari ini untuk menerapkan amalan ketelusan. Inisiatif penerbitan data kerajaan yang terbuka dan dapat diakses oleh orang ramai untuk penggunaan semula tanpa had dikenali sebagai *Open Government Data* (OGD). Kerajaan Malaysia telah mengadopsi OGD pada tahun 2014 dan sejak itu menubuhkan portal berpusat data terbuka kerajaan. Namun, setelah beberapa tahun diguna pakai, pelaksanaan OGD di kalangan agensi kerajaan masih belum jelas. Selanjutnya, literatur yang ada mengenai penggunaan OGD banyak tertumpu pada faktor-faktor yang mempengaruhi keputusan pengadopsi OGD, sedangkan penggunaan OGD yang sebenarnya lebih kritikal. Faktor-faktor yang mendasari untuk memastikan pengguna meneruskan atau menghentikan pelaksanaan OGD dalam fasa pasca-adopsi belum diterokai. Lebih dari itu, berdasarkan pengalaman sebelumnya, banyak inovasi dalam kerajaan terhenti atau berada dalam keadaan inersia setelah fasa adopsi. Berpunca dari isu-isu ini, kajian ini meneroka fasa penggunaan OGD dan mengenal pasti faktor pasca-adopsi OGD di sektor awam Malaysia. Dengan pendirian bahawa fenomena kajian dapat diukur, falsafah positivisme juga diterapkan untuk kajian ini. Disokong oleh teori *Diffusion of Innovation* (DOI), kerangka *Technology-Organisation-Environment* (TOE), dan teori proses adopsi inovasi, kerangka kerja pasca-adopsi OGD dikembangkan dan disahkan. Hasil kajian ini bertujuan untuk membimbing pelaksanaan OGD dalam fasa pasca-adopsi di sektor awam Malaysia. Kajian ini menggunakan reka bentuk *exploratory sequential mixed-methods* di mana kuantitatif adalah kaedah dominan yang dilengkapkan dengan kaedah kualitatif. Pengumpulan data dimulakan dengan wawancara separa berstruktur dengan empat pakar bidang dalam pelaksanaan OGD. Selepas itu, dengan menggabungkan wawancara dengan agensi kerajaan dan analisis dokumen, faktor OGD pasca-adopsi awal diperolehi. Data empirikal dikumpulkan dari 266 agensi kerajaan di sektor awam Malaysia menggunakan soal selidik tinjauan. Kajian ini menggunakan *Partial Least Square-Structural Equation Modeling* (PLS-SEM) sebagai teknik statistik utama analisis faktor. Analisis statistik menunjukkan bahawa tiga faktor dari konteks organisasi (Budaya, sokongan pengurusan atasan, kompetensi IT), dua faktor dari konteks teknologi (Kelebihan relatif, Kerumitan), dan prinsip OGD secara signifikan menyumbang kepada pelaksanaan OGD dalam fasa pasca-adopsi. Sementara faktor dari konteks persekitaran (Insentif, Permintaan data) dan satu faktor dari konteks teknologi (Keserasian) mempunyai sumbangan yang tidak signifikan terhadap pelaksanaan OGD dalam fasa pasca-adopsi. Sumbangan kajian ini dapat dilihat dari tiga aspek iaitu dari segi teori, konsep, dan praktik. Kajian ini menyumbang secara teori dengan memperkenalkan kerangka kerja inovasi OGD pasca-adopsi. Secara konseptual, kajian ini memperkenalkan faktor-faktor baru dari konteks persekitaran untuk pasca adopsi OGD, iaitu insentif dan permintaan data. Dalam praktiknya, hasil kajian ini membolehkan pembuat dasar menyusun strategi untuk pelaksanaan OGD yang mampan dari perspektif penyedia data. Kajian ini membolehkan para penyelidik mengguna semula model kajian yang sama agar dapat menghasilkan hasil dalam suasana yang berbeza, seperti status sosioekonomi yang berbeza. Kelemahan penyelidikan ini ditunjukkan dengan kaedah tinjauan, yang menggunakan satu titik waktu untuk pengumpulan data. Pendekatan *longitudinal* atau kajian kes disarankan untuk penyelidikan masa depan untuk memahami asimilasi OGD di sektor awam dengan lebih baik.

Kata kunci: Data terbuka kerajaan, data terbuka, pasca-adopsi, proses adopsi, sektor awam.

In the memory of

My beloved mother, Allahyarhamah Hjh Fatimah binti Hj Mustafa, who departed peacefully on the blessed dawn of Friday, 2nd October 2009 / *12 Syawal 1430*.

May Allah have mercy on you and place your souls among those of the believers of the highest Jannah.

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LIST OF SYMBOLS AND ABBREVIATIONS

OGD	:	Open Government Data
IS	:	Information Systems
IT	:	Information Technology
IODC	:	International Open Data Charter
CB-SEM	:	Covariance-based Structural Equation Modelling
CSV	:	Comma-separated value
CVI	:	Content Validity Index
HTTP	:	Hypertext Transfer Protocol
JSON	:	JavaScript Object Notation
ODI	:	Open Data Institute
PCA	:	Principal Component Analysis
PLS	:	Partial Least Square
RDF	:	Resource Description Framework
SEM	:	Structural Equation Modelling
SPARQL	:	SPARQL Protocol and RDF Query Language
URI	:	Uniform Resource Identifier
W3C	:	World Wide Web Consortium
XML	:	Extensible Markup Language

LIST OF APPENDICES

CHAPTER 1: INTRODUCTION

This chapter will start by introducing the domain knowledge that will be discovered throughout this thesis. Through the introduction, the problems statements emerge to drive this study to develop the solutions. The research questions and objectives are presented to outline what this study is trying to achieve. This study is conducted for various reasons that are presented in the research significance. Within the defined scope, the significance of the study amplifies the need to carry such research in today's world. The determination to conduct this study is presented in the motivation of the study.

1.1 Introduction

Every day a vast amount of data is being created. These data represent our daily experiences, such as our hospital records, daily commute by train, grocery shopping, and even the parking ticket issues whenever we go to malls. Most of the time, these data are stored in a way that is inaccessible, whereas some of the data that is free to access today by rights can be transformed into a useful piece of information. There are countless benefits when data and information are accessible by the public. The government is known to be the organisational unit that has been collected and stored a significant amount of data for years. As the data owner, the government had a hard time releasing data to the public because of legal rights and confidential issues. The burden is exacerbated by privacy and security concerns over the misuse of the data. However, with the standard for storing, handling, and accessing data, the government can now make data accessible for the public to be use and re-use into anything. The term referring to the non-restrictive government data which is released for public use is called Open Government Data (OGD). The OGD originated from the Open Data concept but specifically referred to the data owned by the government. In this work, OGD can be defined as the non-confidential data published in a machine-readable format on an online platform for public use, re-use, and distribution without restrictions and legal attachment (Tang & Jiang, 2020; United Nations E-Government Survey, 2020).

OGD is not just about data per se, but it is regarded as a new government innovation (Ruijer & Meijer, 2019) in which the diffusion of OGD among government agencies can be conceptualized using the innovation adoption process. Hence, in this study, OGD is viewed as an Information System (IS)/Information Technology (IT) innovation that is new to the public sector. The newness concept includes shifting the openness culture in government and indirectly change the relationship between government and citizens to be more collaborative (Ruijer & Meijer, 2019; Wang & Lo, 2016; Yang & Wu, 2016a).

Nevertheless, much like any other IS/IT innovation, OGD is not immune to implementation challenges and barriers. The challenges and barriers to OGD implementation emerge from the initial step of OGD adoption to maintaining the initiatives. Introducing innovation among the government agency can be challenging in terms of getting feedback. Some agencies are reluctant to accept new ideas, but others are willing to give them a try. Accepting the OGD initiatives would require the government agency to make small changes in the way data was managed. Government agencies that gave lukewarm feedbacks to the OGD initiatives typically resist having change management. However, after some engagement and awareness programs, government agencies started to understand and giving attention to accepting OGD initiatives. These are some of the challenges that happen throughout the OGD adoption process. This study uncovers the activities as well as the challenges and barriers of OGD implementation in each adoption phase in the Malaysian public sector. With this information, this study should be able to strategize how OGD initiatives are going to be sustained in the long term. The study was conducted in the Malaysian public sector for several reasons. First, as part of its digital government transformation journey, the Malaysian government has made significant strides over the last few years. The Malaysian government has constantly improved the endeavour of providing e-government services for their citizen. Among the upper-middle-income economies, the Malaysian government performs very well in E-Government Development Index (United Nations E-Government Survey, 2020). Therefore, this research may serve as a useful reference for other countries in the same socio-economy status by identifying and analysing the variables that influence the adoption of OGD by government entities in Malaysia. Secondly, Malaysia is a well-established country in ICT infrastructure and high penetration of internet connectivity. From the total population of 32 million, 81.2 per cent of the Malaysian citizens are active internet users (United Nations E-Government Survey, 2020). Therefore, OGD post-adoption is perceived to be advanced in the Malaysian government service delivery that enlightens the future trajectory of OGD initiatives.

Nevertheless, the cost of maintaining the OGD initiatives in the future will be too high. Setting up an OGD program might incurred costs for resources like computer software, staff, and training (Ahmadi Zeleti, 2016). Additionally, if the government decided to maintain the OGD initiatives over time, some extra costs might be a burden if not properly planned. A technical response to this situation could focus on the concept of third-party interaction. The publication of crude data enables third parties to transform data into publicly useful information via apps or visualizations. Giving the public access to the data may be all the public needs which relieve the government's responsibility and cost of providing direct data-driven solutions.

Having the aforementioned statements, it is crucial to ensure the OGD initiatives need to be sustained and expanded as an integral part of government core value (Gao et al., 2021). The essential works should be started earlier so that arising risks on OGD implementation could be mitigated. Thus, the post-adoption of OGD in the Malaysian public sector requires further investigation as there has been little attempt to explore how the OGD data providers anticipate OGD implementation in the long term.

1.2 Problem Statement

The government has invested a substantial amount of funds in Information System (IS)/ Information Technology (IT) projects with the intention to improve government service delivery to the public. However, many of these innovations are underutilized, misused, and neglected, leading to the failure to generate the desired benefits to the citizen and the government itself (Fadel, 2012; Jasperson et al., 2005).

The available studies of Open Government Data (OGD) adoption terminate at finding the factors that influence the adopter's autonomous choices to either adopt or not. The government agency's actual practice as the data provider after the adoption decision phase of OGD is mostly ignored. This notion is reinforced by studies that demonstrated that there are organisations that adopt multiple innovations, yet there is just a limited scope, or no deployment exists even after a few years of acceptance (Jasperson et al., 2005). In the innovation adoption process, the adoption decisions are part of the initial stage of the implementation phase (Frambach & Schillewaert, 2002; Kamal, 2006; Mishra, 2010), while sustained implementation put the innovation adoption process to an end state (Gopalakrishnan & Damanpour, 1994). The sustained implementation and many other similar terms such as routinization, assimilation, incorporation, and infusion are among the positive consequences that can be extended in the post-adoption phase. While rejection, termination, obsolete, and discontinued use of innovation are among the negative consequences that can unanticipatedly occurred in the post-adoption phase. However, much of these occurrences in the post-adoption phase has received little attention or is often overlooked from the IS/IT innovation adoption process (Hazen et al., 2012; Jasperson et al., 2005; Mishra, 2010). The negative consequences of innovation at an organisation level could be the worst-case scenario as this implies that the investment in the innovation has been a waste. Furthermore, the inability to acquire the maximum value of an adopted innovation predicts the insignificant impacts, disrupting the subsequent process and loss of productivity and return for the government (Cooper & Zmud, 1990; Zhu, Dong, et al., 2006; Zmud & Apple, 1992). In contrast, successful and worthwhile innovation adoption is recognised when the innovation is practised and incorporated into the organisation (Frambach & Schillewaert, 2002; Gopalakrishnan & Damanpour, 1997; Hameed et al., 2012a; Rogers, 1995). In addition, some empirical research has proven that the anticipated benefits of innovation are primarily expressed in the effectiveness of which innovation is integrated into the organisation's work norm (Damanpour & Schneider, 2006; Hazen et al., 2012; Mishra, 2010).

Findings from the interview conducted with top-level officers in the central agency have indicated that there is a lack of information on OGD acceptance and implementation amongst the government agencies. The scenario can be portrayed by the decreasing rate of data publication in the government data portal starting from 2019. To add to the agitation, Malaysia's ranking in some of the international assessments in OGD implementation has also dropped. Globally, the pioneer countries in OGD implementation, such as the United States of America and the United Kingdom, have also seemed to falter (World Wide Web Foundation, 2018).

Similarly, other IT innovation adoption studies have captured the same scenario in which information on post-adoption of innovation is indeterminate, such as the Geographical information technologies in Mozambican institutions (Amade et al., 2020), Enterprise 2.0 platform, post-adoption in China (Jia et al., 2017), cloud computing (Obal, 2017), and Collaborative Visibility Network (CVN) technology among the United States automotive company (Hong-kit Yim et al., 2013).

In the same view, the activities of OGD beyond adoption or the post-adoption phase in the public sector are rather unclear. A study by Li and Chen (2021) discovers that the Chinese government department had a hard time providing open data even though the central agency had lined out much effort. The resistance from the government departments indicated that there are conflicts of interest between the OGD stakeholders that jeopardize the expected benefits from OGD implementation.

This study believes that studying the factors influencing the post-adoption of OGD from different types of technological, organisational, and environmental contexts would extend OGD acceptance, routinized, and infusion in the public sector. Additionally, there is a shortage of literature investigating the factors that influence innovation implementation, particularly OGD in the post-adoption phase. This study argues the need to investigate the OGD implementation in the post-adoption phase. Therefore, the cumulative explanations mentioned have formed the research problems of this study that require further investigation.

1.3 Motivation of the Study

The OGD initiatives have the potential to be more significant in the world today. During the economic crisis, health crisis, or environmental crisis, the public relies on government data to make better-informed decisions. However, many government data are kept underutilized or hidden from the public. This situation is due to a lack of understanding of the benefits of releasing the data as OGD. Hence, understanding the usage and the influences that carve OGD implementation patterns is an important concern for OGD researchers and practitioners. Furthermore, the Malaysian government is expected to deploy many digital innovation transformation programs that include data-driven initiatives. Having a clear framework of OGD implementation in the more prominent national digital transformation roadmap is unduly call.

1.4 Research Aims

This study aims to gain an understanding of the OGD post-adoption in the Malaysian public sector and the factors that influence the government agencies to commit to the OGD initiatives. In doing so, this study intends to facilitate the OGD post-adoption in the Malaysian public sector with a framework to ensure the way forward can be determined.

1.5 Research Objectives

This thesis concerns the progress of OGD implementation in the Malaysian public sector. However, the adoption process of OGD needs to be deconstructed prior to investigate the OGD implementation. This effort is to confirm that the OGD has entered the post-adoption phase in the Malaysian public sector. It also offers more understanding of the events that lead to a post-adoption phase. This study argues that it is imperative to verify the transitions from pre-adoption to post-adoption to avoid drawing pre-matured assumptions about the OGD's status at this point in time. In doing such, this research is crafted to achieve this objective:

1. To investigate OGD adoption phases in the Malaysian public sector.

Subsequently, this research builds a foundation to foresee the factors that contribute to the implementation of OGD in the post-adoption phase in the Malaysian government. Thus, this next research objective is formulated:

2. To identify the factors influencing the OGD implementation in the post-adoption phase in the Malaysian public sector.

The identified OGD post-adoption factors will be incorporated with appropriate underpinning theories to establish a nomological discernment for the phenomenon under study. Without a framework, it is hard to identify which factors contribute to OGD implementation in the post-adoption phase. This prompt the third research objective:

3. To develop an OGD post-adoption framework in the Malaysian public sector.

Once the framework has been developed, it needs to be validated. The validation method ensures that the developed OGD post-adoption framework possesses realistic features to be implemented in the Malaysian public sector. Hence, the final research objective of this study is:

4. To validate the OGD post-adoption framework in the Malaysian public sector.

1.6 Research Questions

Research questions are among the important component of a thesis because it gives a clear focus on what the study intends to answer. The research questions of this study are made in a sequence order because in order to reach the aim of this study, the foundation has to be solved first. Although the Malaysian government has adopted the OGD initiatives, the current phase must be determined to avoid making a premature judgement on the current phase of OGD implementation in the Malaysian public sector. Thus, the following questions are formulated as the first question for this study:

1. What is the current OGD adoption phase in the Malaysian public sector?

Albeit the Technology-Organisation-Environment (TOE) framework has been widely used in adoption studies, there appears to be no single all-inclusive framework that can be adapted by any innovation adoption in an organisation study. This situation is due to each study being conducted in different organisations' backgrounds or other settings. With all the explored factors, which factors have a significant influence on the sustainable

OGD implementation in the post-adoption phase is indeterminate. Hence, the next research questions would be:

2. What are the factors that influence OGD implementation in the post-adoption in Malaysia's public sector?

With all the explored factors, which factors have a significant influence on the sustainable OGD implementation in the post-adoption phase is indeterminate. The curiosity of the intended objective leads to the third research question as follows:

3. How can the OGD implementation be extended in the post-adoption phase in Malaysia's public sector?

The research objectives and questions are inextricably linked; if the research objectives had been unclear, imprecise, or ambiguous, it would have been impossible to sufficiently detail the research questions. The following Table 1.1 mapped the research questions and objectives to guide the researcher in carrying this study.

Table 1.1: Mapped research questions and research objectives.

Research questions	Research Objectives
1. What is the current OGD adoption phase in the Malaysian public sector?	1. To investigate OGD adoption phases in the Malaysian public sector.
2. What are the factors that influence OGD implementation in the post-adoption in Malaysia's public sector?	2. To investigate the factors influencing the OGD implementation in the post-adoption phase in the Malaysian public sector.
3. How can the OGD implementation be extended in the post-adoption phase in Malaysia's public sector?	3. To develop an OGD post-adoption framework in the Malaysian public sector.
	4. To validate the OGD post-adoption framework in the Malaysian public sector.

1.7 Scope of the Study

The focal point of this study is investigating the factors of OGD implementation in the Malaysian public sector. The OGD initiative is referred to as the IT innovation that is investigated in this study. Within the OGD initiative domain, the branch knowledge that will be discussed in this study includes the definition of the OGD, the characteristics, the issues faced by government agencies, the benefits, the lifecycle and current OGD implementation in the Malaysian public sector.

The ecosystem of OGD comprises three main actors, the data provider, the data user, and the beneficiaries. This study concerns investigating the data provider point of view. The data provider or data supplier in this study is represented by the smallest unit possible in the government agency that produces data and publishes it directly in the government data portal. The smallest unit that is considered a data provider might be referred to as a unit or section or department or division or agency. There might be more than one data provider in a single government agency.

This study emphasized the data provider view as it plays the most important role in the OGD ecosystem. Without data publication from the data provider, there will be no data usage. The government agency holds the responsibility to sustain the OGD initiative even with no usage from the data users. The view from the data provider is crucial to determine the factors that motivate government agencies to keep on publishing OGD. The data user's view is not covered in this study because the opinion may neglect the organisation factors beyond the knowledge of the data users. Simultaneously, the data beneficiary's view may neglect the technological aspect because most of the time, the technical aspects are hidden from the public.

The Malaysian public sector is led at the federal level, and under this federal administration, there are government agencies from various other lower levels. As OGD is known as an innovation at an organisational level, this study's data are collected from government agencies that have adopted OGD and thus is employed as the unit of analysis. The type of government agency that is involved in the study includes the federal agency, federal statutory body, state government, state agency, state statutory body, and local authority from all over Malaysia. A government agency that has yet to adopt OGD is not considered as the data provider to this study. This decision is justified because this study highlights the post-adoption phase of OGD. The actor in this scenario is deemed the existing OGD adopter rather than a non-adopter or potential adopter. The existing OGD adopter has the experience and knowledge in OGD implementation, hence would be able to give meaningful input to portray the post-adoption phase. In contrast, the non-adopter or potential adopter of OGD might be best to study at the pre-adoption or adoption decision phase of the innovation.

1.8 Research Significance

This study attempted to understand the OGD implementation situation in the public sector in the post-adoption phase. In doing so, the post-adoption theory of innovation adoption in an organisation is explored and suggested for other researchers to expand the theory in various innovation disciplines further. A set of new constructs is also introduced in the study's framework to investigate whether the constructs contribute to the OGD implementation in the post-adoption phase. As with any other breakthrough in the modern era that risks being abandoned or discontinued, OGD is no exception. Therefore, this study sheds some light on the decision-makers to provide some guidance to boost the OGD implementation performance in the post-adoption phase.

The significance of this study can be discerned from three alternate perspectives, to be specific theoretical, conceptual, and methodological. By theoretical contributions, this study seeks to extend the OGD innovation adoption theory in the post-adoption phase. While most IT innovation studies focused only on one single stage of adoption, this study promotes the sequence of the innovation adoption process. Conceptually, this study introduces new factors into the developed framework, namely the Incentives and Data Demand for environmental context and OGD principles in the innovation characteristics context.

In terms of methodological contribution, this study offers a research method that can be replicated by others to conduct a similar project for different environment settings or different innovations. In this way, research methodology for innovation adoption in an organisation study can be more robust and durable by having more empirical evidence. The empirical evidence from the view of data providers in the post-adoption of OGD could also open more room for improvement in citizen service delivery.

1.9 Organisation of the Thesis

This study is composed as follows; Chapter 2 commences the Open Government Data background and provides the working definition used in this study. This introduction includes the progress of OGD implementation in Malaysia from the pre-adoption to the post-adoption phase, which is the pivotal part of this study.

In Chapter 3, the theoretical framework of the study is described. Research paradigm that forms the study from a philosophical view until the data collection techniques are explained. This chapter also offers the development details of the research model and hypotheses for this study.

Chapter 4 presents the steps taken to perform this research in a very profound research design. The research design is crafted in a sequential process where each step was taken one at a time. This action is to ensure that the input and output of each step are valid and can be replicated by other researchers. Justification of each method selected to achieve the research objectives are also explained.

The preliminary investigation, which used the qualitative method, is described in Chapter 5. In this chapter, the first research objective is achieved by untangled the OGD adoption phases in the Malaysian public sector. Such a feat is accomplished by conducting interviews with a number of influential individuals within the central government agency. By determining the OGD adoption phases, the researcher is able to identify the information needed to develop the conceptual framework of the study. The output of the preliminary study is crucial to help shape the next phase.

In Chapter 6, the detailed explanations of the empirical study are described. The empirical study utilised the Partial Least Square-Structured Equation Modelling (PLS-SEM) as the statistical technique. The PLS-SEM is chosen as the primary data analysis for this study for many reasons. One of the reasons is that this study is exploratory in nature; thus, PLS-SEM offers a method to explore the factors contributing to OGD implementation in the post-adoption phase. This chapter marks the accomplishment of the second and third research objectives.

In chapter 7, the validation and discussions of the study take place. The validation procedure is employed to validate the empirical findings with several experts in government data management. This procedure is to ensure that the developed conceptual framework is feasible to be deployed in the Malaysian public sector. Completing the validation procedure allows the study to meet the fourth research objective. At the same time, the discussions section elaborates the overall findings of the study.

Thereafter, Chapter 8 concludes the study findings by explaining how each research question is answered and how the study achieves its research objectives. This chapter also presented the contributions of the study. Simultaneously, limitations and future research are discussed.

1.10 Summary

Chapter 1 is designed to introduce the foundation of this thesis. This chapter starts with the problem statements that lead to the works of the study. Driven from the problem statements, the research questions and objectives were discussed to proposed solutions at the end of this study. The significance of research and motivation of the study corroborated the urge to conduct this study. At the same time, the research scope sets the boundary of the domain knowledge covers in this study.

CHAPTER 2: LITERATURE REVIEW

This chapter develops an understanding of OGD as organisational innovation. As an innovation, OGD offers a variety of branches of knowledge to be explored. In OGD taxonomy, the knowledge expands from the theoretical, methodological, and technical aspects. This chapter applies the theoretical concept and widens the concept of OGD adoption in the public sector. Prior to the theoretical concept, the basic knowledge about OGD, including the principles, benefits, challenges, and barriers to implementing OGD, is described. On top of that, the ecosystem, lifecycle and existing study on OGD adoption are steadily discussed. As the organisational entity that is the focus of this study, the Malaysian public sector structure is presented. Followingly, the progress of OGD implementation in the Malaysian public sector is elucidated.

2.1 Introduction

The value of data in the modern digital world is now as precious as the value of a commodity market. Almost every single entity, including humans, objects, or events, generates an infinite spectrum of data that can form a valuable asset. The tech giants such as Google, Facebook, Twitter, Amazon, to name a few, have been known for their capability of turning the data they collected into profits. But little is known that for years the government has also been gathering and producing data. There is no doubting that most government data is confidential, but some of the data is available to the public. For example, the daily weather from the meteorology department, the traffic update from the transportation agency, and the healthcare facilities list are all accessible to the public. People are benefiting from these available government data without they even realizing it. There are even fewer people who realize that they could gain more advantages by manipulating the open government data. But what is open government data? Why is it important to the citizen? The next subsections will narrate the OGD background, ranging from its principles to the OGD ecosystem's formation.

2.2 Open Government Data (OGD)

As a single word, it is easy to understand what is open, government and data mean. These words can stand independently with their own meaning. But as two words combined together, we get open government, open data, and government data. These words gave a different meaning and context. The 'open government' is a movement that promotes transparency, participation, and collaboration to be institutionalized in government administration (Linders & Wilson, 2011; Tai, 2021; Yu & Robinson, 2011). One of the primary purposes of open government is to improve public trust in government operations. This aspiration can be achieved by fulfilling the right for citizens to access non-confidential government information (Criado et al., 2018). The movement is steadily growing with many more emerging open-focused initiatives, such as open spending (Bates, 2014; Hartog et al., 2014), open contracting (Clare et al., 2016), open science (Sullivan et al., 2019), and many other 'open' initiatives.

On the opposite side, 'open data' itself is an initiative that almost all individuals could implement, groups, or organisations, which intend to share data publicly. Scholars have been using the definition of 'open data' as data that is freely accessible, used, re-used, and shared by anyone for any reason without restrictions (Crusoe, 2021; Lodato et al., 2021). The open data is much the same as the normal data that can be present in either a structured or unstructured manner. The structure data corresponds to a predetermined data structure and is thus simple to interpret. In contrast, the unstructured data does not come in predetermined ordered and normally qualitative data such as audio, video or text-based information (Schrier, 2014).

The last intersection between the elements from Figure 2.1 is the 'government data', which refers to any data created, obtained, recorded, and documented by any medium on the basis of public duties bound by law and legislation (OECD, 2020). The government is a well-known organisation that collects and produces an enormous amount of data. Of all the data held by the government, not everything can be released to the public. Most of the government data are subject to security and privacy policy and have limited accessibility by the public. There are, however, the type of government data that is considered non-privacy and non-confidential data that is visible and reachable to the public. The non-confidential government data includes data that has a fee structure before being released, such as geoscience data. This data is usually used for research and development purposes. Figure 2.1 illustrate the foundation elements and intersection of open, government, and data.

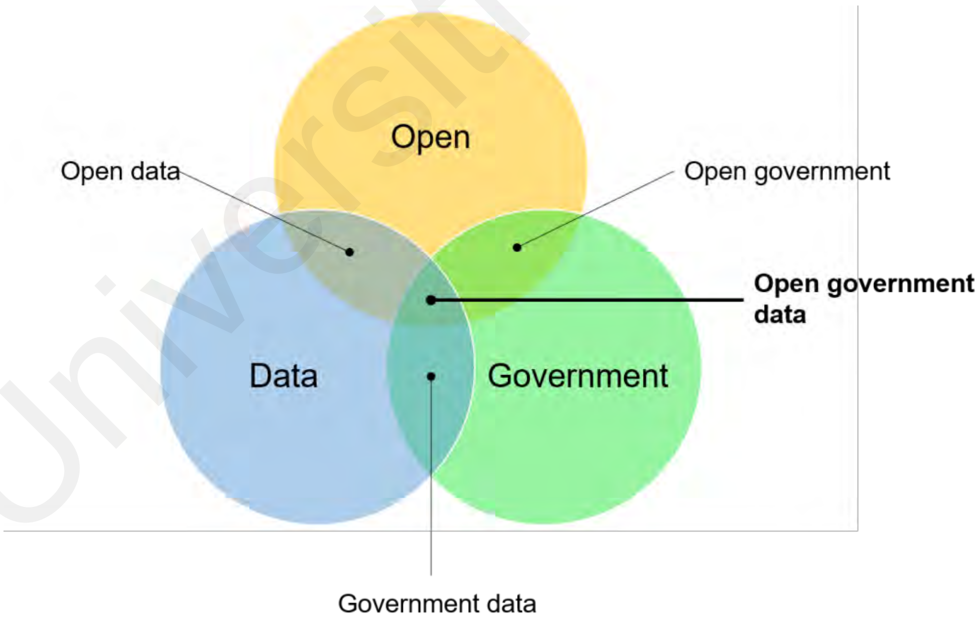

Figure 2.1: Basic Elements of Open Government Data (Gonzalez-Zapata, 2015)

2.2.1 Defining Open Government Data (OGD)

The Open Data initiatives become a prominent interest among the government in early 2009 as the 44th President of the United States of America, President Obama, with his administration, initiated the idea of publishing government data to increase public trust in the government (O'Reilly, 2011). Thereafter, the concept of open data was extended to government data to become the widely used term of Open Government Data (OGD). The term 'Open Government Data' does not relatively new in the information technology world (Sigit Sayogo, Pardo, et al., 2014). It comes from an intersection of open, government, and data (Figure 2.1). The OGD appears to segregate the focus to only government-owned data that is releasable to the public. Government data consists of any data produced and commissioned by a government entity or public governing bodies (Ubaldi, 2013). The government data comprises data generated from all sectors, including legal, healthcare, defence, geographic, meteorology, education, transportation, business and whatnot (Ubaldi, 2013).

For years, the government has been publishing data, but it was often limited in an unstructured format or incurred charges for the data to be used. Some scholars relate it to 'public sector information' (PSI), where it refers to the government's effort to facilitate public access to information from the viewpoint of human rights (Ubaldi, 2013). For years, the government used to share their information through reports, news, first-generation web portals, and many other mediums. The public was left with fewer options to re-use or share the information because of the limited accessibility and undynamic data format. As the capacity for economic and social benefit extracted from PSI has been steadily emphasized, the relevance of usability of the underlying data reports, research and knowledge has increased. The idea of Open Data was first promoted in the private sector and business economy but has slowly been embraced by the public sector. It has triggered an Open Government Data movement by the Open Knowledge Foundation (OKF) to widen the context (Ubaldi, 2013).

Information is regarded as a collection of data; without data, there will be no information. However, having an OGD implemented in the government does not automatically result in the government adopting the open government directive. OGD initiative is only a small fraction of the wider open government movement that has bigger challenges (Janssen et al., 2012; Susha, Zuiderwijk, et al., 2015). The open government directive requires the participating government to agree upon the Open Government Declaration as well as other criteria.

The OGD is a combination of innovation, methodology and organisational-level initiative that operates ideally in a data-sharing ecosystem. There are three main actors in the OGD environment: the OGD provider, OGD user, and OGD beneficiaries. OGD providers refer to the stakeholders, or particularly the government bodies, who publish OGD on the online platform (Dawes et al., 2016; Heimstädt, 2014). In comparison, OGD users could be independent individuals or organisations interested in accessing, manipulating, analysing, re-use, and re-publishing open data (Dawes et al., 2016). Sometimes, the OGD user and OGD providers could be the same entity, such as government agencies. This is due to the government agency that publishes data also re-uses data from other agencies to produce more useful details. This study examines the later role that is the OGD provider or, specifically, the government agency.

The digital transformation has made the government generate a huge amount of data and store it digitally. Some of the data can be released to be accessed by the public, and some data has restricted access. Government data and information security level is classified into five categories, as depicted in Table 2.1. Those data classified 'Secret' to 'Limited' remain undisputedly confidential data for the public. Sadly, most of the data classified as 'Open' is not really open or shared publicly. One of the reasons for this situation is because; most of the data are still in conventional printed form. It may take a lot of effort for the agency to convert the data to digital form. But for the most data that are already in the digital format, are underutilized whereas some of it can be publicly shared for re-use.

Table 2.1: Government Data And Information Security Level (Administrative Instructions for Record Management No. 1 of 2018, 2018)

	Security level	Description	Example
1.	Top secret	If disclosed, it can cause major damage to the interests and dignity of the country or give substantial profits to a foreign power.	• Data on main policy with political and economic matters. • Correspondence with foreign countries regarding important trade and defence. • Data on movements and military placement in the event of war.
2.	Secret	If disclosed without permission will endanger the national security, causing a major damage to the interests and dignity of the country or to give substantial profits to a foreign power.	• An important direction for a representative of a country that negotiates with a foreign country. • Important information mounting
3.	Confidential	If disclosed without authorization although not jeopardizing national security but harmful to the interests of the state or governmental or individual activity or would cause embarrassment or administrative hardship or favourable foreign powers.	• Ordinary intelligence reports. • Documents and technical guides for military or police officer training
4.	Limited	Other than those classified in the Secret, Secret or Difficult Secret but are also given a level of security protection.	• Department books for referral purposes. • Orders and directions of the department.
5.	Open	Non-sensitive data that can be accessed independently shared, and re-used by citizens, public or private sector.	• List of government facilities such as schools, clinics, fire departments, etc. • A number of accidents, crimes, consumers index, etc.

2.2.2 OGD Principles

As suggested by Tornatzky and Klein (1982), innovation characteristics play a much important role in innovation adoption and implementation. A study by Damanpour and Schneider (2006) has shown that innovation features enhance innovation adoption's predictive ability compared to environmental and organisational factors. However, it is necessary to note that each innovation has distinct characteristics. OGD characteristics come in a set of principles that define how OGD should be practised. There are several open data principles that are available and produced by international bodies that have very focused goals on open data initiatives. The most prominent principles used in the OGD study are the eight OGD principles identified and presented for government consideration in December 2007 at the Open Government Working Group meeting held in Sebastopol, California, United States (Open Government Data Working Group, 2007). The conference was hosted by Public.Resource.Org, funded by the Sunlight Foundation, Google and Yahoo, and bringing together thirty open government supporters.

Subsequently, in 2012, the United Kingdom Public Sector Transparency Board released the Board's Public Data Principles to help the United Kingdom (UK) public sector publish their open data (Ubaldi, 2013). Another OGD principle was proposed by a civil society organisation called the International Open Data Charter (IODC) (Open Data Charter, n.d.), which collaborates with more than 150 national and local governments around the world to set out six principles for OGD. The IODC's version of OGD principles was launched in 2015 in conjunction with the G8 Open Data Charter's meeting (Open Data Charter, n.d.). In 2017, the Sunlight Foundation later revised the list from the Open Government Working Group. Two principles (permanence and usage cost) have been added, making it become the ten principles designed to focus on determining the degree to which government data is available and obtainable by the public. Due to the consistency and widespread use, this study thereby employed the eight OGD principles from the Open Government Working Group. The OGD principles proposed by the various international working group are presented in Table 2.3.

Although following these principles is not a mandatory rule in OGD implementation, it is meant to set a benchmark of the best OGD practices for any organisation to implement. However, these principles play an essential role if a government wants to know the level they have achieved and compare it to other countries whenever an international assessment is made. To date, the study on looking at how these principles influence OGD adoption in an organisation is scarce.

Apart from the OGD principles, the most common principle that OGD adopters follow is the Five-star deployment scheme suggested by Sir Tim Berners-Lee (Hausenblas; & Kim, 2018). In 2010, Sir Tim Berners-Lee, the inventor of the World Wide Web and the originator of the Semantic Web and Linked Data, proposed a five-star deployment strategy for Linked Open Data. This scheme became the guideline for OGD providers and users to rate the dataset's openness level. The scheme was divided into five categories; the more stars the dataset is scored, the more flexible and adaptable it is. Table 2.2 describes the mentioned categories.

Table 2.2: The five-star scheme for data openness (Hausenblas; & Kim, 2018).

Openness level	Descriptions
One star	The data is freely available on the web in any format.
Two-star	Available on the web freely in machine-readable format (e.g. Microsoft Excel).
Three-stars	Available on the web freely in a machine-readable and non-proprietary format (e.g. comma-separated value).
Four-stars	Available on the web freely in a machine-readable, non-proprietary and open standard format from W3C (SPARQL or RDF). The URI is also use to identify things, so that people can point to the datasets.
Five-stars	Available on the web freely in a machine-readable, non-proprietary, and apply open standard format from W3C (SPARQL or RDF) plus the data is linked to other data to provide context.

Table 2.3: OGD Principles from Various Research Body.

	Principle	Description	OPWG	UK's	IODC	SF
1.	Complete	Data are made accessible in a complete form, not bound to any privacy, and security limitations, meaning the entire datasets can be obtained.	✓			✓
2.	Primary	Data are collected at the origin source, with the most astounding possible details, not in total or modified structures.	✓			✓
3.	Timely	Data shall be made available as soon as possible in order to maintain its value.	✓	✓	✓	✓
4.	Accessibility	Data are accessible by anyone on the online platform at any time.	✓	✓	✓	✓
5.	Machine-processable	Data are well organized in an automated form for easier processing.	✓	✓		✓
6.	Non-discriminatory	Data are attainable with no necessity for user enrolment.	✓	✓		✓
7.	Non-proprietary	Data are accessible that has no specific control by any patent or trademark or copyright.	✓			
8.	License-free	Data are free from any copyright, patent, trademark, or competitive advantage direction. Sensible protection, security and benefit confinements might be permitted.	✓	✓		✓
9.	Open standards	The data shall be published using the open standards, as suggested by the World Wide Web Consortium (W3C).		✓		✓

Notes: OGWG: Open Government Working Group; UK's: The United Kingdom Public Data Principles; IODC: International Open Data Charter; SF: Sunlight Foundation

Table 2.3: OGD Principles from Various Research Body (continue)

	Principle	Description	OPWG	UK's	IODC	SF
10.	Encourage re-use	Public agencies should positively promote the re-use of their public data.		✓		
11.	Publish data inventory	Public agencies should preserve and report inventories of their data holdings.		✓		
12.	Publish relevant metadata	The public agencies are required to publish the metadata about their datasets on a single web access point.		✓		
13.	Open by default	An assumption that the data is open except it is justified to keep close.			✓	
14.	Comparable and interoperable	Commonly agreed data standards.			✓	
15.	Improve governance and citizen engagement	Transparency to enhance public facilities and to keep governments responsible.			✓	
16.	Inclusive development and innovation	To promote sustainable economic growth.			✓	
17.	Permanence	Online information can be maintained online, with the necessary monitoring and archiving of copies over time.				✓
18.	Usage costs	The data can be accessed with no fees incurred.				✓

Notes: OGWG: Open Government Working Group; UK's: The United Kingdom Public Data Principles; IODC: International Open Data Charter; SF: Sunlight Foundation

2.2.3 OGD Benefits

The OGD initiatives have been received a lot of attention internationally. The attention is due to the benefits that OGD can offer and the potential growth in the long term. Nonetheless, the benefits of open government data (OGD) do not arise instantly just because the data is publicly available on an internet platform (as is the case with traditional government data. It takes some promotion and efforts to encourage data use among all the potential data users to reap the benefits. There are a few ways to discuss the benefits of OGD. One way is to look for what OGD can bring in social, economic, political or technical aspects, as portrayed in Charalabidis et al. (2018). Another way to discuss OGD benefits is to observe the impact of OGD implementation on the beneficiaries. This study will delve into both ways of presenting the OGD benefits.

The foremost beneficiaries of the OGD initiatives are the government agency themselves. These days, the demand for government data is more apparent than ever. When a crisis happens, the government, businesses, and citizens require data to get more information and make better decisions. However, interagency bureaucracy sometimes has discreetly become obstacles to data sharing initiatives among government agencies. Priorly, government agencies had to formally request the data owning agency with detailed justifications and other requirements. Adding to the complicated procedure, the data-owning agency may need some time to respond, and the communication prolongs if there is a miscommunication. With OGD initiatives, government agencies can obtain data seamlessly without going through the complicated protocol. The availability of OGD from the centralized data portal makes it easy for government agencies to obtain freely the data they need at any time.

The following beneficiaries of OGD initiatives are the data user community: any individual, private business, start-ups gig, civil society organisation, academia, government agency itself, among others (Dawes et al., 2016). With some creativity, these data users or innovators can transform the data they obtained from the data portal into useful services or data products such as mobile applications. High-value and marketable data products or services would allow the profit-oriented organisation to create business opportunities by offering the products or services to potential clients. Indirectly, the OGD generate economic growth, especially amongst ICT industry players by stimulating innovation creation and experimentation using OGD (Shaharudin, 2020).

The final beneficiaries of OGD are the public at large. Benefits for the citizen is only accrued if the data is in use by the citizen (Dawes et al., 2016). Not all individuals in society can transform the raw data of OGD into something useful. Only a small group or less than a few of the citizens are interested in utilizing the OGD, but for some, there is simply no reason to use the data even if they have the knowledge and skills to manipulate the data (Hedström, 2015). Although the citizen is not the target group of the raw data of OGD, interested citizens can use the data for their own personal purposes, for instance, checking the nearest health facilities in the housing area, comparing the consumer price index, among others. The citizen could be the best beneficiaries if they use the data products produced by the group of technology creators in the second beneficiaries of OGD mentioned previously. Using the available applications made by public data will help the developer to gradually expand the applications.

The impact of OGD is used interchangeably to represent the benefits of OGD by some studies. To this date, there is no mechanism to measure the impact of OGD as it is complicated and may take a longer time to prove the evidence of impact. However, OGD is expected to have an impact on the social, political, economic and operational aspects. The initial aim of creating OGD by the Open Knowledge Foundation (OKF) was to promote transparency of government activities. Having data on government spending, for instance, give more accountability among government agency to be aware that the public can scrutinize their actions. Consequently, the public will put more trust in the government to run the country, particularly when involving public interest.

From an operational aspect, OGD can reduce the burden of the government agency to attend to public demands for government data. Sometimes the government agency has to deal with the same data request multiple times; hence, having OGD in the data portal would allow the government agency to have more time for other tasks and receive fewer data requests. Having data available online will increase government service delivery to be more efficient in internal operations (Hardy & Maurushat, 2017). Additionally, with cloud computing technologies, OGD can be hosted on a platform that ensures data availability. Thus, the government use fewer resources for the operational and maintenance of OGD initiatives.

The benefits of OGD in social aspects are very much related to improving citizens' quality of life. This notion was emphasized by a study by Zdjelar et al. (2021), in which the researchers explore how OGD enhances citizens' quality of life. The researchers claimed that the availability of OGD affects almost all aspects from people's quality of life including health, work, education, social connections, personal security, environment and subjective well-being among others (Zdjelar et al., 2021). For example, data on hospital admissions could be analysed to correlate with demographic and census data to increase healthcare efficiency among vulnerable groups. With the availability of data on number of manufacturing industries in a certain area, the local authorities can predict the intensity of carbon emission into the atmosphere. A study by Martin and Begany (2017) emphasized the OGD benefits in healthcare has a long-term impact. To maintain its momentum, critical areas for the healthcare industry include rethinking legislative guidance on data protection in the open data paradigm and evaluating return on investment.

With regard to economic benefits, OGD alleviates some organisations' financial burdens associated with obtaining particular datasets. A study by Zhu et al. (2019) highlights that having an open data policy manages to lessen users' cost to use satellite data called Landsat. Previously, some costs were involved, from processing the digital imagery to media until sending it to the customers by postage. But with an open data policy imposed, users can download the image from the data portal without charge (Zhu et al., 2019). The OGD initiatives are also claimed to increase economic growth by offering opportunities for technology development to create products or services based on OGD. In proving the potential economic value creation from OGD, Ahmadi Zeleti (2016) study has identified various business models to aid the business entity in exploiting OGD for monetization purposes. With a myriad of data available, technology developer has the freedom to integrate OGD with other data sources to produce creative products or services. Indirectly, it sparks healthy competition among technology developers to produce a better idea. Hiding the data underutilized will not only stunted innovation creation from the data but deny the right of the citizen to have the right to information.

In operational category, the benefits include fair decision-making through facilitating comparison, enhanced government data and processes, efficient availability of data, rich qualitative data, and long-term data sustainability (Ibrahim et al., 2021). The publication of OGD can help to reduce the number of requests for data because individuals and organisations will be able to satisfy their information needs by utilising the datasets that have been published.

With the multitude of OGD potentials, scholars have synthesized the OGD benefits into the political, social, economic, and operational categories (Ibrahim et al., 2021). Table 2.4 presents the summary of OGD benefits by the mentioned category.

Table 2.4: OGD Benefits

Category	Benefits	References(s)
Political	• Increased the government accountability and transparency. • Improved citizens' trust.	Hardy and Maurushat (2017), Martin and Begany (2017)
Operational	• Increase government service delivery. • Reduce internal data silos in government. • Improved the government data quality and processes. • Provide a convenient platform for data availability.	Hardy and Maurushat (2017), Martin and Begany (2017), Ibrahim et al. (2021)
Social	• Improve the quality of life of the citizen. • Creation of innovative data products for the public.	Zdjelar et al. (2021), Martin and Begany (2017)
Economic	• Reducing cost. • Create business opportunities. • Stimulating the economic growth.	Martin and Begany (2017), Zhu et al. (2019)

2.2.4 OGD Barriers

Although OGD may theoretically have several benefits, a variety of barriers are often involved in its implementation. The OGD barriers can be seen from different perspectives, such as barriers of using the OGD from the data user's perspective, barriers of publishing and promoting OGD from the data provider's perspective, and barriers of implementing the OGD itself initiatives if looking from the decision-makers perspective. This section discusses the barriers from the data provider, particularly the government agency's perspective, and barriers from the decision-makers stand or the central agency.

Over the past years, several studies from various countries have demonstrated the barriers to OGD adoption. Given that each nation has a diverse history, socioeconomic, cultural and governance structure, and a policy framework, more study on OGD barriers must be visible from diversified perspectives (Sandoval-Almazan et al., 2021), as this innovation also evolves over time. Having more OGD barriers study allow other researchers to find the solutions or mitigate the risks from happening. Many OGD adopters from amongst the cities or countries authorities face barriers and challenges in implementing OGD. However, it is hard to articulate the most challenging aspects of OGD implementation due to different socio-economic, cultural and geopolitical statuses. The abundance of literature discussing the OGD barriers and challenges does not represent the universal issues of OGD implementation but rather focus on their case study. The unit of adopter could vary between government, organisation, private firm, community or any individual. Furthermore, the objectives of implementing OGD may vary depending on the stakeholders' goals. For example, some countries may have the intention to foster government transparency and gain public trust (Hardy & Maurushat, 2017), while others would like to encourage innovations creation for better smart city initiatives (Le Breton et al., 2021; Prieto et al., 2019) all via the OGD publication. Considering all the diverse aspects that OGD implementation entails, it is imperative to focus on one perspective at a time so that better solutions can be planned. Hence, for the most part, this study highlights barriers and challenges from the perspective of the public sector as the data provider.

Nevertheless, a study by Saxena (2018) managed to investigate OGD implementation from three different regions, Asia (Japan), Europe (Netherlands) and West Asia (Saudi Arabia). Strikingly, Saxena (2018) found that culture plays a vital role in influencing the government to release public data. For example, in Saudi Arabia, the government is more reserve and only publishes data that are readily available and non-sensitive compared to Japan and the Netherlands, which are more open to data sharing. Saxena further probes the OGD barriers from one of the countries in the Africa region, Tanzania, and found that OGD did not gain full support from the stakeholders, resulting in the slow progress of OGD development (Donald Shao & Saxena, 2019). The same lukewarm responses were also recorded from Oman's government, apart from technical barriers in OGD publication (Saxena, 2017). Unlike the countries from the European region, the technical barriers seem to hinder OGD implementation the most compared to organisational barriers. A study by Gerunov (2017) has indicated issues on technical aspects of OGD publication faced by the Bulgarian government, for instance, data integration and inconsistencies. Other research on OGD based on the country's performance is by Kassen (2017). He found that the lack of data-driven projects, data quality, and government culture towards data sharing hinder OGD implementation in Kazakhstan. In Korea, the local governments faced setbacks from lack of demand for data use, the poor-rate in information system usage, and resource limitations (Kim & Eom, 2019). Overall, the OGD implementation in the developed countries seems to face more technical barriers compared to the developing countries due to their advancement in the OGD initiatives. At the same time, the developing countries faced more challenges on the organisational aspects such as the policy, top management support, security and privacy, and the lack of awareness among data providers as these countries are mostly at the infancy stage of OGD implementation. However, some researchers argue that OGD implementation barriers are prolonged issues that happen as it advances to a maturity state. The barriers should be addressed based on their category.

OGD adoption barriers can be divided into many categories. The extant studies on OGD adoption have discussed OGD barriers from many aspects, and these barriers were interrelated. In the recent study, Donald Shao and Saxena (2019) consolidate the OGD barriers into four main categories, i) organisational barriers, ii) technical barriers, iii) legal barriers, and iv) social barriers. The organisational barriers relate to governance, policy, procedure, costs, change management, and all public agency management issues. Includes in the organisational barriers is the risk-averse culture that stems in the government agency for so long. In such a culture, government agencies felt reluctant to release data (Barry & Bannister, 2014; Li & Chen, 2021) as this will minimize the agency's control over the data. The fear that data users might be misunderstood, misused or manipulated data was still rooted in the agency's mindset. In reality, the change management mechanism has not been developed to handle the perception of OGD initiatives by the government agency.

Spanning from the infrastructure of OGD ecosystems to the agency's technical skills in managing OGD and the quality of OGD publication itself, the technical barriers have indicated the importance of the government to have proper infrastructures skilful staff before OGD implementation (Kučera, 2017). To worsen the situation, many OGD adopters ignored the OGD principles that lead to data quality issues such as fragmented datasets, duplication, unstructured metadata, outdated, among others, being released to the public (Luna-Reyes & Najafabadi, 2019). The legal barriers refer to the protection over the rights of the stakeholders (Donald Shao & Saxena, 2019). Many legal concerns are due to the absence of legislation to protect the data owner from any public dispute. There are various national and global open data policies; however, none has a standard agreement on the best practised in case a disagreement between the data owner and data users emerges (Hardy & Maurushat, 2017). To this day, due to its convolution, legal and litigation of the OGD publication and usage is still an open discussion. Lastly, for the social barriers, as stated by Donald Shao and Saxena (2019), the government agency's lack of awareness and participation towards the OGD initiatives hinder more OGD development. In addition, the lack of efforts in promoting OGD use among exacerbate the social aspects of OGD publication.

Much research remains to be done exploring the barriers and challenges of OGD implementation from various countries worldwide. New challenges emerge depending on the situation; for instance, the year 2020 has seen the novel Coronavirus (Covid-19) outbreak tremble countries from every part of the world. The situation has caused the OGD role to become more significant in helping most nations to combat the pandemic through the dissemination of scientific data. However, much of the data is untapped because of access restriction and transparency issues regarding data sharing (Alamo et al., 2020). Despite the advantages of having OGD initiatives, it always comes with a bundle of OGD implementation issues (Ibrahim et al., 2021). Table 2.5 outlines the recent barriers or challenges faced by OGD providers for a better viewpoint.

Table 2.5: OGD Barriers

Category	**Barriers/Challenges**	**Reference(s)**
Organisational	• Imposing license fees for data released.	Crusoe and Melin (2018), Donald Shao and Saxena (2019), Sandoval-Almazan et al. (2021),
	• Unclear OGD implementation policy.	Donald Shao and Saxena (2019), Li and Chen (2021)
	• OGD initiatives do not align with the organisation's objective.	Crusoe and Melin (2018), Li and Chen (2021)
	• Lack of leadership and training in managing the OGD initiatives.	Wang et al. (2019), Li and Chen (2021)
	• Impunity from any rules or laws if not publish OGD.	Sandoval-Almazan et al. (2021)
	• Resistance to data release.	Donald Shao and Saxena (2019), Li and Chen (2021)
	• Perceived OGD as risky and unprofitability.	Li and Chen (2021)
Financial	• Lack of funding to support OGD implementation.	Donald Shao and Saxena (2019), Li and Chen (2021)
	• Lowers the income to some organisations that used open data in their core tasks.	Crusoe and Melin (2018)
Technical	• Lack of technological infrastructure such as internet access to publish and promote OGD.	Crusoe and Melin (2018), Donald Shao and Saxena (2019), Sandoval-Almazan et al. (2021)
	• Lack of skills and competency among organisation's members to support data publication.	Hardy and Maurushat (2017), Kučera (2017), Crusoe and Melin (2018), Donald Shao and Saxena (2019)

Table 2.5: OGD Barriers (Continue)

Category	Barriers/Challenges	Reference(s)
	• Data quality – lack of standardization	Sethi (2016), Donald Shao and Saxena (2019)
	• Data compatibility – difficult to make integration with other application.	Gunawan and Amalia (2016)
Legal	• Conflicting regulatory that hinders data access and publication.	Martin and Begany (2017), Sandoval-Almazan et al. (2021)
	• No legal framework for OGD implementation.	Donald Shao and Saxena (2019)
	• Privacy and security concerns.	Donald Shao and Saxena (2019), Wang et al. (2019),
Social	• Fear that the data release might be misinterpreted by the public.	Donald Shao and Saxena (2019), Sandoval-Almazan et al. (2021)
	• Lack of public innovation and engagement to promote citizen participation.	Wang et al. (2019), Sandoval-Almazan et al. (2021)
	• Lack of data literacy among the public to encourage data use.	Donald Shao and Saxena (2019)

2.2.5 OGD Ecosystem

OGD in its field consists of actors who are mutually interdependent with each other. The ecosystem perspective's basic tenet is that the interoperable entities that comprise the OGD environment form a closed-loop system (M Najafabadi & Luna-Reyes, 2017). To fully reap the benefits of OGD, an ecosystem should replace existing merely supply-driven open data practices (Charalabidis et al., 2018, p. 11). In general, an OGD ecosystem can be defined as a system of mutually interdependent actors between various organisational contexts responsible for data generation, establishing conditions under which data may be exchanged, and eventually using government data to create public benefit (Styrin et al., 2017). It is cyclical, sustainable, demand-driven, and environment-oriented, and it revolves around open data (Charalabidis et al., 2018, p. 11; Heimstädt et al., 2014). Attempts to translate the OGD ecosystem metaphor onto an empirical analogue in government have been few and far between; instead, ecosystems are mostly characterised in fragmentary terms. For example, a study by Wiener (2016) focuses on neuroscience's open data ecosystem. In comparison, a study from Turki et al. (2017) takes the effort to make public procurement more transparent by monitoring the OGD ecosystem. None of these studies was close to describing an OGD ecosystem with all of its interdependency elements. Nonetheless, Dawes et al. (2016) study managed to portray the OGD ecosystem structure that incorporates a dynamic relationship between social and technical elements. Figure 2.2 presents the OGD ecosystem model by Dawes et al. (2016).

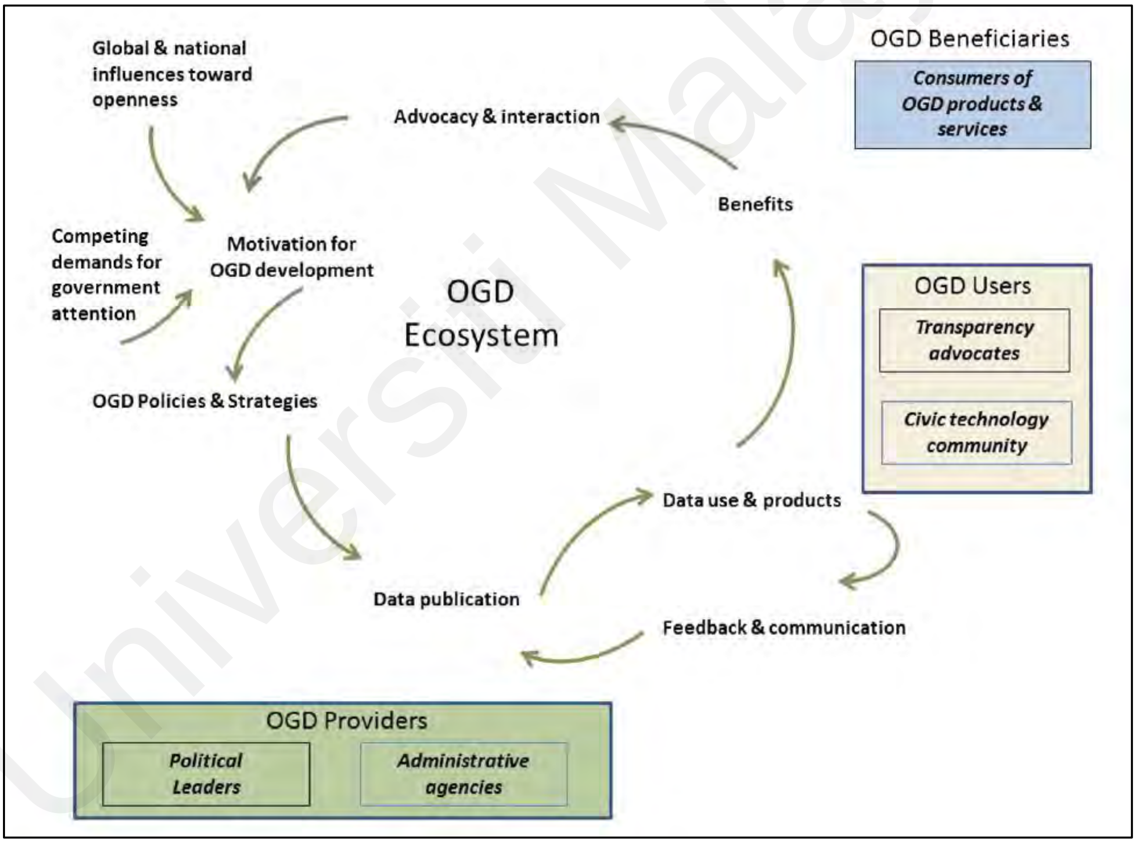

Figure 2.2: The OGD ecosystem model adapted from Dawes et al. (2016).

The OGD ecosystem model introduced by Dawes et al. (2016) consists of three main stakeholders' groups: i. OGD provider, ii. OGD users and iii. OGD beneficiaries. Table 2.6 summarises the roles of each stakeholder.

Table 2.6: Stakeholders' Role Descriptions in OGD Ecosystem (Dawes et al., 2016).

Actor	Role description
i. OGD providers	The heads of government and the organisations, including elected officials, managers and sometimes OGD champions, whose major purpose is to promote and advance the OGD initiatives.
ii. OGD users	Consists of transparency activists, experienced data analysts, and members of the community of civic technology that develop pro-bono and commercial applications with OGD.
iii. OGD beneficiaries	It includes both individuals and organisations in a broader society that embrace, purchase and employ products and services made available by OGD.

Implementation of the OGD is claimed to have achieved maturity when it has become an ecosystem in the government working structure (Ubaldi, 2013). OGD ecosystem is a digital ecosystem that allows a feedback cycle between the OGD providers and OGD users or consumers. The salient elements in the digital ecosystem in the provision of value consist of; i) cyclical, ii) sustainable, iii) demand-driven environment, and iv) interdependent (Harrison et al., 2012; Heimstädt, 2014). The cyclical element refers to the potential of the OGD passing through the chain of use and return to its origin, which is the data provider. The OGD could loop back to its source in any form, such as data products that help the data providers make better decisions and many more.

A sustainable OGD ecosystem is a long-term process with ongoing involvement from the government. Heimstädt (2014) contends that a sustainable OGD ecosystem is very much dependent on the experience of tangible benefits of OGD to the relevant data provider. However, the benefits of OGD would not be visible if the data does not meet the demand and requirements of the data consumers. Thus, the third element in the OGD ecosystem is to have a data-driven environment in which the supply and demand of OGD are met. The demand for unavailable datasets from the public sector in Malaysia's OGD ecosystem is answered via a government data web portal. Once a data request is received, the central agency will escalate to the data provider or related government agencies. The data provider will review each data request before the demanded data can be disclosed to the public. The datasets will be made available on the data portal upon approval by the central agency. The demand and supply flow of OGD is not a relatively new concept, as it has been practised quite sometime between the government agencies, which is generally known as data sharing. Potential data consumers have long demanded raw data from the government, but the process of the bureaucracy limits its usage. Therefore, getting such a data portal generates some consciousness within government agencies about the value of publishing their datasets. Although much of the OGD usage is currently noticeable in news reports or academic research, the use of OGD in the form of IT products is still scarce.

The fourth element in the OGD ecosystem is interdependency. The interdependency element demonstrates the mutual reliance between the actors in the OGD ecosystem. However, the dependency is one-sided due to the lack of tangible benefits of OGD to the data providers and beneficiaries. The data users very much depend on the data providers and not vice-versa. In this case, the data provider does not get any side effects if they decided to stop publishing OGD. On the other hand, the data users may not be able to continue their business or application that uses OGD. Ergo, the OGD implementation should be sustained to support OGD-driven applications.

In the recent 2021-2022 Malaysia Digital Economy Blueprint, the Malaysian government has identified open data initiative as one of the strategic thrusts to drive the digital transformation in the public sector (*MALAYSIA DIGITAL ECONOMY BLUEPRINT*, 2020). As far as action is concerned, every year since 2015, MAMPU has organized a hackathon competition to promote the usage of OGD among societies, private companies, start-ups, universities, schools, or any individual. This effort indirectly helps the government reduce its resources to develop data products that likely generate the economy by producing digital services for the citizens. The data products from the hackathon, though, have limited interest from the public. Some of the data products use static data, in which there is no longer-term continuity to be used. In addition, there is a lack of promotions to the public on what services or products have been created from the OGD. Thus, the intended benefits for the beneficiaries in OGD ecosystems are still far from being realized.

2.2.6 OGD Life Cycle

Various terminology for the description of different models for open data or OGD has been suggested by scholars and is used interchangeably. For example, the open data life cycle, the open data value chain, the open data maturity model, and the open data process are all terms that serve numerous objectives, such as practical advice or analytical knowledge and focus. Some studies use the ecosystem term interchangeably to represent the same goals as the life cycle. Nonetheless, this thesis distinguishes the OGD ecosystem and OGD life cycle by its aims. The OGD life cycle in this section refers to the process of OGD creation until it is consumed.

Moreover, the open data life cycle can be viewed from different perspectives. Most major studies distinguish the open data life cycle from the view of the data provider and the data user. The open data life cycle from the aspect of OGD users describes how OGD is utilized by the users starting from discovering the OGD until it becomes an end product. In contrast, the open data life cycle from the data provider perspective describes primarily the step taken by the data providers to prepare OGD until its publication on the online platform. However, a life cycle paradigm requires the cycle to have a closed-loop system. Thus, the roles of data users are added within the sphere of the OGD life cycle to create the feedback loop for the data provider. The number of stages of the OGD publication life cycle varies. Generally, OGD publication starts with its preparation, including formatting the datasets into a machine-readable format and then the datasets are published or uploaded into the online platform.

The process is called an OGD life cycle. The process is not obligatory in a sequence; some agencies use to skip a few processes due to the insufficient resources and time to perform the task. If the datasets come from a legacy application, there will be a probability in which the datasets have to be converted to a universally machine-readable format. This conversion is because not all computer machines could read the same Relational Database Management Systems (RDBMS) format. Such a process already took hours to perform. This data selection process will be followed by a data harmonization process that involves activities like data cleaning. Some data may suffer from an invalid format, duplication, or missing values, thus produce low-quality datasets. The next process is called data cataloguing. Metadata for the published data is crucial as it provides corresponding links to online resources, and this will allow the datasets to be easily discovered. Given the tedious and daunting process of updating the metadata of the datasets, some agencies chose to skip this data cataloguing process, leaving the publication with a low-quality dataset. Publishing data on the online platform may not be such a complex task if the online platform is already established. It is a matter of uploading the datasets into the data portal. Some agencies went to more advanced steps by providing an Application Programming Interfaces (API) link from their sites that allow the datasets to be streaming.

Data interlinking is one of the emerging trends in OGD, which facilitates opening, linking, and re-using OGD to the highest level of Tim Berners-Lee's Five Star Scheme of Open Data. This phase of the OGD lifecycle involves activities starting from using Uniform Resource Identifiers (URIs) as names for things. Thereafter, one must use HTTP URIs to allow users to search for those names using the standard Resource Description Framework (RDF) data model. The data model includes references to each dataset by defining the relationships between resources. The intense technicality of creating or converting existing datasets to linked OGD itself will demotivate the agency to publish high-quality OGD. Some agencies regarded the converting process as an extra task. Once data is made accessible to the public, it is up to data consumers to find, investigate, and integrate open data into any data innovation.

The studies on the open data life cycle are still lacking. A universally perfect open data life cycle model that can represent OGD from all aspects is impossible (Charalabidis et al., 2018, p. 16). Various open data life cycle models have been suggested with different aims and contexts, such as a model that is best for the linked-data users (Ngomo et al., 2014; Van Veenstra & Van Den Broek, 2015), others focused on scientific data life cycle (Demchenko et al., 2013) and not to mention life cycle that aims at political, economic and social value creation (Attard, 2016). Nevertheless, the model from Attard et al. (2015) represents the best standard procedure for the OGD life cycle model. The model is divided into three sections: pre-processing, operation and maintenance. The pre-processing section is where the government agency prepared and published the datasets. In the operation section, the datasets are made to be more discoverable by the public. While in the maintenance section, the datasets are reviewed and updated to ensure they can be sustained (Attard et al., 2015). Figure 2.3 presents the life cycle of OGD in general practice, adapted from Attard et al. (2015).

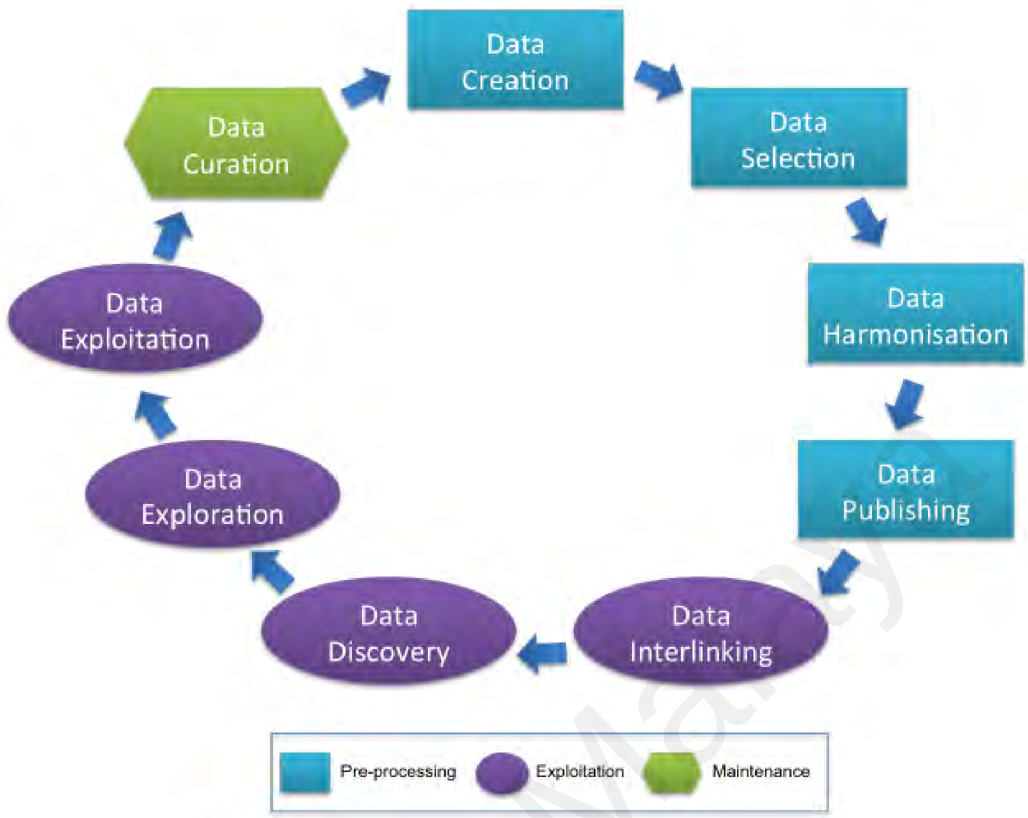

Figure 2.3: The OGD Publication Life Cycle (Attard et al., 2015).

There are nine steps in the OGD life cycle, as advocated by Attard et al. (2015). Each step has a different set of activities to be carried out by the stakeholders. However, Attard et al. (2015) did not specify the stakeholders involved in every step. A study by Van Veenstra and Van Den Broek (2015) managed to incorporate the role of the stakeholders in the open data life cycle. Van Veenstra and Van Den Broek (2015) defined five main stakeholders in their community-driven open data life cycle model: data owner, information manager, legal advisor, community manager, and top management. The data owner is responsible for selecting the datasets that are suitable to be assigned as OGD. This is because the data owner has the most knowledge about the data their organisation's own. The information manager and top management involved in identifying the process and strategy of publishing the datasets. Another task of the information manager together with the legal advisor is to recognize the requirements of the datasets before it can published. This task include applying technical requirements such as applying the licensing type, metadata dan value proposition of applicable. While the community manager is responsible on the interaction with the potential data users including promoting the datasets to be re-used (Van Veenstra & Van Den Broek, 2015). Table 2.7 summarises the steps, descriptions and stakeholders involved in the OGD publication life cycle. The steps' name may be used interchangeably with other names; nonetheless, the description describes the same intention.

Table 2.7: Open Data Lifecycle description adapted from Attard et al. (2015) and Van Veenstra and Van Den Broek (2015)

	Stage	Description	Stakeholders
1.	Data Creation	OGD typically start with raw data. It might come from some legacy application systems that already have a series of data collection or a new discern that is specifically collected to be published as open data.	Data owner, Information manager
2.	Data Selection / Anonymization	The process of selecting the right data to be published. Some may refer to an anonymization process in which some indicators have to be removed or anonymous so that they would not breach any data privacy issues.	Data owner, Information manager
3.	Data Harmonization	The data to be released should be prepared by cleaning the data from the erroneous input. This process may require the publisher to cross-check with the OGD principles.	Data owner, Information manager, Community manager
4.	Data Cataloguing	The activities to store structured description of the actual data which is referred to as metadata.	Information manager
5.	Data Publishing	The action of posting the datasets online in the web portal.	Data owner

Table 2.7: Open Data Lifecycle description adapted from Attard et al. (2015) and Van Veenstra and Van Den Broek (2015)

	Stage	Description	Stakeholders
6.	Data Interlinking	The process of linking the datasets to other datasets. The interlinking process could be done if the datasets are Uniform Resource Identifier (URI) enabled, allowing the interaction to other datasets over a network, typically the World Wide Web.	Data owner, Information manager
7.	Data Discovery	Through the open data portal, data is being exposed and promoted to be discovered by data users.	Community manager
8.	Data Exploration	Most data users will have to explore what data is being offered, whether the metadata is sufficient, in good quality or provided in an open license before they get to use it.	Data users
9.	Data Exploitation/ Use	This activity is controlled by data users who are free to search, identify and download data. The data user is also allowed to exploit the data into any data products such as data visualization, mobile applications, analytics, etc.	Data users
10.	Data Curation	Updating the outdated data, metadata improvement, and data cleaning to ensure that the data can be sustainable.	Top management, Legal advisor, Information manager, community manager, Data owner

2.2.7 OGD Adoption

The OGD is experiencing a steady adoption rate among data providers and data users. Research in OGD adoption from the data users has steadily increased as researchers intend to understand what are the constituents that influence the people to use OGD. In this way, the data provider can improve the data publication and thus continuously induce the supply and demand chain of OGD. Though it takes more than just any individual to become the data user, the person or organisation must have sufficient knowledge to understand the data they downloaded. Furthermore, researchers constantly debating on what a data user refers to? Is it proper to call someone as an OGD user even if they only use the data once? To what extent is OGD usage is sufficient? Would it be just viewing the data or making any products? Even if there is a small group of avid OGD users, these users' feedback may not reflect the actual usage of OGD realistically. Getting the correct response for OGD adoption among data users involves a proper sampling procedure for the data collection approach. The study by Charalabidis et al. (2014) has admitted that their research was using sampling from postgraduate students who may be less experienced OGD users, and response bias may have occurred. It is undeniable that more research is needed to investigate the adoption of OGD by data users. However, this thesis is not based on the adoption of OGD by data users.

Due to the focal point of this study is the OGD adoption among the data providers, a systematic literature review is employed to elicit the niche background of OGD adoption. A series of searches for relevant literature was conducted using a few criteria through main databases on the Information System body of knowledge. The databases include the IEEE Xplore Digital Library, Digital ACM Library, Science Direct and Web of Science databases. To get the correct papers, the search terms used were "open data", "open government data", "adoption", "diffusion", "acceptance", "implementation", "post-adoption", "infusion", "factors", and "routinization". Table 2.8 described the inclusions and exclusions searching criteria for literature considered the key articles on OGD adoption among data providers. The studies featured are the most recent in terms of the OGD adoption trend and the use of the Information System (IS) theory. Given the nature of this study, which is grounded from the IS theory of innovation adoption, OGD implementation assessment or evaluation study using specific applications or tools is excluded.

Table 2.8: Inclusion and Exclusion Criteria for OGD Adoption Literature

Inclusions	Exclusions
1. Articles published in the English language.	1. Papers published in other than the English language.
2. Articles that focused on OGD or OD adoption among data provider in an organisation.	2. Concentrating on adoption among OGD or OD users.
3. Articles published in a peer-reviewed journal with at least Scopus if not ISI indexing.	3. Articles that evaluate OGD maturity or assessment using applications or pre-program tools.

Although OGD initiatives have been in practice since 2009, studies on OGD adoption emerged in 2012. At the early stage, the developed countries were spearheaded of the OGD initiatives and thus have moved beyond initiation in various aspects of OGD, such as governance, policy, and infrastructure. Prior to OGD, most developed countries had an established data infrastructure. Their governments are more open to sharing information with the public, resulting in a natural pathway for OGD implementation. Another factor facilitating OGD adoption is that some countries already committed to Freedom of Information (FOI) or Right to Information (RTI) law from the government.

Several OGD studies which use the term 'adoption' predict the intention and behaviour of the data users towards using OGD (Saxena & Janssen, 2017; Susha, Grönlund, et al., 2015; Zuiderwijk, Janssen, et al., 2015), and it is indicated if the adopting unit is individual. In contrast, the study that chooses an organisation as the adopting unit takes an effort to find determinant factors that influenced the organisation to publish the data (Yang & Wu, 2016a; Zhenbin et al., 2020). Although knowing the factors of individual intention to use innovation is essential, in the case of OGD, it is not as simple as asking the random public at large. It is unlikely the public will understand and appreciate the value of OGD, even knowing they can access the data. The situation is that not all people can read or transform information in raw data format, especially non-IT literate people.

Table 2.9 is tabulated after reviewing key articles on OGD adoption research. The table shows the comparison of the theory adopted and the adoption phase for the targeted adopting unit. In these studies, each dimension, and appropriate variables, including technology, organisation, and the environment, were empirically evaluated based on the organisation's circumstances and diverse needs.

Table 2.9: Key Research on Open Data or Open Government Data Adoption Studies.

Author(s)	Adoption phase	Adopting Unit	Theory/Theories	Perspective	Challenges/ Barriers/ Limitations	Research Methodology
Zhenbin et al. (2020)	Adoption decisions	Public agency	Resource dependence theory (RDT)	Data provider	The sensitivity of agencies to data sharing.	Quantitative
Çaldağ et al. (2019)	Adoption decisions	Government	Technology Organisation Environment (TOE)	Data provider	No empirical findings.	Not stated
Leonardo Ferreira de and Carlos Denner dos (2019)	Post-adoption	Government agency	Diffusion of Innovation (DOI), Stakeholder Theory	Data provider	Not stated the factors that influenced the stakeholders to perceived OGD consequences.	Not stated
Haini et al. (2019)	Adoption decisions	Local government	Diffusion of Innovation (DOI), Institutional Theory, Technology Organisation Environment (TOE)	Data provider	No empirical findings.	Not stated
Fitriani et al. (2019)	Post-adoption	Public	TAM, TPB, and DeLone & McLean IS Success Model	Data user	The model only describes 43.8% variance explained on behavioural continuance intention	Quantitative
Altayar (2018)	Adoption decisions	Government institution	Institutional theory	Data provider	The study was conducted in closed government cultures, which limits the actual findings.	Quantitative

Table 2.9: Key Research on Open Data or Open Government Data Adoption Studies (Continue)

Author(s)	Adoption phase	Adopting Unit	Theory/Theories	Perspective	Challenges/ Barriers/ Limitations	Research Methodology
Yang and Wu (2016b)	Intention & behaviour towards open data publication	Government agency	Technology Acceptance Model (TAM) & Institutional Theory	Data provider	Agencies' concern about data misuse.	Quantitative
Hossain and Chan (2016)	Adoption decisions	Government agency	Diffusion of Innovation (DOI)	Data provider	No empirical findings and resource constraints.	Not stated
Wang and Lo (2016)	Adoption decisions	Government agency	Technology Organisation Environment (TOE)	Data provider	Minimal factors were explored specifically in the organisational context.	Quantitative
Shkabatur and Peled (2016)	Post-adoption	Government	Diffusion of Innovations Theory	Data provider	Poor monitoring of the OGD policy implementation and short-term expectation from the supporting institution.	Not stated
Maccani et al. (2015)	Pre-adoption, Adoption decisions, Post-adoption	Business company	Diffusion of Innovations Theory	Data provider	Utilizing only one case study (one company) for generalization and no empirical findings.	Qualitative
Susha, Grönlund, et al. (2015)	Adoption decisions	Business company	Unified Theory of Acceptance and Use of Technology (UTAUT)	Data user	The sample size does not allow for generalisation.	Quantitative

The adoption of open data has been explored in various ways, for instance, from the data users context (Saxena & Janssen, 2017; Zuiderwijk, Janssen, et al., 2015), citizen's perception towards a data portal (Fitriani et al., 2019), a private business using OGD for innovation creation (Susha, Grönlund, et al., 2015) or even from both the data user's and data provider's viewpoint (Albano & Reinhard, 2014). It is undeniable that study on OGD adoption from the data providers view has been steadily growing, yet the majority of the study only focused on the adoption decision phase. The study on the phase after the OGD adoption decisions, which is the post-adoption phase, is most scarce.

Centred on the innovation adoption process, the studies from Table 2.9 mostly concentrated on the adoption decision phase of OGD in the organisation. The initiation phase was not presented except from Maccani et al. (2015), partly because these studies were conducted in a developed nation with high IT-literate citizens; therefore, the need to create OGD initiation and awareness among government agencies was not really essential. Only three studies highlighting the post-adoption phase of OGD (Leonardo Ferreira de & Carlos Denner dos, 2019; Maccani et al., 2015; Shkabatur & Peled, 2016) though the term these studies referring to is not specifically mentioned the post-adoption, but the objective of the studies was to investigate the OGD implementation beyond adoption.

Although the organisation's body seems to have the same characteristics, the factors that influence OGD adoption may respond differently. There are several studies of OGD adoption and implementation in the organisation; however, only a few apply an IS theory in their research. The study by Wang and Lo (2016) and Yang and Wu (2016b) investigated OGD adoption among government agencies in Taiwan, while the study by Hossain and Chan (2016) examined the OGD adoption among Australian government agencies. Each of these studies used different IS theories to determine factors that influence government agency to OGD publication. Although a study by Estermann (2014) mentioned about using DOI theory in their paper, determinant factors to influence the OGD adoption among agency was not clearly stated. Nevertheless, these studies on OGD adoption in an organisation have agreed that organisational context is the most significant factor in influencing government agency to adopt OGD. Under organisation readiness, Wang and Lo (2016) specify organisation infrastructure and top management are highly influential constructs related to OGD adoption. On the contrary, Yang and Wu (2016b) separate organisational contexts in their study into two constructs, namely, organisation culture and organisation capability. Despite that, the use of organisation capability as a construct could be argued because capability could be presented in many forms, such as infrastructure, governance, resources, finances, etc. Hossain and Chan (2016) highlighted that organisational readiness is a more accurate theme as a construct, consistent with Iacovou (1995) research.

Another significant factor found to have a positive influence on OGD adoption in an organisation is coercive pressure, as mentioned in the institutional theory by DiMaggio and Powell (2000). Coercive pressure refers to the formal and informal pressure imposed by an external organisation in which they rely upon each other (DiMaggio & Powell, 2000). Although there are some thoughts that open data were just an enthusiastic action by the government, agencies tend to absorb the pressure and are willing to participate in the open data initiatives. The government agency is forced to respond to their environment; thus, internal and external pressure plays a significant role in influencing OGD adoption (Wang & Lo, 2016). The study by Yang and Wu (2016b) associate the external pressure from three different sources: higher-level management, peer government agency, and society. The external pressure effort is further intensified by existing precondition rules that were made by some international bodies to release certain information on products before they can enter trade markets (Hossain & Chan, 2016). Such information on products will increase product transparency and gain more trust amongst the consumers. In internal pressure, government agencies are driven to compete with each other on which agency would release more data (Hossain & Chan, 2016). The aggressive rivalry between government agencies has thus shown that open data works as a competitive gimmick for the benefit of the citizens indirectly (Sigit Sayogo, Zhang, et al., 2014).

As the number of open datasets being released at a different level from local, national, or regional level is growing, open data will have to deal with the technical characteristics, for instance, interoperability. One of the respondents in Hossain and Chan (2016) study stated that interoperability insufficiency was a genuine boundary to open data adoption. This statement is supported by Barry and Bannister (2014), where the researcher suggested improving interoperability by creating a facility to process the public sector's information. Clearly, the OGD potential needs to be reinforced and activated by immense dedication from government agencies, corporate leaders, civil society, academia, and the community. Each implementation problem related to innovation must be dealt with in great detail in order to sustain OGD innovation in the organisation. The protracted and unresolved question of implementation could lead to an unfavourable situation for OGD innovation, such as the decommissioning of innovation. In this context, this study seeks to explore the OGD implementing issues in the public sector from the perspective of the policymakers of the OGD governance structure.

2.3 The Malaysian Public Sector

The public sector, in general, is defined as the sector of the economy that the government controls or finances (Kasemsap, 2018). An organisation theory approach to the public sector assumes that understanding public policy and decision-making requires understanding how political-administrative systems are organised and operate (Christensen et al., 2020). The public sector can be classified into two categories: i) departmental bodies, i.e., government departments, and ii) non-departmental bodies, i.e., public corporations or public enterprises.

Under the administration of a Constitutional King, Malaysia implements a system of Parliamentary Democracy with His Majesty the King as the Head of the Country. The implementation of this constitutional monarchy system has been enacted by the Federal Constitution through legislative conditions. The primary principles of the Parliamentary Democracy system are the separation of power which is divided into three branches, namely the Legislature Body, the Judiciary Body, and the Executive Body (Harding, 1996). The Legislature body consists of the parliament as the highest legislative body, which represents by the Senate and House of Representatives. The Judiciary body is led by the Chief Justice of the Federal Court as the highest court of Malaysia. While the Executive body is led by the Prime Minister and the cabinets. Under the administration of the Prime Minister, the Chief Secretary to the Government headed the public services to carry out various services to the nation (Mokhtar, 2011).

The public sector service is the main institution or executive power in implementing policies and decisions from the government of the day. Malaysia's early history of modern administration dates back to the year 1786. The legacy was formed by the British Public Service when the British East India Company was established in Penang (Aun, 1975). To date, the Malaysian public sector administration continues to evolve to adapt to with current situation. Figure 2.4 illustrates the Malaysian Public Service within the federal government governance structure.

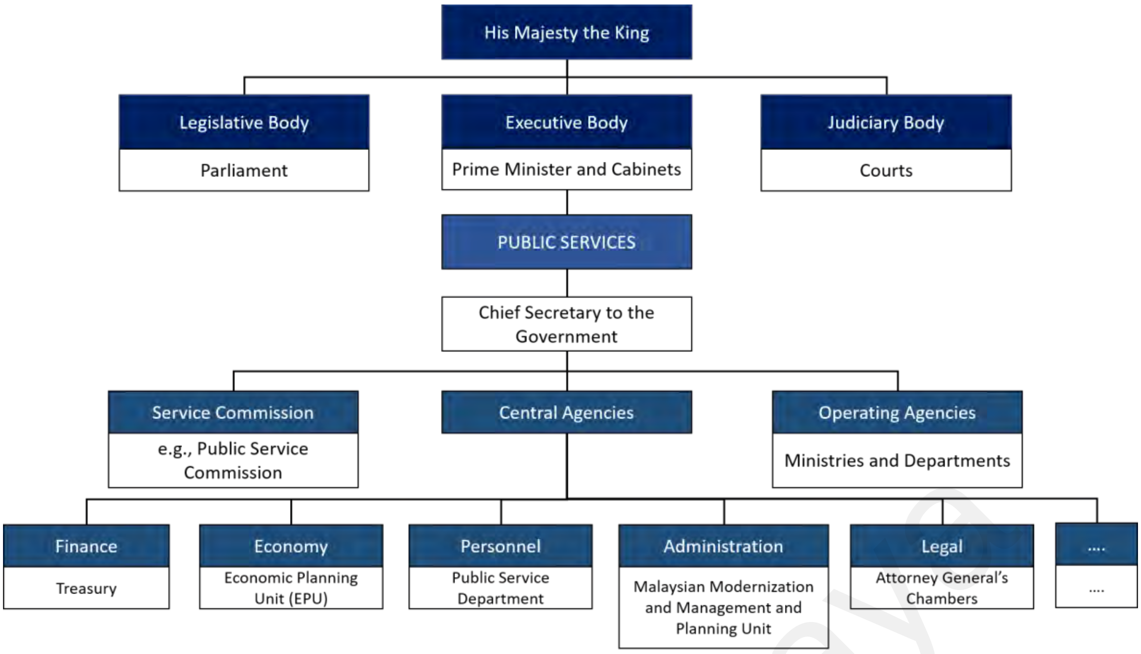

Figure 2.4: The Malaysian Public Service Within the Federal Government Governance Structure.

Public sector power management relies on the centralisation of power principle in the federal constitution. The public sector is empowered by the civil servants who work for the King, the government, and the society at large. The Civil Service in Malaysia consists of 1.6 million employees (as of August 2020) in total. The Civil Service is headed by the Chief Secretary to the Government and is directly accountable to the Prime Minister. There are three categories of posts in Malaysia's public sector in general, namely Top Management, Management & Professional, and Support. The Support Group is the largest group with 75 per cent, followed by the Management & Professional group (21%) and Top Management (4%). The public sector is also divided into 20 Classification of Services wherein these 20 classifications of services consist of 274 (as of January 2010) service groups. Examples of Science (C) services consist of Minerals, Earth Chemistry, Environment, Science, Geology, Weather, Film Laboratory and Nutrition, and other service classifications where it consists of various service groups.

The operations of public sector organisations are planned according to the desires of the ruling government and the citizens' needs. The admission to the civil service is managed by the Public Service Commission of Malaysia. In terms of public sector resources management, there is not much difference to any other types of organisations. Staff turnover in the government agency is normal due to multiple reasons such as retirement, promotion, and relocation to another agency. The development of a public organisation depends on the provisions in the budget set by the ruling government. The decision-makers carefully decide to embark on new development, investment, collaboration, and spending in high-level meetings. Such a process is due to any activities and actions carried out by the public sector organisations that can easily be noticeable by the news media, which acts as a watchdog to the citizens.

2.3.1 ICT Landscape in the Malaysian Public Sector

In the last two decades, ICT development in the Malaysian public sector has seen a tremendous transformation. The launch of the Multimedia Super Corridor (MSC) flagship in 1996 has become the most significant catalyst in shaping the growth of ICT-based services. Stretching over 750 km^2 from north of Kuala Lumpur City Center to the Sepang area, the MSC is a special corridor that offers the world's renowned ICT companies to position their regional office within a stimulating technological environment. At the same time, the companies were offered comprehensive packages to expand their research and development in the country (Kaliannan et al., 2009).

Through the MSC initiatives, the role of ICT in the economy has been uplifted and turning Malaysia into ICT-cultured and knowledge-based society (Awang, 2004). The MSC also lay the foundation of the emergence of many e-Government initiatives today. Electronic government (e-Government) is the government's efforts to improve the efficiency and effectiveness of the public service delivery system by converting conventional delivery methods to a more systematic delivery method with the use of information and communication technology (Carter & Belanger, 2004). As one of the

MSC flagship initiatives, the e-Government vision is made possible with the ongoing collaboration between the public and private sectors. Within these joint efforts, private companies are encouraged to exchange knowledge and experiences with the government while at the same time gaining the benefits of MSC status company (Kaliannan et al., 2009). The government continues to work with the private sector to re-engineer service delivery using ICT up to this date.

The government's commitment to spearheading the surge into the information-rich digital era continues by formulating the ICT strategic plan every five years. In 2015, the government launched the Eleventh Malaysian Plan (11MP) as the final strategy in achieving Vision 2020 in which at that time it aimed to be the foundation for the future development of the country. To realize the vision, a central agency called the Malaysian Modernization and Management Planning Unit (MAMPU) under the Prime Minister Department has been given the mandate to spearhead most of the ICT transformation programme in the Malaysian public sector. In 2016, to support the government aspirations of the Eleventh Malaysia Plan (11MP), MAMPU has launched the Public Sector ICT Strategic Planning 2016-2020. The ICT strategic planning was developed by taking into account the changing scenarios and current environment of Public Sector ICT, global ICT best practices, global economic challenges, and national aspirations by 2020. One of the thrusts in the ICT Strategic Planning 2016-2020 was to have a data-driven government concept (Public Sector ICT Strategic Planning 2016-2020, 2016). The objective of the data-driven concept was to optimize the data usage and leverage the values of government data. With the data-driven concept, government data is perceived to be managed more efficiently, holistically and strengthens data sharing policy across government agencies. This consists of an effort to expand the Open Government Data initiatives by identifying, classifying, and publishing open datasets at the agency level based on demand and identification of open data requirements from the agency's clients.

Thereafter, the government launched another plan called the Digital Government Transformation Action Plan 2017-2018. The Digital Government Transformation Action Plan is an action plan that outlines the Public Sector ICT implementation program in line with the United Nations E-Government (UNEG) Survey report. This plan was developed in 2017 to increase Malaysia's ranking in the United Nations E-Government Index (UN-EGDI). UN-EGDI is a composite index for three sub-indices, namely the Online Service Index (OSI), Telecommunication Infrastructure Index (TII) and Human Capital Index (HCI) measured through the UNEG Survey. The UNEG Survey is a systematic assessment of ICT use in 193 countries to transform the public sector by enhancing effectiveness, efficiency, transparency, accountability, access to public services, and citizen engagement. The UNEG Survey is highly significant as the government has set the target to achieve a better position in the Online Service Index (OSI). The 11th Malaysia Plan (11MP) has set the target of achieving Malaysia's position for the Online Service Index (OSI) is ranked 30th in 2018 and 15th in 2020. The UNEG Survey report is issued every two years. The objective of the Digital Government Transformation Action Plan 2017-2018 was to support the government's goal in the 11th Malaysia Plan (11MP), which is people-centred growth. Another objective of the Digital Transformation Action Plan 2017-2018 was to align the agency's ICT implementation program with the public sector ICT agenda and the direction at the international level. A total of 25 programs and 83 activities were drafted in the Digital Transformation Action Plan 2017-2018, according to the short, medium, long, and continuous periods. This action plan was also formulated according to the evaluation theme area based on the analysis on the UNEG Survey Report 2016, namely: i. Whole of Government; ii. Open Government Data; iii. E-Participation; iv. Multi-Channel Service Delivery and Expanding Usage; and v. Bridging the Digital Divided & Emphasis on Vulnerable Groups.

By the time the UNEG Survey 2018 was released, the achievement of OSI Malaysia in 2018 was ranked at the 27th level (United Nations E-Government Survey, 2018), slightly greater than what was targeted in 2017. However, the targeted rank for the year 2020 is not accomplished as the recent UNEG Survey 2020 has been reported that OSI Malaysia is at the 25th (United Nations E-Government Survey, 2020). Albeit the targeted rank is not achieved, nonetheless, the rank increases by two levels. Recent development has seen assorted government efforts to accelerate the progress on OSI achievements; this includes launching the latest plan called the Online Services Index (OSI) Action Plan 2019-2020. The objective of the OSI Action Plan is to facilitate the recognition of ICT measures that need to be adopted by public sector organisations. In line with the demands of industries and marginal communities, the quality of the government service delivery must meet the expectation whilst at the same time taking into account Industry Revolution 4.0. The focus of the OSI Action Plan remains the same as the previous Digital Transformation Action Plan 2017-2018, and some are new focuses areas such as the Cyber Security and Disaster Response & Recovery; and Fast-Evolving Technologies. Altogether, there are five focuses of the OSI Action Plan 2019-2020, including three remaining themes, which are the Whole of Government, Open Government Data, and Online Service Index.

All the national action plans, ICT strategic plans, and global reports have demonstrated that the OGD is an important initiative in ICT to be focused on at the global and national levels for a long time. The Open Government Data (OGD) is not merely about information technology, more than that; the OGD reflects the readiness of a government to be transparent and accountable for every action, particularly involving the public interest.

Table 2.10: Selected directives related to Open Government Data initiatives in Malaysia Public Sector (Source: MAMPU, 2020)

Year	Directives
2015-2020	11th Malaysia Plan
2016-2020	Public Sector ICT Strategic Planning
2017-2018	Digital Transformation Action Plan
2019-2020	Online Services Index (OSI) Action Plan
2021-2022	Malaysia Digital Economy Blueprint
2021-2025	Public Sector Digitalization Strategic Planning

2.4 OGD Implementation in Malaysia

The open data initiative started to be practised by the Malaysian government in 2014. A central agency called the Malaysia Administration Modernization and Management Planning Unit (MAMPU) is given the federal government's authoritative high-level management mandate to spearhead the OGD implementation in the country. MAMPU is responsible for overseeing the country's policies and strategize the OGD implementation nationally and globally. Subsequently, this mandate provides a clear path for the central agency to deploy OGD initiatives at the government agency from all levels. Among the task of MAMPU in OGD implementation is hosting the official government data web portal that can be accessed at www.data.gov.my. At the early phase of OGD adoption, only several datasets were published in the government data web portal. To add to the setback, some of the datasets were not in a machine-readable format and hardly can be re-use using computer applications. However, through various involvement efforts with data ownership agencies each year, the number of datasets increases gradually.

Regarding data use, each year, MAMPU organized a hackathon competition to promote the use of data by different groups of data users, such as academia, schools, corporate businesses, civil society organisations, digital start-up entrepreneurs, among others. The hackathon competition's encouraging responses have shown that the target group has gradually realized the value of OGD. To date, more than 200 data providers from 18 different clusters have published their datasets in the government open data web portal, and this number is growing steadily. In line with the Eleventh Malaysia Plan (11MP) 2016-2020, OGD is anticipated to improve the government powered by data by magnifying the value of data and intensify inter-agency data exchange in the public sector.

In the recently published report of Strategic Planning of Public Sector Digitalization 2021-2025, the government aspire to embrace OGD as an 'Open by Default' concept. In this concept, every data that comply with OGD principles can be published openly if not comprising the data's security and privacy. Besides the national programme, the government is aiming to achieve a better rating in the UN E-Government Survey (UNEG). As Malaysia embarks into new information and communication technology (ICT) frontiers, leaping up in the global benchmark will exhibit the government commitment to provide data transparency and accountability. Since OGD received tremendous support from countries worldwide, numerous evaluation bodies appear with various criteria to measure country rankings in OGD implementation.

In this respect, the Malaysian government is currently concentrating the efforts to the E-Government Development Index (EGDI) by The Division for Public Institutions and Digital Government (DPIDG) under the United Nations. There EGDI comprises of three main dimensions: 1) Online Service Index (OSI) 2) Human Capacity Index (HCI) and 3) Telecommunication Infrastructure Index (TII) (United Nations E-Government Survey, 2018). Open government data initiatives are part of the OSI through which it contributes to one of the online services it offers to its citizens. In the recent UNEG Survey 2020, Malaysia ranks 25th out of 193 United Nations Member States in OSI (United Nations E-Government Survey, 2020).

In 2017, the Malaysian government decided to collaborate with the World Bank Group Global Knowledge and Research Hub to perform an evaluation called Open Data Readiness Assessment (ODRA). The government delineates that the objective of ODRA is to aid the government authority to improve the ongoing OGD implementation in Malaysia by identifying the gaps and suggest for mitigations (World Bank Group, 2017). Realizing the significance of OGD among developed countries, the government perceived that the ODRA was necessary to benchmark the OGD implementation against global best practices. The ODRA methodology is based on eight dimensions that have been identified as vital elements in order to implement open data or OGD program successfully. The eight ODRA's dimensions are:

i) Senior Leadership,
ii) Policy and Legal Framework,
iii) Institutional Structures,
iv) Government Data Management Policies and Procedures,
v) Demand for Open Data
vi) Civic Engagement and Capabilities,
vii) Funding and Open Data Program, and
viii) National Technology and Skill Infrastructure.

The results of the ODRA have found that Malaysia's has put a fair effort on most of the dimensions; however, there is room for improvement for certain dimensions (World Bank Group, 2017). For instance, the dimensions from the policy/legal framework shown paucity evidence of practice. A single regulatory structure that defines when data can be released or not, such as the Access to Information (ATI) rule was not present. Without the ATI rule, the public face structural barriers of getting the government-held data or information which concern the public interest. Whereas at the same time, the government agency has no obligation to meet the data demand from the public. Similarly, request from other government agencies is entertained based on case-by-case depending on the security and privacy of the data as well as the fee structures (World Bank Group, 2017). Due to the absence of such rule, government agencies made their own decisions on releasing data to the public. This also implies that the decisions relating to the publication of information and confidentiality or (personal) data security components are largely delegated to the government agencies themselves (World Bank Group, 2017). As a consequence, many non-uniform rules emerge from the practice of various agencies. Realizing the absence of standard regulations on data release is essential, the ODRA report suggests strong support from high-level leadership to urge the government agencies to work in hands to standardize the policy or legal framework.

Moreover, the ODRA also reported that the government data management policies and procedures are the second dimensions that need further attention (World Bank Group, 2017). Although MAMPU has issued the guideline for data management practices, individual government agency possesses firm control over their own internal systems. The government agencies' reluctance to follow standard guidelines by MAMPU, resulting in no comprehensive data inventories, exists in most agencies. The data inventories are useful in making other agencies aware of what data is available and can be released publicly. The inefficiency of data management practices in government agencies is also emanated from requesting and receiving the data. Due to the uncertainty of legal constraints, the data request procedure sometimes took longer as the case-by-case approval needs to come from the higher-level management. To add to the disappointment, the requester agency claimed that often the data received was not in a complete form, some value was missing, incompatible file format, data not aggregated and not granular enough (World Bank Group, 2017).

The value of OGD lies in its use (Janssen et al., 2012). Publication of data is merely inadequate; indeed, it is just part of the broader government data-driven ecosystem. Drawing the demand for data is thus important to keep the government agency's momentum to publish data. Frequent demand of data also helps to ensure that a larger open data environment evolves and that OGD is transformed into an economically or socially beneficial to the citizen. The ODRA report has indicated that there are strong demands for OGD from the various party. The most data request comes from academia and the business community as opposed to other notable users such as the media (World Bank Group, 2017). Only a handful of Civil Society Organisation (CSO) was found interested in requesting data from the government, whilst others seem to lack awareness of OGD or did not possess ICT skills to articulate the OGD (World Bank Group, 2017). Rationally, most requestors have certain purposes of using government data that urge them to make the data demand. Nevertheless, data demand does play an important role in the OGD ecosystem and act as a pull factor of more data publication from government agencies (Fan & Zhao, 2017).

2.4.1 OGD Governance Structure

The OGD governance structure was formed together with the directive of OGD implementation in government General Circular 2015, No. 1. The governance structure involves all stakeholders in the decision-making process from the top level of the federal government to the agency at the bottom. Figure 2.5 depicts the OGD governance of Malaysia's OGD governance structure.

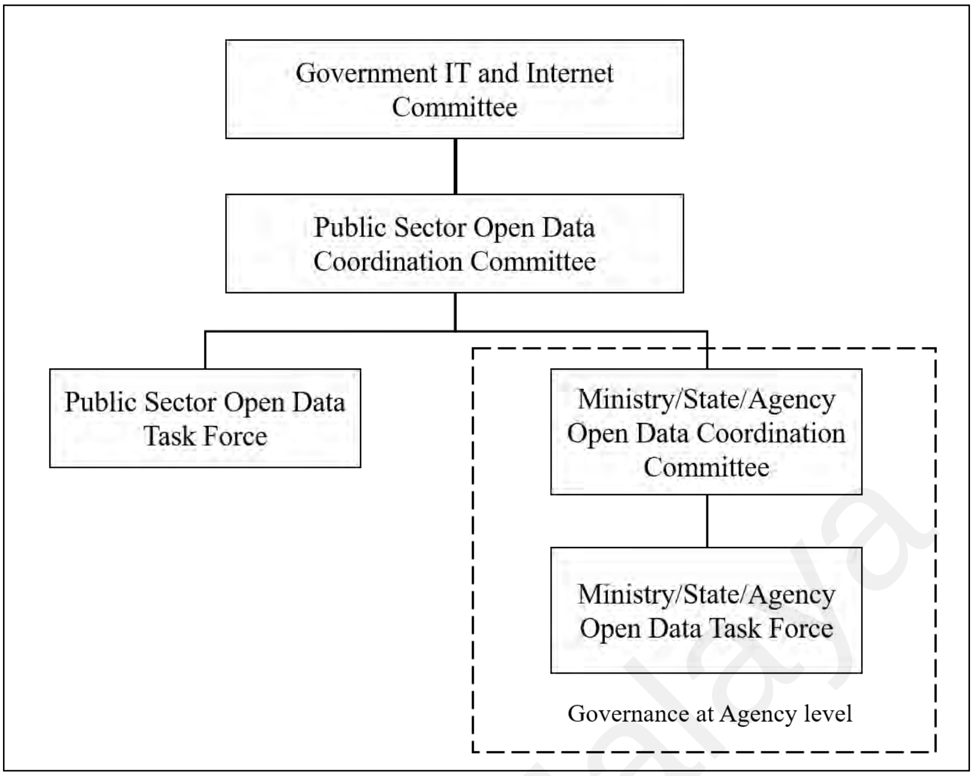

Figure 2.5: OGD Governance Structure in the Malaysian Public Sector (General Circular 2015 No. 1)

2.4.1.1 Government Information Technology and Internet Committee

The highest structure of OGD governance structure was headed by the Government Information Technology and Internet Committee (GITIC) chaired by the Chief Secretary. The members of the committee were head of the central agency namely the Malaysian Digital Economy Corporation (MDEC), Malaysian Communication and Multimedia Commission (MCMC), Public Service Department, and Malaysia Administrative Modernization and Management Planning Unit (MAMPU). This committee plays the most important role in making decisions on OGD implementation in the country, including budget allocation and human resources.

2.4.1.2 Public Sector Open Data Coordination Committee

The Public Sector Open Data Coordination Committee is chaired by the Director-General of MAMPU. The responsibilities of this committee, including to drive the direction, monitor the implementation progress and strategize the OGD initiatives in the country. Aside from that, the committee also acts as an advisor on relevant policies and current issues of OGD to the GITIC.

2.4.1.3 Public Sector Open Data Task Force

The public sector open data task force members are represented by a dedicated unit under MAMPU called the Digital Government Divisions. This task force is the main committee that implements most of the OGD implementation works, whether reporting the progress to the top management and engaging the agency at the bottom level. Another task of this task force is to ensure a safe publication platform for the OGD publication.

2.4.1.4 Agency Level

The Chief Information Officer (CIO) of the agency plays an important role in the implementation of OGD in their agency. While at the state level, it is the responsibility of the State Secretary to lead the OGD initiatives within the government of their state, as well as the local authorities or municipalities in the state. In addition to being an advisor and leading its OGD implementation, the CIO should ensure that their agency's key indicator of OGD performance can be achieved. Other than that, the CIO's task entails identifying the datasets that can be published on the data portal and obtaining the proper permission from the head of the department or unit before the datasets are published.

2.4.2 OGD Implementation Progress

Both academics and practitioners have recently introduced a number of methods to evaluate the OGD implementation progress. Measuring the OGD progress is essential as it will provide reliable visibility of a specific country's capability in the digital evolution (Susha, Zuiderwijk, et al., 2015). However, there is yet to exist a single universal measurement approach recommended to evaluate the OGD implementation progress. Most of the country that has implemented OGD initiatives relies on what is being practised by the majority instead of what is the best practices. A study by Tang and Jiang (2020) has found a variety of practices in terms of data formats and data clustering or category (e.g., health, education, transportation, environment) among the top ten leading countries in OGD implementation. Tang and Jiang (2020) added that it is quite challenging for researchers to compare and analyse data globally within the same cluster as the data clustering is inconsistent from one country to another. It seems that a global effort must be made across countries to articulate standards from many angles.

While the effort to increase the number of published datasets is essential, the data quality is not overlooked. The Eight Open Government Principles are currently used to determine the degree of reusability of datasets. At the early stage of the OGD implementation, the datasets published were in various data formats. To date, though, the datasets on the government data portal are 100% machine-readable, as opposed to just 30% machine-readable back in 2014. In addition, some of the datasets achieved five stars of the openness benchmark. At the beginning of 2018, a range of agreements was made by the central agency heading the OGD project with the data-owning agency of the state government and statutory bodies. The endeavour manages to boost OGD consciousness across these organisations and has consequently expanded the number of datasets released in the data portal. Besides that, the government is also planning to publish real-time data or more Application Programming Interface (API) in the data portal to achieve higher quality datasets and promote better usability.

Figure 2.6 exhibits the number of datasets by data openness score retrieved for all datasets in the government data portal (data.gov.my). As suggested by Tim Berners-Lee's Five Star Scheme (Hausenblas; & Kim, 2018), there are five levels of data openness. Zero (0) stars indicate that the resource URL of the dataset is broken or errors are generated.

The one-star openness implies that the datasets only appear in a format that is not machine-processable, such as word processing (.doc), Hypertext Markup Language (HTML) or Compact Database Format (PDF). Over 70% of datasets achieve two-star since most datasets are available in a proprietary spreadsheet format. Three-star openness is achieved when the datasets are ready in a non-proprietary format, such as the typical Comma Separated Value (CSV). The data is set to provide a Uniform Resource Identifier (URI) at four-star openness, which reflects a special definition of things to enable anyone to identify the data. The data is said to score five-star openness if the datasets are ready for API integration along with a high-intensity machine-processable format such as the Resource Description Framework (RDF), Keyhole Markup Language (KML), JavaScript Object Notation (JSON), or Operational Data Store (ODS).

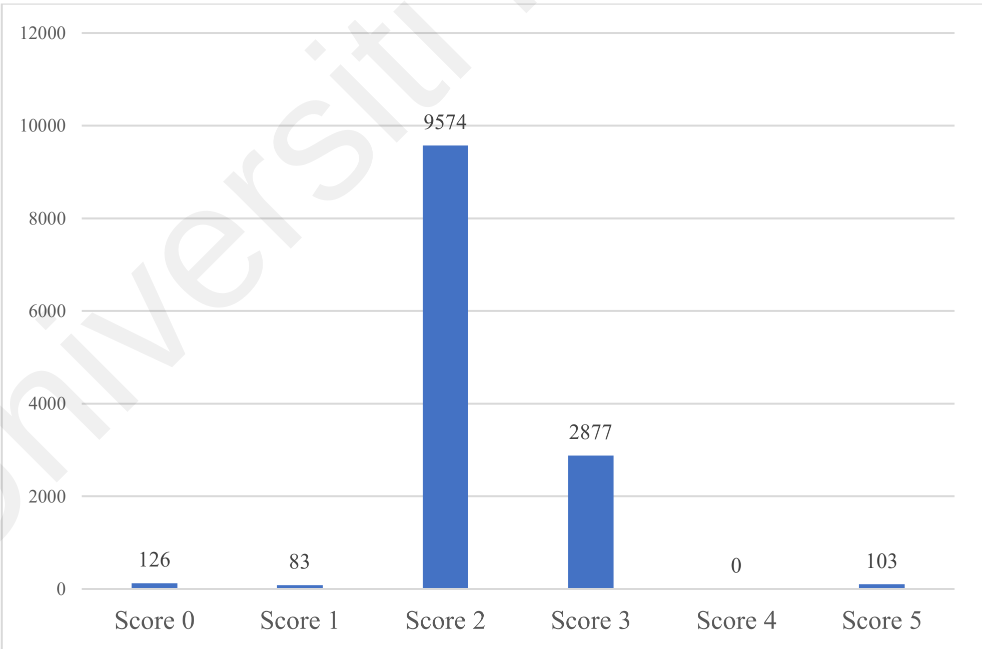

Figure 2.6: Number of Datasets by Data Openness (Source: data.gov.my, *retrieved on 31st December 2020*)

The categorization of these datasets by the star, however, is not thoroughly in accordance with the Five Star Scheme of Tim Berners-Lee, although the portal asserted to apply the scheme. For instance, the datasets which claimed to score five-star do not provide a link to other related data use by the semantic web. This contradicts the interpretation of the five-stars openness by Tim Berners-Lee (Hausenblas; & Kim, 2018). A greater understanding of the data set deployment scheme between the data publishing agency is obviously in need. Providing the wrong data openness classification will give a bad impression of the capability of the datasets and the data publishers.

2.4.3 Issues of OGD Implementation in the Malaysian Public Sector

According to the Open Data Readiness Assessment (ODRA) report, the OGD implementation in Malaysia is generally well-placed. However, there are some issues and challenges inherently from time to time and may hinder the future OGD progress if not addressed at an earlier stage. Through semi-structured interviews, OGD implementation issues in the Malaysian public sector were consolidated. The first glimpse of the issues was extracted from various documents related to OGD implementation in the Malaysian public sector. Some of the documents are the 2016-2020 Eleventh Malaysia Plan (*ELEVENTH MALAYSIA PLAN 2016-2020*, 2015), 2017 Malaysia Open Data Readiness Assessment report (World Bank Group, 2017), 2018 Organisation for Economic Co-operation and Development (OECD) Government Survey report (OECD, 2018) and General Circular No. 1/2015: Implementation of the Public Sector Open Data Initiative (*General Circular No. 1 of 2015: Implementation Of The Public Sector Open Data Initiative*, 2015).

To further investigate OGD implementation issues in the Malaysian public sector, a series of semi-structured interviews were performed with four field experts from the central agency. The semi-structured interview sessions lasted about an hour for each interviewee and were voice-recorded. The interviews were carried out in dual languages, English and Malay, but the final transcripts were translated into English for reporting purposes. These top-level reviewers were selected based on their position in the national OGD implementation governance structure. The highest position of the top-level reviewer for the interview was the Chairperson of the Public Sector Open Data Coordination Committee. The second interviewee is no less important; she is the Chairperson of the Public Sector Open Data Task Force, which play the main role to drive the OGD implementation activities in the country. Whilst the last two interviewees were the member of the Public Sector Open Data Task Force.

The interviewees' background can be seen in Table A.1 in Appendix A and will be called top-level reviewers with the prefix *TLR* in this study. Whereas the interview questions set is attached in Table A.3 in Appendix A. This next sub-section discusses the issues and challenges of OGD implementation in the Malaysian public sector. The issues are separated according to three themes: operational, technical, and external issues. Some excerpts from the semi-structured interviews were embedded as evidence of the issues discussed.

2.4.3.1 Organisational aspects

The organisational issues of OGD implementation were primarily associated with the internal operation of the government agency. Studies of OGD implementation in various regions have highlighted organisational aspects as the prominent barriers (Donald Shao & Saxena, 2019; Gunawan & Amalia, 2016). Interestingly, some barriers or challenges are similar from one country to another, and some barriers uniquely occur in that particular country. A study by Donald Shao and Saxena (2019) has identified policy, legal framework and Open Government Partnership (OGP) movement as the main organisational barriers in Tanzania's OGD implementation. In comparison, a study by Kassen (2017) has discovered the government agency's culture as the organisational aspect that hinders open data development in Kazakhstan. Nevertheless, organisational barriers may appear in various factors from one country to another. In this study, the government's culture, policy, resources and governance structure have been identified as the organisational issues. The following subsections will be detailing the said issues.

(a) ***Culture***

More than 200 government agencies have participated in data publication since the OGD was initiated in the Malaysian Government in reference to the data portal. There are, however, a small number of government departments that feel dubious about the advantages of OGD. These agencies perceived that it is an extra challenge to their current activities to contribute to the OGD initiative since they need to dedicate resources to classify, compile, clean and publish a dataset.

The lack of awareness on openness culture was noted by the central agency as this was mentioned by some of the field experts:

"Based on my experience consulting the government agencies, some of them question what benefits they will gain by sharing their agency's data" (FE3).

"I think first and foremost, because you want to change the mindset of the agency, specifically tailored change management program had to be designed to tailor with the agency's issue. In that change management program, we have to highlight a lot of questions such as what the need from the agency is, what motivates the agency to be part of the change management program and willing to change for any better. So, what is need to convince them is how can giving some data will help their business." (FE1)

Earlier research by Janssen et al. (2012) noted that insufficient resources, especially for smaller agencies, impedes the activity of open data. The same tone was mentioned in Attard et al. (2015), in which the research mentioned about provisioning raw data is a demotivating factor. Moreover, some programs at the national level often involve the government department's attention as well that switches the agency's focus in providing a better quality of OGD.

(b) ***Policy***

The current data and information policy legislated by the government comprises of the Official Secrecy Act (OSA) 1972 and the Personal Data Protection Act (PDPA). The OSA is an Act of Law relating to the protection of official secrets, primarily intended to protect official government matters from falling into the hands of unauthorized persons. At the same time, the PDPA is intended to prevent the violation of privacy by commercial businesses that may misuse their customer information. To date, the PDPA mainly extends to private entities in commercial transactions, but some of the government agencies use this justification for not publishing any of the critical data on the data portal.

In comparison to demands for the exchange of data between government agencies, it is determined officially case-by-case, and the two government agencies typically take charge of the safety of data and privacy (World Bank Group, 2017). Although much of the OGD is free, certain material has accrued a data release fee system. Certain agencies have imposed this policy long before the OGD initiative emerges, especially for high demand datasets such as geoscience and healthcare data. The abolition of this fee system would require a number of regulatory processes in a substantial period of time.

(c) ***Resources***

The division of resources in terms of the workforce is a little concern since the government agencies avouch that they have so many ongoing projects operating jointly by the central agency. However, the same circumstances apply to the central agency that has minimal capacity to conduct an outreach approach to build change management programs and data-owning agency's competency. This situation forces the government personnel to multitask between their daily task and managing the OGD implementation. On the infrastructure side, there are no barriers to OGD implementation as the innovation is being leveraged on the open-source platform accessible to the government.

(d) ***Data governance***

Generally, the higher-level management has sound support towards OGD initiatives; however, the number of data owning agencies joining the OGD initiatives is still a major concern (World Bank Group, 2017), especially in key data clusters. A minor resistance and inertia still exist amongst data owning agencies due to some security and privacy building block. During the initial stage of OGD implementation, a data champion was appointed at each pioneer agency to facilitate and motivate the government agency to publish more data. Due to frequent staff turnover, the data champion appointment approach was discontinued. Furthermore, the data champion was appointed among lower-level management which created a conflict of power to attract the government agencies into following the OGD implementation guideline. The ODRA report suggests to a appoint data champion from a stronger position in the government agency for the easier *divide et impera* (World Bank Group, 2017). In this way, the government agency will likely be motivated towards OGD initiatives by receiving a commitment from the top management.

Another issue revolves around data governance was the data archiving. In certain government agencies, archiving past data and publications did not seem to be a high priority (World Bank Group, 2017). Though MAMPU offers general guidelines on data management practices and procedures, individual government agencies have clear devolved authority and responsibility to administer their own internal structures. Hence, individual agencies have the final say when it comes to publishing their valuable data.

Furthermore, a centralised data repository was not established to consolidate all existing data that the government hold. No detailed inventories of the data the agencies keep are released publicly. It seems that individual agencies may not have a clear knowledge of relevant data that could be accessed from other agencies (World Bank Group, 2017).

2.4.3.2 Technical aspects

Perhaps the most common issue in OGD implementation in most countries involves the quality of the data and Malaysia is no exception. Failure to provide quality and useful data will only push the potential data users aside, and reuse will be discouraged (Vetrò et al., 2016).

(a) ***Data quality***

Managing OGD implementation does not merely entail placing the data on the data portal. Rather, much has to be taken into consideration, including the quality of the data to be published. The technicality aspects of the data published still lack due to non-compliance to the Eight OGD Principles. A study by Schieferdecker (2012) stated that the quality of OGD should be originated from the information system, which generates datasets. Lamentably, some legacy information system also neglects to incorporate quality data entries that caused poor datasets accumulated in the database. This issue can hardly be resolved because it requires a substantial amount of work to rectify the data input process to a more structured database. In addition, according to the 2017 Malaysia ODRA report, the Malaysian public sector sits in a well-developed data infrastructure; however, there are fewer quality data published (World Bank Group, 2017). Among the issues found in the existing OGD are some of the datasets have missing values, incomplete datasets, the metadata information is insufficient, and the wrong format of data were published. As these issues revolve around OGD, the value of OGD declines and is less useful.

*(b) **Skills***

Managing OGD initiatives involves a lot of activities than just publishing; the preceding measures included data creation, filtering, standardisation, and cataloguing. Any of these measures needs government personnel with requisite information technology (IT) capabilities. The Ubaldi (2013) research emphasized that the forthcoming public servants managing OGD implementation require more than just average IT expertise. To cope with more advanced situations, government employees must be equipped with high demand skills in predictive analytics, data science, and Web 2.0 technologies, to mention a few. In line with the issue, the 2020 study of the Organisation for Economic Co-operation and Growth (OECD) has identified six main aspects of government employees' core skills to be added to OGD management (OECD, 2020). While these key skills are not required to be incorporated into their everyday jobs, a certain degree of knowledge is necessary for government employees to train them for the current development in public service delivery (OECD, 2020).

Knowing this constraint, the central agency has invested in competency growth in which chosen government agencies have been trained by the Open Data Institute representative in technological capacity coaching. In this coaching strategy, agencies were motivated to produce their own data output, such as a business case using the actual data and indirectly develop improving their skills in handling OGD. The trained government employees who have learned the skills are expected to convey their experience to their respective agency's other staff. While it is far from the necessary OGD skills, certain foundations must be nurtured first before a higher degree of competence is established.

2.4.3.3 External aspects

The external issues revolve around the surrounding environment that influences the government agency in OGD implementation, including the data users, peer agency, or the public. Some issues came from within the government environment but different organisations, for instance, the central agency. Such issues were not actually the hindrance to the government agencies implementing OGD, but it gives a pinch that makes the agency feel a little demotivated.

(a) ***Incentives***

In the initial process of the introduction of the OGD, government agencies present questions regarding the unmistakable implications of accessible data for the public and the government itself. Furthermore, there is a lack of concrete proof that OGD has brought about a shift in society to take as an example. On top of that, there is a shortage of continuous incentives to provide to the government agencies in OGD implementation programs. In the beginning, government agencies have been acknowledged by the central agency for their active involvement in OGD programs, such as awards, contributions and tokens of gratitude. However, over time, the recognitions schemes are no longer in practice. Part of the central agency's reason was the lack of funding and lack of enthusiasm from the government agencies for the recognitions scheme. On the other side, while the prizes were not worth the government agency's contributions to take part in OGD initiatives, some government agencies felt demoralized if their efforts were not recognized. Clearly, the incentive program, to some extent, injects government agencies' ardour to continue to commit to the OGD initiative. This is particularly true when a study by Zuiderwijk, Susha, et al. (2015) outlined the need to support the government agency in data publishing in many aspects, including a reward system as one of the OGD's crucial success drivers.

(b) ***Use and participation.***

Publishing OGD is undoubtedly an immense challenge to the government agencies, and yet another OGD deployment challenge is to encourage the citizens to use the OGD. The importance of OGD resides in putting some meaningful good that will help the public. The OGD is only worth it when it is focused on some physical good that might help the public (Janssen et al., 2012). It is promising to have a hackathon event each year, but this is inadequate. The competition competitor might have produced inventions that serve the intent of the competition rather than a long-term data invention that can be used. There are no new changes to any of the programs, and almost no utilization is registered to add to the deterioration of OGD use. This condition is a little concerning since the organizer has no idea whether the participant's goal was to win over the cash prizes or create an application that significantly impacted society. In the future, rather than being a one-off occurrence, a mechanism to support the developed application's progression up through the hackathon competition could be in effect.

(c) ***Data demand***

In response to a data request, government agencies acknowledge that they get data requests from multiple sources, even inter-agencies, periodically. These specifications, though, have been reviewed and handled on a case-by-case basis (World Bank Group, 2017). If the data requested is too big and complex, the government agency will likely hesitate to facilitate the demand. Such action is due to resource allocation and time to entertain the demand sometimes meddle with their daily tasks. As suggested by the 2017 Malaysia ODRA report, the government agency should attend to the public's data request to encourage more OGD use (World Bank Group, 2017).

(d) ***Global competitiveness***

The exponential rise of the digital transition forced the government to feel pressure from peer government. Leaving a project behind the wide pile of the ICT pattern would open a void and later become a large gap that is impossible to fill. For the OGD project, the same patterns might exist as OGD is proposed to be implemented in conjunction with other data initiatives such as Big Data. Newly evolving innovations, such as the Internet of Things or Blockchain, at one point, will absorb OGD to produce highly data-driven technologies. This is due to the OGD scale that is expanded over time and needs to be evaluated by sophisticated machine learning techniques. Other than that, OGD is also said as a cornerstone for adopting Smart City policies that would enhance people's well-being. In addition, OGD is the initial step before every authority tries to proceed with the Open Government Directive, which would create further resources for democratic participation. (Lee, 2011). All these technologies are developing rapidly, but the absorption rate of these technologies in the public sector is very low. The Malaysian public sector is often categorised as a laggard in adopting the latest technology, which is seen as a disadvantage in competing against the global level.

Adding to the pressure, Malaysia's achievement in digital initiatives at the international level is not convincing despite the various efforts made. One of the important indexes is the E-Government Development Index (EGDI) in the United Nations E-Government Survey. Aside from analysing the trends of website growth in a country, the E-Government Creation Index integrates access features, such as infrastructure and educational levels, to represent how a country uses digital technology to facilitate access and participation of its citizen. In order to realize the multiple digital transformations that have been envisioned, obtaining lower scores in the EGDI would reflect the sum of further work that needs to be accomplished.

2.5 Innovation Adoption Process

The notion that the application of innovation is a multi-level and sequential process is rarely emphasized by innovation adoption studies (Hameed et al., 2012a). In reality, the innovation adoption process arises in a sequential series in which one moves parallels from the previous one explicitly, and the intersectional points are easily recognisable (Damanpour & Schneider, 2006; Rogers, 1995; Van de Ven et al., 2000; Zaltman et al., 1973). There are two types of the innovation adoption process; the type of innovation adoption process that occurs in a linear sequence is called the 'unitary sequence pattern' (Gopalakrishnan & Damanpour, 1994; Poole, 1981). Unlike the unitary sequence, the 'multiple sequence pattern' perceives the innovation process as a complicated and cluttered process with numerous and aggregated progress of convergent, aligned, and conflicting flow of operations (Gopalakrishnan & Damanpour, 1994; Poole, 1981; Van de Ven & Rogers, 1988). The obvious differences between unitary and multiple sequence patterns thus consist of three elements: apparent breakpoints between stages, constant pattern in the occurrence of stages, and the orderly manner in the occurrence of stages across innovations. Understanding the innovation adoption process's sequence pattern is essential as it offers useful insight for choosing the right theory to deploy in the innovation adoption study in an organisation. Gopalakrishnan and Damanpour (1994) added that simple and controllable innovation might best use the unitary sequence pattern, while random and complex innovation may need multiple sequence patterns to unfold the innovation adoption process. Cooper and Zmud (1990) advocate in another study that the sequential process is best suited if the innovation is borrowed or adapted, unlike custom-made innovation that may require multiple sequence patterns for the adoption model.

Furthermore, the structure of an organisation also plays a role in determining the innovation adoption process pattern. An organisation with a centralised structure is easier to deploy the unitary sequence pattern innovation process, whereas decentralized organisations should apply the multiple sequence pattern of the innovation adoption process (Gopalakrishnan & Damanpour, 1994) particularly for complex IT innovation. Theoretically, the unitary sequence pattern provides a standard framework that describes how the innovation process, in line with a rational policy model, should evolve, whereas the multiple sequence pattern is useful for describing abnormalities in the innovation adoption process (Gopalakrishnan & Damanpour, 1994). Due to its complexity, the multiple sequence pattern may employ a research strategy that suits the nature of its name, such as a multiple case study. Meanwhile, the unitary sequence pattern may employ the research strategy, such as the survey method, due to its simple research design. Hence, this thesis applied a unitary sequence pattern by conducting a survey method as the research strategy.

The process for IT innovation adoption concerns a series of actions that an organisation undertakes before initiating a new technology (Rogers, 1995). Over the years, the IT innovation adoption process has been studied into diverse stages or phases. The innovation adoption phases literature has been found describing the phases from just two phases (Fidock, 2011; Zaltman et al., 1973) to as many as eight phases (Kamal, 2006). It can be claimed that there is no universal agreement among innovation theorists on the number of phases for a technology-based innovation lifecycle to be spanned. Considering the dynamic attributes that the IT innovation possesses and the adopter's perceived behaviour, research on the IT innovation adoption process evolves implicitly through the body of knowledge from other disciplines.

The technologically oriented organisational innovation and adoption literature is based on the early paradigm of social change proposed by Lewin (1947). The process of change, according to Lewin's model, is a sequence of three steps: i) unfreezing, ii) moving (or change), and iii) refreezing. The 'Unfreezing' phase trains the system for transition, learning new behaviour trends in the organisation's movement or unit or method and assimilating the consequences of change. The moving or change step refers to shifting a group or unit to learn new conducted trends are acquired, and the outcome of the transition is assimilated. The refreezing step allows certain behavioural habits to endure and become a lasting feature of the system (Kamal, 2006).

Centred on Lewin's (1947) concept of change, Kwon and Zmud (1987) and Cooper and Zmud (1990) suggested a six-stages IT implementation model as presented in Table 2.11. Cooper and Zmud (1990) further linked the six-stage model with Lewin’s model in which the initiation is correlated with the unfreezing stage, the adoption and adaptation are correlated with the ‘change’ state. The last three stages from the six-stages IT implementation model are acceptance, routinization, and infusion, which correlated with Lewin’s freezing stage. Followingly, Damanpour (2006) suggestion, the six-stages IT implementation model can be grouped into three broad phases; pre-adoption (initiation); adoption decisions (adoption, adaptation); and post-adoption (acceptance, routinization, infusion).

Table 2.11: Six-Stage IT Implementation Model (Cooper & Zmud, 1990)

Stage	Description
Initiation	The process of identifying the problems and the need for IT innovation as a solution.
Adoption	The decision-making process to execute an IT innovation and allocating the resources needed.
Adaptation	The IT innovation is created, installed and retained, while IT innovation is learned to be used by the organisation members.
Acceptance	The stage at which the members of the organisation are convinced to use and implement IT innovation.
Routinization	The utilisation of IT innovation is viewed in the organisation as a daily practice.
Infusion	IT creativity is integrated with the job structure of the organisation.

Diffusion of Innovation theory is another notable study in the innovation adoption process. Despite the abundance study utilizing the Diffusion of Innovation theory as part of their research model, little is known to quote the Diffusion of Innovation as an innovation adoption process study. The Diffusion of Innovation theory consists of an extensive study conducted by Professor Everett M. Rogers with various models introduced in each stage of his research. The innovation adoption process was one of the parts of the Diffusion of Innovations study. There is also a model for categorizing the adopter on the basis of their innovativeness in the Diffusion of Innovations study; however, it is not covered in the scope of this thesis. The description of the innovation adoption process by Rogers (1995) advocates that it has to be embraced, adapted, routinized, and incorporated into the organisation after innovation is adopted. Roger (1995) innovation process model consists of five stages (Figure 2.7) as follows:

i. The knowledge stage is the extent when a person (or other decision-making units) is introduced to the presence of an innovation and gets an awareness of how it works.

ii. Persuasion is the extent when a person (or other decision-making units) develops a positive or disagreeable attitude towards innovation.

iii. The decision stage occurs when a person (or other decision-making units) takes part in actions contributing to the option of accepting or resisting innovation.

iv. Implementation is the extent when a new concept is placed into use by a person (or other decision-making units).

v. Confirmation is the extent when a person seeks affirmation of an innovation-decision already taken; however, if subjected to opposing innovation effects, the person can revoke the previous decision (Rogers, 1983, pg. 363).

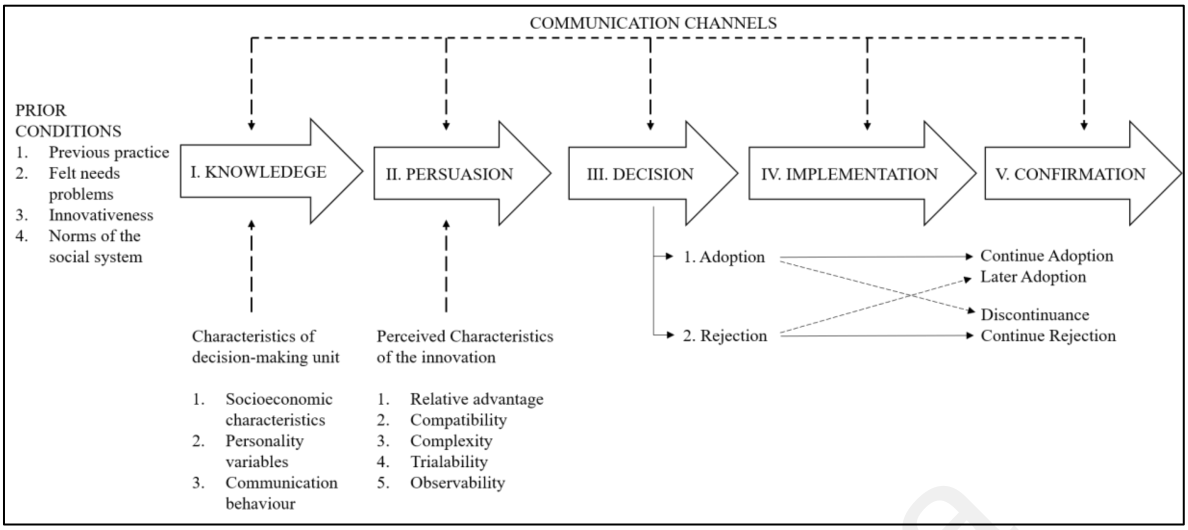

Figure 2.7: Innovation Decision Process Model (Rogers, 2003).

However, these studies measured the innovation adoption as a dichotomous decision and conceptualized adoption as a single event rather than a multistage process (Damanpour & Schneider, 2006). Kamal (2006) concludes in his study that innovation theorists largely limit the study of the innovation adoption process at the adoption stage, and further analysis beyond the adoption phase remains absent. Similarly, Hameed et al. (2012a) assert that the study on details explanation of the innovation adoption process in an organisation is very much lacking.

The innovation theorists have discussed various stages of innovation adoption that lead to categorising innovation adoption process into three main phases; pre-adoption, adoption and post-adoption (Agarwal & Prasad, 1998; Cooper & Zmud, 1990; Damanpour & Schneider, 2006; Greenhalgh, 2004; Kamal, 2006; Karahanna et al., 1999; Pierce & Delbecq, 1977; Tornatzky & Klein, 1982). The first phase is known as the pre-adoption or initiation phase, in which activities such as getting familiar with the innovation, planning to acquire the innovation and proposing the innovation to be adopted took place (Karahanna et al., 1999; Rogers, 1995). A relevant example of a pre-adoption study can be seen in Campbell et al. (2013), where the research attempted to understand the initial customer perception prior to e-commerce adoption.

Figure 2.8 simplified the three phases of the innovation adoption process, as agreed in most IS literature (Damanpour & Wischnevsky, 2006; Hameed et al., 2012b). Other positive consequences of innovation in the post-adoption phase defined by scholars include the routinization, infusion, incorporated, continued use and assimilation of the innovation in an organisation (Bhattacherjee, 2001; Gallivan, 2001; Karahanna et al., 1999; Kwon & Zmud, 1987). However, there are also negative consequences of innovation adoption at the post-adoption phase, such as retrenchment, discontinued use, termination, abandonment, and rejection (Rogers, 1995).

Figure 2.8: Innovation Adoption Process

Details of the three phases of the innovation adoption process are deliberated in the next subsections. Together with the elaboration are the findings of the OGD adoption process in the Malaysian public sector from the semi-structured interviews, which have been mapped with the innovation adoption process.

2.5.1 Pre-adoption

The pre-adoption is a specific stage in a more expansive, multi-phase process. The theory of innovation adoption processes by Rogers (1983) has been recognized as fundamental in IS/IT adoption research (Cooper & Zmud, 1990; Moore, 1991). The theory identified the five stages for innovation adoption: knowledge, persuasion, decision, implementation and confirmation. Rogers further points out that adoption (or rejection) would not happen before the decision stage, suggesting that knowledge and persuasion were regarded as pre-adoption stages that are significant to understand the user's intention (Campbell et al., 2013). Significant criteria of pre-adoption include knowledge of the innovation by intensive adopters, accurate details about how it is achieved and how to use it and how innovation can impact the adopter directly (Greenhalgh, 2004). Thus, the pre-adoption at an individual level is a crucial precursor stage to understand user adoption before proceeding to the next stage (Campbell et al., 2013; Karahanna et al., 1999).

In cases where an individual cannot adopt an innovation due to organisation decision's constraint, Rogers (1983) suggests the organisation's innovation process that was slightly different from the individual approach. The innovation process in an organisation comprises two broad stages: initiation and implementation (Rogers, 1983). Under the initiation stage are the agenda-setting and matching substages. While under the implementation stage is the redefining/restructuring, clarifying and routinizing substages. Rogers (1983) defined the initiation stage as the selection, conceptualization and preparation of all the knowledge for the implementation of an idea that contributes to the decision to adopt. The initiation stage by Rogers (1983) in an organisation is further extended by Damanpour and Schneider (2006) and acknowledge the initiation as the pre-adoption stage. Initiation includes activities aimed at understanding a need, seeking alternatives, being informed of current technologies, discovering appropriate innovations and recommending for adoption (Damanpour & Schneider, 2006; Rogers, 1995).

Although an extensive study has been carried out on adoption and post-adoption, researchers have also started identifying and analysing pre-adoption research. However, most of the research of innovation at the pre-adoption stage was conducted at the individual level due to perceived significant differences in the behaviour of individuals before and after innovation adoption (Campbell et al., 2013; Chang & Zhu, 2011; Karahanna et al., 1999). Only a handful of research is found to study pre-adoption of innovation at the organisational level by measuring the intention of an organisation prior to adopting an innovation (Hinnant, 2003; Veiga et al., 2014). Nevertheless, the study on innovation adoption at the pre-adoption phase offers a lot of opportunities to be explored for an organisation that just started to initiate to adopt an innovation.

2.5.2 Adoption decisions

The second adoption phase is the adoption decision phase, a mechanism that shifts from pre-adoption to defined adoption, where the personnel of an organisation become conscious of an innovation and access knowledge with which to draw a decision whether to accept or to reject the innovation (Damanpour & Schneider, 2006; Frambach & Schillewaert, 2002; Karahanna et al., 1999). In this phase, adopters evaluated the proposed innovation and decided based on the influenced factors, either from behavioural beliefs or normative beliefs or both. At the end of the adoption decisions process is whether the adopter decided to adopt the innovation or not based on the identified factors. Studies about the adoption decision phase of innovation are the most abundant of diffusion literature available today. This claim can be understood in a comprehensive study by Hameed et al. (2012a), in which the researcher presented an extensive list of literature on IS/IT innovation adoption in the organisation.

Among the prominent theories used in the adoption decision phase are the intention-based models from social psychology, namely, the theory of reason action (Ajzen & Fishbein, 1975), the technology acceptance model (Davis et al., 1989), the theory of planned behaviour (Ajzen, 1991), unified theory of acceptance and use of technology (Venkatesh et al., 2003), and social cognitive theory (Bandura, 1986). These dominant studies have delivered an assortment of contending and correlative models with a distinctive set of individual factors towards accepting the IT/IS innovation. Implicitly, these theories also postulate that the IT/IS innovation will be easier adopted by individuals if more variables are accounted to their behaviour (Jeyaraj, 2006). However, scholars argue that IT/IS innovation adoption theories at an individual level are prone to several biases (Fichman, 2004; Rogers, 1995). A pro-innovation bias occurs when the adoption study perceives the individual will positively accepting the IT/IS innovation. A rational bias occurs when the individual is perceived to always make rational decisions towards adopting IT/IS innovation. The methodological bias consists of recall bias and pro-adopter bias. The recall bias occurs when the self-reports from the individual are considered as an unreliable source of adoption. A pro-adopter bias occurs when the non-adopter in the social system is not covered in the scope of the study (Rogers, 1995).

2.5.3 Post-adoption

The last and the third phase in the innovation adoption process is the post-adoption phase (Damanpour & Schneider, 2006; Karahanna et al., 1999). In this post-adoption phase, the adopter will acquire the innovation and is set to be put into practice or established until it becomes a regular feature in the adopter's environment (Damanpour & Schneider, 2006; Rogers, 1995; Zaltman et al., 1973). After a certain period, studies predict that an innovation considered new at the time of adoption will lose its identity as an innovation as it has been embedded in the organisation's task routine (Rogers, 1995).

The post-adoption phase resembles 'consequences' in a study by Rogers (1983), which is defined as the changes that happen to a person or social structure resulting from the acceptance or rejection of an innovation. The consequences of innovation in the post-adoption in an organisation vary depending on the organisation's action itself. The post-adoption stage is enriched by studies that conclude the innovation adoption phase model to either continue or discontinue the use of the innovation by adopters (Bhattacherjee, 2001; Jasperson et al., 2005; Jia et al., 2017; Karahanna et al., 1999). Some studies emphasized the business value creation and impact of the innovation in the post-adoption phase because these contexts can only be realized when the innovation is in use (Zhu, Dong, et al., 2006; Zhu & Kraemer, 2005). Sustained implementation signals the conclusion of the innovation adoption phase, which brings to posit that at this phase, the innovation has been thoroughly assimilated into the organisation (Gopalakrishnan & Damanpour, 1994). Table 2.12 presents all the sub-phases of post-adoption from previous studies, with the definition for a deeper understanding. Unlike the value-chain model, the innovation post-adoption phase does not promote a complete adoption life cycle of innovation; rather, it suggests the possibility of actions that the adopter will take towards the innovation.

Table 2.12: The Variety Sub-Phases of Post-Adoption Phases

	Sub-phases	Description	Reference
1.	Refreezing	Anchor new approaches in the culture and ensures that the change becomes permanent.	Lewin (1947)
2.	Implementation	The establishment and installation activities of innovation to use to gain the anticipated benefits.	Zaltman et al. (1973); Grover and Goslar (1993)
3.	Routinization	The degree to which innovation has become steady and treated as normal activity in the organisational procedures and conduct.	Fichman (2000); Saga and Zmud (1993); Zhu, Kraemer, et al. (2006); Rogers (1995)
4.	Incorporation	The implementation activities directed towards embedding an adopted innovation within an organisation.	Kwon and Zmud (1987)
5.	Infusion	The degree to which an innovation's features are utilized profoundly into the organisation's work systems.	Fichman (2000); Saga and Zmud (1993)
6.	Continued use	Continued usage of innovation.	Bhattacherjee (2001); Karahanna et al. (1999)

Table 2.12: The Variety Sub-Phases of Post-Adoption Phases (Continue)

	Sub-phases	Description	Reference
7.	Assimilation	The process of innovation to be absorbed within organisations starting from the early awareness to potentially, formal adoption and extending until full-scale deployment.	Meyer and Goes (1988); Fichman (2000)
8.	Redefining/ re-structuring	The process of re-invented the innovation to facilitate the organisation needs and structure.	Rogers (1995)
9.	Clarifying	The stage where the innovation becomes more apparent to the organisation's members.	
10.	Discontinuance	The decision to cease the use of an innovation after previously adopting it.	
11.	Replacement discontinuance	It is the sub-type of discontinuance that refers to the decision to reject an innovation in order to adopt better innovation or idea that supersedes it.	
12.	Disenchantment discontinuance	It is the sub-type of discontinuance that refers to the decision to reject an idea as a result of dissatisfaction with its performance.	
13.	Termination	The extent when innovation terminates either implemented, institutionalized, or the resources went out.	Van de Ven et al. (2000)
14.	Actual use	The actual usage of the innovation.	Zhu and Kraemer (2005)
15.	Value creation	The value creation from the usage of the innovation.	

The literature on post-adoption of innovation seems growing as many researchers are starting to realize the scarcity of post-adoption study of innovation. Various post-adoption stages emerge depending on the consequences of action the adopter takes. Researchers argue whether the post-adoption stage of innovation adoption should measure the impact of the innovation after adoption (Zhu, Kraemer, et al., 2006). This is due to the emergence of a significant 'post-adoption gap' that occurs amongst innovation adopters. The post-adoption gap was mentioned in Zhu, Kraemer, et al. (2006) to refer to the lacuna between the rate of organisational use of innovation and the rate of adoption of innovation. Zhu, Kraemer, et al. (2006) believe that not all business organisations have been reliably effective in allowing profound use of technology. The organisation often varies substantially in the value generation of the innovation. Moreover, significant barriers and challenges faced by the organisation worsen the value creation of the innovation in the post-adoption phase. Consequently, one of the reasons for insignificant innovation implications may be that it is not used deeply enough after the initial adoption.

2.5.4 The Importance of Post-adoption of Innovations

A study by Kimberly (1981) was one of the earliest studies that highlighted that most studies seek to predict the adoption of technological innovation and ignore what happens after adoption. The situation leaves researchers a question on the development of technological innovation beyond adoption in an organisation. Kwon and Zmud (1987) and Saga and Zmud (1993) added the importance of innovation to undergo the post-adoption phases, as failure to do so may result from problems with implementation or failure assumption that innovation is necessitated. Besides, if an organisation anticipated the long-term viability of the adopted innovation, it does not come from the first-time use; instead, it is noticeable on its continuous use (Bhattacherjee, 2001). The same tone was reinforced by Zhu, Dong, et al. (2006), stating that one of the rationales for the inefficiency impacts of IT use may be falling to reach more profound use beyond its adoption. Hence, the innovation in the post-adoption extends the opportunities for the adopter to explore and gain the full potential of the innovations. Eventually, the evidence of impact from the innovation adopted is more noticeable and more solid to measure.

Another substantial benefit of the post-adoption study is the usage and value creation of the innovation, which is more visible in the implementation phase than the adoption phase (Zhu, Dong, Xu, & Kraemer, 2006; Zhu & Kraemer, 2005). The impact of the innovation implementation will be more visible and easier to measure given to a certain period. If the innovation is not in practice, an organisation might risk losing the value from its adoption. The efforts to curb this issue are varied, and one of it is by making the innovation part of the routine in the work process of the organisation, then the anticipated benefits of the innovation could be realized (Cooper & Zmud, 1990; Hazen et al., 2012)

2.6 Summary

This chapter has successfully discussed the overview of OGD as an innovation and its implementation in the Malaysian public sector. Subsequently, this chapter argues the process of innovation adoption comes a sequence of stages rather than just a single event. The comprehension of the three distinct phases of an innovation adoption process barely have attention among IT/IS adoption researchers. Most studies focused on adoption and ignored what happened to the innovation after the adoption phase. In contrast, the phase beyond adoption offers more insight to understand the future of the innovation. Realizing the need for innovation such as OGD to reach the end state of adoption process superseded the effort to create the impacts of OGD implementation. In most innovation adoption scenario, it is barely possible to create an impact in the short amount of time. Some innovation may take years before the benefits could be realized. This study argues the importance of OGD to reach the desired post-adoption phase in order for the tangible evidence of impacts could be recorded.

CHAPTER 3: THEORETICAL BACKGROUND

Scaling down from the theory of innovation adoption process explanation in Chapter 2, this chapter argues the process of innovation adoption comes as a sequence of stages rather than just a single event. The argument thus explains the construction of the conceptual framework of this study. This chapter aims to identify theories that address the post-adoption of innovation in an organisation that forms the basis of this thesis's conceptual framework. The second section explains the diverse theory of innovation in an organisation. Within the context of an organisation, several theories were found suitable for this study. In the third section, the OGD adoption process in the Malaysian public sector is duly deliberated based on the theory of the innovation adoption process. The fourth section illustrates this study's proposed conceptual framework and explains the hypotheses development for each construct. Three main theories are used to construct the conceptual framework: Diffusion of Innovation (DOI), innovation adoption process, and Technology-Organisation-Environment (TOE) framework. Justifications of the chosen theories are also presented. The summary of this chapter is presented in the last section.

3.1 Introduction

Theory in academic research is just as important as the domain knowledge featured in a study. It provides the researcher's foundation to explain the phenomenon under study or make an assumption for a testable scenario (Gregor, 2006). Depending on the discipline of knowledge, the definitions of theory can be varied. The same notion is applied to IS discipline as IS theory differs from a certain perspective. The main characteristic that differentiates IS theory from other disciplines is the use of IT artefact that unites the interaction between humans and machines (Gregor, 2006).

In this study, the IT artefact is represented by a research model developed from theories that best represents the phenomenon under study. The human aspect is represented in the Malaysian public sector, specifically the government agency, while the OGD innovation represents the machine or technology aspect. The developed research model will be used to perceive how OGD implementation could be extended in the Malaysian public sector. These representations and their elaboration in the next subsections satisfied the IS theory paradigm, as Gregor (2006) inferred.

3.2 Theory of Innovation Adoption in Organisation

The study of innovation adoption started in the early 1960s, when Everett Rogers, a professor of rural sociology, researched the spread of agricultural innovation. In his ground-breaking research, Rogers (1983) defines innovation as a new idea to an individual, regardless of its time to use or discover it. The innovation definition later expanded beyond just an idea to practice, program, policy, structure, or product perceived as new to the adoption unit (Acharya, 2016; Gopalakrishnan & Damanpour, 1994; Premkumar & Roberts, 1999). Despite the definition, not all technologies are regarded as innovations; they only refer to newly implemented into an environment. It is no longer called an innovation after being incorporated in an organisation (Tornatzky & Fleischer, 1990). In order to analyse the behaviour and antecedents of innovation, scholars have grouped innovation into products or processes (Hameed et al., 2012b). Product innovation simply refers to a new product or service, while process innovation refers to a new way or method of an operational procedure (Damanpour & Gopalakrishnan, 2001; Hameed et al., 2012b). Under the process research, scholars bifurcate to another two groups of research under the process research, namely the generation process research and adoption process research (Gopalakrishnan & Damanpour, 1994).

The generation process researchers treat innovation as a process in which new products or services commence and develop in an organisation. In contrast, innovation is conceived by the adoption process researcher as a process of stages in which an organisation passes, from awareness to a new idea or practice to its adoption until assimilation as the end state (Gopalakrishnan & Damanpour, 1994; Tornatzky & Fleischer, 1990). Figure 3.1 describes the differences between generation process research and adoption process research as taken from Gopalakrishnan and Damanpour (1994). Based on the innovation's elucidations, this thesis is thus applying the adoption process research with OGD as the IT innovation.

Feature	Generation research	Adoption research
Definition of innovation	Generation of new products, processes or services	Assimilation of products, processes or practices into an organization
Source of innovation	Internal generation	Primarily external
Focus of research	Innovation-centered	Organization-centered
Typical substages	Idea generation, problem-solving, design and development, production, and commercialization	Initiation (awareness, attitude formation, and evaluation); Implementation (trial and sustained implementation)
Level of analysis	Organization	Organization
Representative studies	Utterback (1971); Robertson (1974); Baker and McTavish (1976); Kidder, 1981; Pinchot (1985); Copper and Kleinchmidt (1990)	Ettlie and Vallenga (1979); Kimberly and Evanisko (1981); Damanpour (1988); Cooper and Zmud (1990)

Figure 3.1: Comparison Between Generation Research and Adoption Research by Gopalakrishnan and Damanpour (1994)

To define the meaning of adoption, as stated by Rogers (1995), is the extent of a person or other decision-maker unit moves from the first encounter of innovation to deciding whether to adopt or not until confirming to utilize the innovation fully. Damanpour and Wischnevsky (2006) define the innovation adoption as a mechanism that refers to the implementation and usage of a new product, process or procedure by the adopting unit. A study by King (1990) has distinguished three levels of adopting a unit: individual, group, and organisation.

Innovation adoption research has produced a compilation of opposing and comparable models, often suggesting distinct collections of indicators of adoption. Throughout the past two decades, due to the lightning speed development of the digital world, research on IS/IT has been a subject of interest among researchers. There have been extensive studies to help grasp the factors shaping innovation adoption at the individual and organisational levels (Hameed et al., 2012a). The relation between innovation adoption and the implementation of IT/IS was first established by Kwon and Zmud (1987). Since IT/IS is regarded as technological innovation, scientific studies on IT/IS adoption and theories focused on technological innovation are considered legit (Hameed et al., 2012a). However, neither single uniform theory of innovation adoption can be applied at all levels of analysis and to any IT/IS innovation. In defining, illustrating, or anticipating one or more elements of IT adoption, there is a wide range of nominee theories used. The theories addressed in the next subsection are discussed based on the agreement with the concepts of this thesis which is an organisational level analysis and the significance to the IS research context.

3.2.1 Model of Technology Appropriation (MTA)

The Model of Technology Appropriation (MTA), as presented in Figure 3.2, is a mechanism that captures the process of how users assess, accept, adjust and embed technology into their daily lives (Carroll et al., 2003).

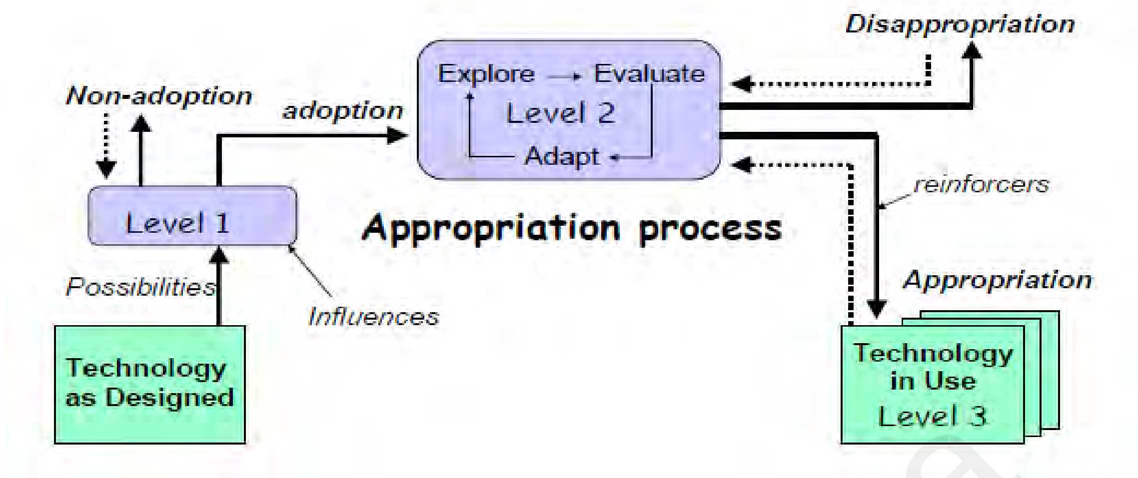

Figure 3.2: The Model of Technology Appropriation (MTA) (Carroll et al., 2005)

The MTA creators have identified three potential consequences for technology evaluation among users: non-appropriation, disappropriation and appropriation. Each of the potential consequences has certain criteria that influence the user's evaluation. For example, Carroll et al. (2002) study on mobile telephones appropriation and has identified that social management, critical mass, leisure, safety and security, lifestyle, and contact as the influence criteria. The disappropriation was influenced by usage cost, health, reception, usability, and ease of learning. Whilst the non-appropriation was filtered by purchase cost, convenience, usefulness, style or fashion, adaptability, and familiarity criteria. The appropriation process refers to the essence of the transition and evaluation of the technology in three stages, as presented in Table 3.1.

Table 3.1: The Model of Technology Appropriation stages adapted from Carroll et al. (2003)

Stages	Description
Level 1	The first encounter of user with the technology. At this stage, the user will decide whether to adopt or not. If the user decides to adopt, then the appropriation process is initiated.
Level 2	This stage represents the profound usage of technology by the user. Appropriation happens when the user takes advantage of the technology's capabilities.
Level 3	Indicates a prolonged use of the technology by the user. The appropriation is recorded when the technology is embedded in the regular routines of the user. This practice is constantly reinforced until user's change its evaluation that may result in disappropriation.

One of the advantages of the MTA is its ability to cover the entire life cycle of technology acceptance from pre-use to consistent use. The model also allows control over the complexities of use and understandable behaviours and is conveniently available in a rather parsimonious fashion. Although the MTA has several advantages, there are aspects where the MTA is lacked off. Firstly, the MTA has less explanatory power to clarify how and why the appropriation process happened. Secondly, the MTA shows a very minimal accumulated tradition (Fidock, 2011). Moreover, MTA the evidence of the appropriation and its criteria can only be captured after the technology passes all three stages. The statement brings to the assumption that the model has a paucity of predictive power. Perhaps, more empirical research in various disciplines is needed to establish the MTA as a reliable and robust model to explain technology use.

3.2.2 Information System Success Model

The Information System (IS) Success Model was introduced by DeLone and McLean (1992). The model consists of six success dimensions that are interrelated with the objective to provide a comprehensive measurement of IS performance (Delone & Mclean, 2004). The six dimensions are information quality, system quality, service quality, use, user satisfaction and net benefits. Figure 3.3 illustrates the updated version of the model by the author.

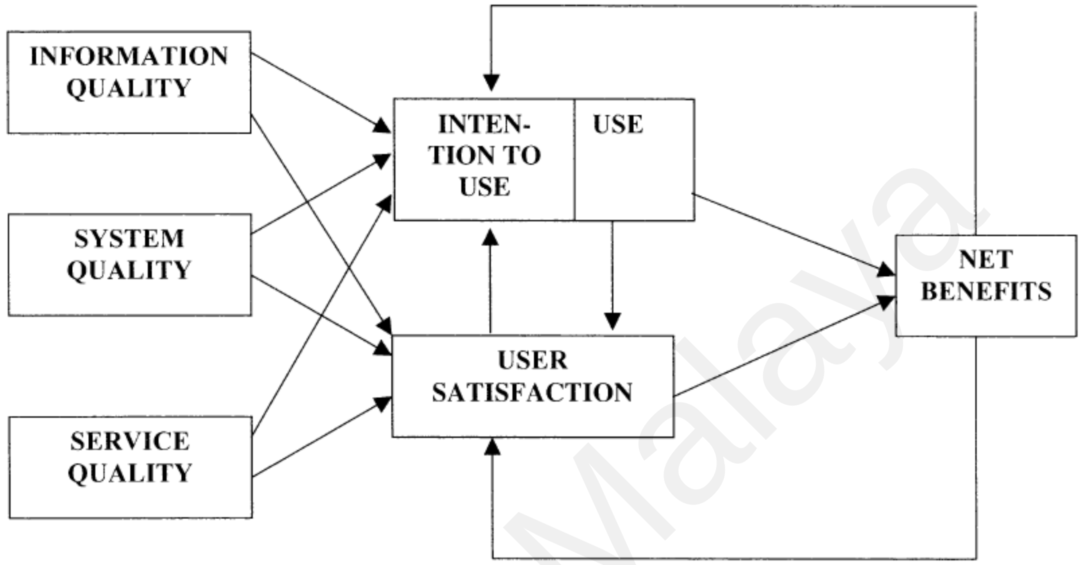

Figure 3.3: The Updated Information System Success Model (Delone & Mclean, 2004).

The IS Success Model views success as a dynamic process; thus, the model shows a simple and salient aspect of IS effectiveness usage and clear relationships between the dimensions (Yusof et al., 2008). These advantages, however, are overshadowed by the lack of organisational factors that are crucial for IS implementation in an organisation.

The IS Success model has been commonly used, tested, checked, and expanded in numerous studies since it was introduced by DeLone and McLean (1992). In 2003, the model was revised to include net benefits resulting from intention to use and customer satisfaction (Delone & Mclean, 2004). In addition, they introduce a new antecedent for system use and user satisfaction called service quality together with system quality and information quality. The IS Success Model shows the simple, basic aspects of progress or effectiveness and the interaction between variables.

Dimensions suggested are system quality, information quality, service quality, intention to use, actual use, user satisfaction, and net benefits. In their paper, Petter and McLean (2009) have given a detailed description of each of the constructs. However, the limitation of this model is that it does not include organisational factors that are crucial to IS appraisal (Yusof et al., 2008).

3.2.3 Human Organisation Technology-fit model

The Human Organisation Technology-fit (HOT-fit) model was introduced by Yusof et al. (2008) to evaluate the hospital information system. The HOT-fit model integrates two prior models between the IS Success Model (DeLone & McLean, 1992) and the IT-Organisation fit model (Morton, 1990). As depicted in Figure 3.4, the HOT-fit model extends the IS Success Model by incorporating the human and organisation aspect due to the limited abilities of IS Success Model to explain influence from both aspects to net benefits of adopting a technology. Whilst the human and organisation aspect was derived from IT-Organisation fit model where the researchers' grouped elements from the IT-Organisation model to human and organisation aspects. The human aspect consists of system use and user satisfaction, while the organisation consists of interaction between organisation structure and its environment. The technology aspect of the HOT-fit model caters for quality aspects of the system, information, and service quality adapted from the IS Success Model.

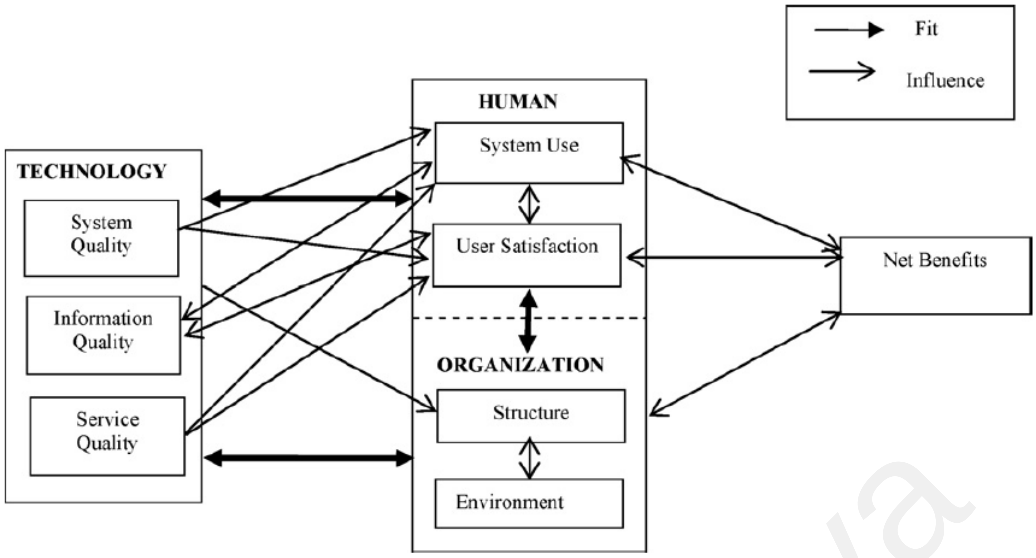

Figure 3.4: The Human Organisation Technology-fit Model (Yusof et al., 2008).

The HOT-fit model suggests that the more technology, humans, and organisation fit, the more innovation's capacity will be realised. The objective of the HOT-fit model was to measure the performance, effectiveness, and impact of an innovation. Yusof et al. (2008) described the effectiveness in their study as the capacity of a healthcare institution to attain objectives consistently within a given period utilising maximum capital. However, the model was not tested through quantitative methodology by Yusof et al. (2008); instead, the model defines only its dimensions and variables. The result of the study was based on a case study in a single hospital. The researchers also fail to explain on what scale the innovation is considered effective and what not. Nevertheless, it cannot be ascertained at what adoption phase the HOT-fit model can be applied in an innovation adoption study.

3.2.4 Diffusion of Innovation

Diffusion research was started by a professor in rural sociology, Everett Rogers, in his book *Diffusion of Innovations*. The book's first version was written in 1962, and the latest edition is the fifth edition which was published in 2003. There are parts from the earlier edition of the book that is not available in the latest version and vice versa. Ergo, researchers have to refer to all editions of the book for a clearer explanation of the diffusion of innovations. The diffusion research appraises how innovation is spread within an adopting unit through a communication channel (Rogers, 1983). Rogers perceived that the cycle of diffusion exhibited trends and consistency even through innovations, environments, and cultures of a social system (Stacks & Salwen, 2009).

The literature on the diffusion of innovation is widely available in various models that discuss individuals' or organisations' decision points and actions. Most research applied the perceived attributes of innovations (relative advantage, compatibility, complexity, trialability, and observability) to identify the factors that influence the adoption of an innovation. However, in Rogers (1983), perceived attributes were only one of the variables to determine the rate of innovations adoption. There are four other variables that determine the rate of adoption as depicted in Figure 3.5 that consists of the type of innovations-decision, communication channels (e.g., mass media or interpersonal), nature of the social system (e.g., the norms, degree of interconnectedness, etc.) and extent of change agents' promotion efforts.

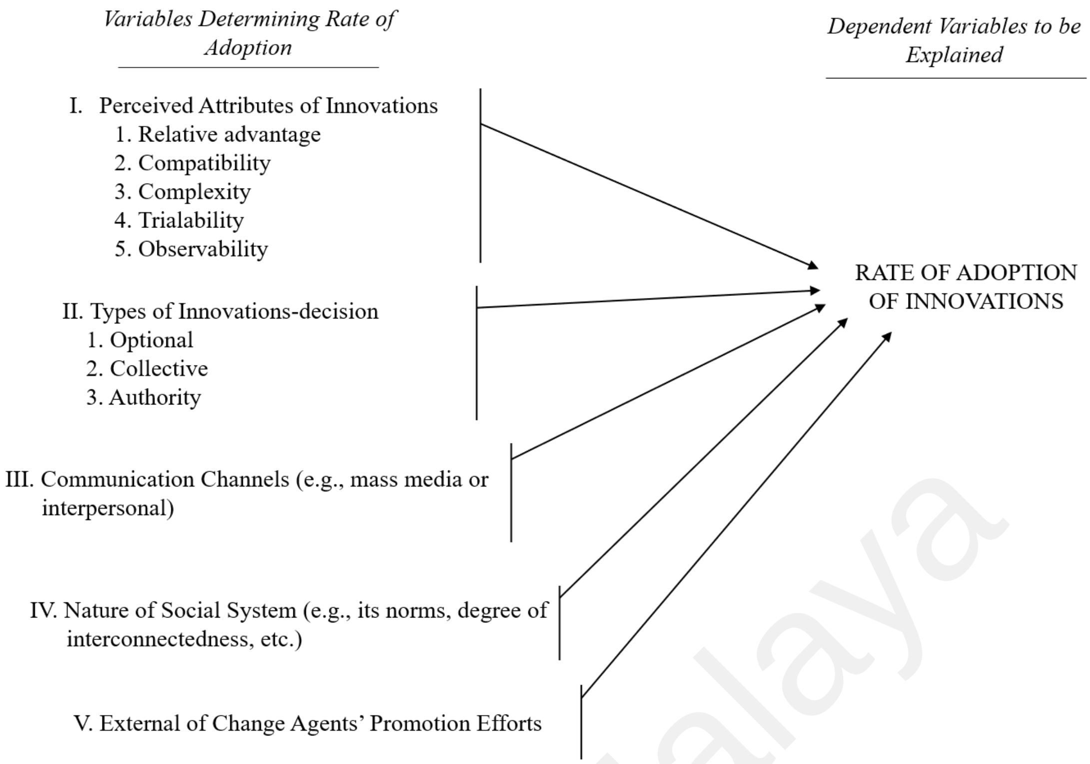

Figure 3.5: Model of Determining The Rate Of Adoption of Innovations. Adapted from (Rogers, 1983)

The word adoption is used by Rogers (1995) to refer to a decision-making point to accept and use innovation. There are three types of innovation decision-making units, as described in Rogers (1983). The first decision is the choice made by an individual who will decide whether to adopt or reject an innovation, and this is called innovation decisions. The collective innovation decisions are the second type of innovation decisions in which the choices are made by having a collective judgement among members of a social system, whether to adopt or reject innovation. Thirdly, the authority innovation-decision, in which people with a higher power, status, or technical expertise represent the social system, decides whether to adopt or reject an innovation. The second and third innovation-decisions types are the regular practice in an organisation. An organisation's employee is usually obligated to agree upon the authority innovation-decision type (Rogers, 1983). The communication channels variable is defined as the mechanism in which participants build and exchange knowledge to achieve shared understanding. The nucleus of the diffusion process is the exchanging of ideas, in which one person communicates a new concept to one or more others (Rogers, 1983). The two most common methods for communication channels variable are the mass media and interpersonal channels. All those ways of distributing communications that require a mass medium, such as radio, television, newspapers, and many others, are mass media mediums to reach a bigger audience. In contrast, the interpersonal channel includes a face-to-face exchange between two or more persons.

3.2.5 Technology-Organisation-Environment (T-O-E)

The theory of innovation adoption in an organisation consists of a compilation of theories taken from several fields of investigation that underlies much of the study of mechanisms of growth and technical progress (Tornatzky et al., 1983). The organisation is the highest unit of analysis in a study involving IT adoption. Various studies have attempted to classify diverse influences as possible determinants of IT adoption in organisations. Wejnert (2002) developed a system in which innovation adoption determinants were clustered into three key components: innovation characteristics, innovator characteristics, and environmental background. Similarly, Iacovou (1995) structure the organisational readiness, benefits of the innovations, and external pressure in his framework for Electronic Data Interchange (EDI) in small businesses. However, Tornatzky and Fleischer (1990) have the most recognised attempt to identify and categorise the determinants of technological innovation adoption in organisations in their book; *The Process of Technological Innovation*. Tornatzky and Fleischer (1990) present a framework (Figure 3.6) for how it is possible to cluster the determinants of technological innovation adoption into three systemic elements that affect innovation adoption and implementation decisions in an organisation.

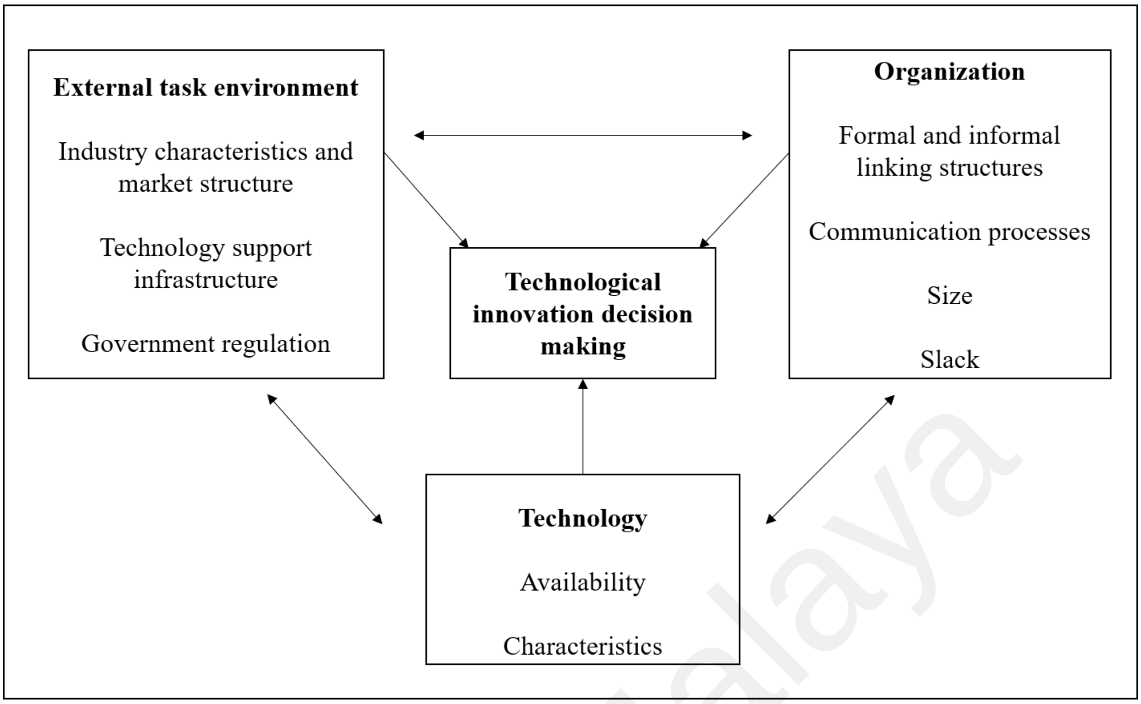

Figure 3.6: The Technology-Organisation-Environment Framework (Tornatzky & Fleischer, 1990)

The environment context consists of business features and market structure, resources for technological support, and government regulation (Tornatzky & Fleischer, 1990). It may also contain an agency external to the company with relevant experience to assist in IT/IS adoption (Zhu et al., 2010). Apart from that, the organisational context includes structured and informal systems of connections, coordination methods, scale, and slack of the organisation. Nevertheless, the technology context represents the availability and characteristics of a particular technology.

The ability to vary the variables or measurements within each context renders the TOE configuration highly adaptable (Baker, 2012). Scholars have also found no reason for the principle itself to be modified. Since the TOE paradigm contains variables and has great analytical influence in a broader sense, in order to expand and enrich theoretical lenses, Tornatzky and Fleischer (1990) did not implement a fixed model and instead suggested combining the TOE framework with other theories (Awa et al., 2017; Hameed et al., 2012a; Thong, 1999). Previous scholars have consistently focused on the variables within the TOE's framework to improve its theoretical ground and empirical compliance. Table 3.2 presents studies that have utilized the TOE framework at the organisational level in various disciplines.

In brief, TOE presents a viable method for researching organisational IT/IS implementation through a range of technologies. Various forms of innovations have diverse influences that affect their adoption. In the same manner, different socio-economic, geo-political or cultural backgrounds would often have varying influences (Baker, 2012). The framework extends the debate on implementation beyond a technical narrative and combines organisational and external viewpoints. Nevertheless, the technological, organisational, and environmental contexts of the framework raise both limitations and potential for innovation adoption in an organisation (Tornatzky & Fleischer, 1990).

Contrary to many other models and theories of information systems, the TOE framework is a flexible theory, which suggests different influences for different system components but does not prescribe the variables of each component (Wang & Lo, 2016; Zhu & Kraemer, 2005). Specifically, the TOE framework provides a reasonable theoretical foundation for analysing technology adoption processes at the organisational level (Chandra & Kumar, 2018). As such, the researcher utilises the TOE framework for conducting a systematic investigation of factors that influence Malaysian public sector organisations' post-adoption of OGD. The TOE framework allows diverse factors that surround the Malaysian public sector to be studied in three broad contexts (technology, organisational, environmental).

Table 3.2: Studies Based on the Technology-Organisation-Environment (T-O-E) framework

Author(s)	Innovation	Determinants		
		Technological	**Organisational**	**Environmental**
Hao et al. (2020)	Automatic warehousing systems	• Cost • Perceived relative advantage	• Firm size • Firm scope • Operation performance	• Technological turbulence • Business partner influence
Çaldağ et al. (2019)	Open Government based technologies	• Relative advantage • Complexity • Data Governance	• Organisational readiness • Organisational culture • Top management support	• External pressure • Government regulations • Trust
Chandra and Kumar (2018)	Augmented Reality (AR)	• Technological competence • Relative advantage	• Decision-makers knowledge • Financial strength • Top management support	• Consumer readiness • Competitive pressure
Awa et al. (2017)	Technology adoption	• Perceived simplicity • Compatibility • Perceived values	• Management support • Size of the enterprise • Scope of business	• Normative pressure • Mimetic pressure
Wang et al. (2016)	Mobile reservation systems	• Relative advantage • Complexity • Compatibility	• Top management support • Firm size • Technological competence	• Competitive pressure • Critical mass • Information intensity

Table 3.2: Studies Based on the Technology-Organisation-Environment (T-O-E) framework (Continue)

Author(s)	Innovation	Determinants		
		Technological	**Organisational**	**Environmental**
Ahmad (2015)	E-Commerce	• Relative advantage • Complexity • Compatibility	• E-Commerce Knowledge • Management attitude towards E-Commerce	• External change agent • Pressure from trading partners • Pressure from Competitors
Puklavec et al. (2014)	Business Intelligence Systems (BIS)	• Expected benefits • Perception of strategic value • Cost • BIS is a part of ERP	• Management support • Organisational culture • Project champion • Organisational data environment • Organisational readiness • Size	• External support
Lin (2014)	e-Supply Chain Management	• Perceived benefits • Perceived cost	• Firm size • Top management support • Absorptive capacity	• Trading partner influence • Competitive pressure
Wang (2010)	Radio frequency identification (RFID)	• Relative advantage • Complexity • Compatibility	• Technology competence • Firm size • Top management support	• Trading partner pressure • Competitive pressure • Information intensity

3.3 Identification of theories for organisation innovation adoption process

Each of the theories or models discussed above has a unique set of strengths and weaknesses that can aid in understanding one or more aspects of the innovation adoption process. Table 3.3 summarise the strengths of each theory.

Table 3.3: Relative strengths of theories understanding organisation innovation adoption process

Strengths	Model of Technology Appropriation	Information System Success Model	Human Organisation Technology-fit Model	Diffusion of Innovation	Technology-Organisation-Environment
Understanding of dynamics of influences and patterns of adoption in an organisation	High	Low	Low	Medium	High
Ability to explain the process of change (explanatory power)	Low-Medium	Low-Medium	Low-Medium	High	Low
Applied to a range of user cohorts and use contexts	Medium	Medium	Medium-High	High	Medium
Cumulative tradition	Low	High	Medium	High	High
Heterogeneity of use across organisations	Low	High	High	High	High
Suitable for organisation level of analysis	Medium	High	High	High	High

This thesis concern the innovation adoption process theory in an organisation and the factors that influence the organisation adoption. The Model of Technology Appropriation (MTA) possesses a strong aspect in understanding the dynamics of influences and patterns in adoption in an organisation (Carroll et al., 2003). However, the MTA shows some disadvantages in explaining how and why the appropriation process occurred and limited cumulative tradition (Fidock, 2011), in which only a handful of studies found to adopt this model. The MTA is also more suitable for individual level of analysis compared to the organisation level of analysis. The Information System (IS) Success Model possesses a strong diversity in organisation level of analysis and high cumulative tradition. However, the IS Success Model's major disadvantages are the exclusion of organisational factors crucial in this study.

Subsequently, the IS Success Model is unable to explain the change process of IS adoption in an organisation, and the influence patterns are not highly dynamic. To overcome these constraints, the Human Organisation Technology-fit (HOT-fit) model was built on the IS Success Model by incorporating organisational factors. (Yusof et al., 2008). Nevertheless, the HOT-fit model has the same limitation as IS Success Model, in which the model has a low ability to explain the innovation adoption change process. In comparison, the Diffusion of Innovation theory provides advantages in most of the strengths aspects. At the same time, the Technology-Organisation-Environment (TOE) shows equal strengths in most aspects. However, the TOE framework has a low ability to explain the process of change (explanatory power) of innovation adoption. Considering the strengths and limitations of all models, the Diffusion of Innovation and the TOE framework complement each other in presenting a comprehensive evaluation framework for OGD post-adoption in the Malaysian public sector.

3.4 Summary

This chapter has set the theories that underpin the direction of the study. Five theories of innovation adoption in an organisation have been synthesized to uncover each theory's strengths and weaknesses. The study resorts to combine DOI and TOE as the underlying theories for the study because these theories complement each other strengths and weaknesses. Furthermore, these theories are best suit the six-stage IT implementation model by Cooper and Zmud (1990) to present the OGD adoption process. To the researcher's best interpretation, this study is pioneering the study that employed the post-adoption phase from Cooper and Zmud's (1990) Six-Stage IT Implementation Model as the dependent constructs for OGD post-adoption phases.

CHAPTER 4: RESEARCH METHODOLOGY

This chapter explains the research methodology employ for this thesis. The first section elucidates the research onion paradigm introduces by Saunders et al. (2016). The second section delineates this thesis's output, which is the research design that involves all the efforts taken to achieve each of the research objectives. The previous chapter has managed to explore the initial constructs of OGD implementation in the post-adoption phase. These findings are leveraged in this chapter to develop the research instrument. This chapter also completed the operationalization of the research instrument and the data collection method.

4.1 Introduction

A research methodology is a systematic approach to address research problems (Kothari, 2015). Essentially, research methodology also serves the purpose of guiding the researcher on how to conduct research in a scientifically systematic way. When mentioning research methodology, one would prompt on what is the difference from the research method. Firstly, the research methodology is the umbrella of the research method. By elaborating the research method, the research methodology is referred to as well. Secondly, the research method described the action taken to obtain research data. Typically, a researcher would describe whether their method of data collection is qualitative or quantitative, or mixed-method. In comparison, the research methodology described the science of the method (Kothari, 2015). For a clear pathway to address the research problem, this study employed the research onion paradigm by Saunders et al. (2016). The next subsections deconstructed each layer of the research onion for this study.

4.2 Research Paradigm

A paradigm is essentially a way of looking at something that represents an established standard, a set of related ideas. Guba and Lincoln (1994) define a paradigm as "basic belief systems based on ontological, epistemological and methodological assumptions" (p. 107). Additionally, the researchers assert that there is no way to prove that one paradigm is superior to the others; therefore, any choice is debatable. However, one does not just simply choose which paradigm to use in conducting research. The research paradigm must be aligned with the research problems, research objectives and hypothesis. The choice of the research paradigm will also give implications to the flow of the research from the methodology to be used in the study until the data collection techniques (Kivunja & Kuyini, 2017).

The nature of this study is somewhat mixed with exploratory and explanatory. This study integrates multiple theories that have not been tested in any research. The idea of exploratory nature is to take well-defined theories and applying them to the study area. In contrast, the explanatory nature comes in when the research model of this study attempts to explain the relationships between variables. The following subsection describes the research paradigm from the outer to the innermost layer of the research onion as introduced by Saunders et al. (2016).

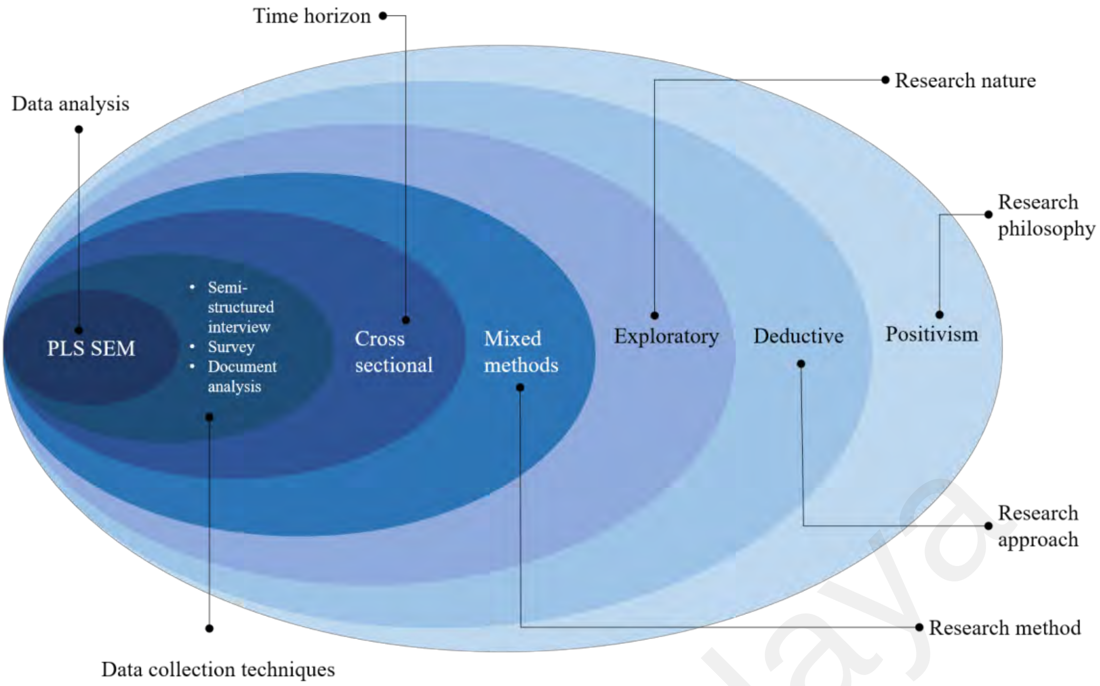

Figure 4.1: Research Onion adapted from Saunders et al. (2016).

4.2.1 Research Philosophy

The most outer layer of the research onion is the research philosophy. As a foundation for any research, research philosophy creates a stance of beliefs and expectations regarding knowledge creation (Saunders et al., 2016). This study applies the positivism approach. Positivists advocate the ontology stance that there the reality is real, and the truth is universal. While for the epistemological stance, positivism construes that knowledge can be obtained through observation and measurement of a phenomenon. In terms of axiology, which means creating the values, positivism produces values by understanding that logic is the absolute fundamental way to understand the world.

Having said that, positivism is very much representing the paradigm that this study is trying to portray. The reason is that the problems investigated in this study are related to society and social facts. These social contexts can be studied scientifically and objectively in the same way as natural sciences. Furthermore, the measurables facts or phenomenon allow other researchers to replicate this study to check the findings. Some of the positivist methods include experiments, comparative methods, surveys, and non-participant observation. There are three crucial features to positivism; the first one is that it aims to predict behaviour, particularly human behaviour. Second, positivism is useful for testing theories or whether a phenomenon is happening. Thirdly, positivism also looks for complex rules or laws, in which generally it aims to find a universal truth and absolute laws to apply in all circumstances. Positivism rejects metaphysics that cannot use hard observable facts (Saunders et al., 2016).

4.2.2 Research Approaches

When talking about the reasoning approach, this study employs both the inductive and deductive methods. The reason for the deductive stance is because the hypotheses of this study are mainly developed from previous research. Although the deductive approach is often related to theory testing, this study's goals are not merely testing the existing theory. For the most part, this study explores new factors to integrate with the existing theories. The inductive approach is applied to develop the hypotheses from the newly discovered factors. The deductive approach is the reasoning process that concludes the logical relationship of two assertions, usually one broad judgment or definition and one more specific assertion, often an inference. Whilst the inductive approach makes broad generalizations from specific observations. In summary, the inductive gives new knowledge, whereas the deductive does not as there is already a theory out there. The deductive approach starts with a presentation of a rule and is followed by examples in which the rule is applied (Saunders et al., 2016).

4.2.3 Research Strategy

A research strategy is a plan of how the study aims to achieve the research goal. The research strategy is placed by Saunders et al. (2016) in the middle of the research onion. It is a critical layer because choosing a particular research strategy also aligns and justifies the outer layer (approach and philosophy) and the inner layer (choices, time horizons, and techniques and procedures) of the research onion. The list for research strategy varies but is not limited to experiment, survey, ethnography, grounded theory, and some others. The previous section has justified the choice for the research philosophy and research approach for this study. Hence, to align with these paradigms, a survey is deemed suitable as the strategy for this study. A survey is a representative selection from the population of a particular type (Taherdoost, 2017). The target population for this study is identified as the government agencies that have adopted the OGD initiatives. Thus, to investigate the factors of OGD implementation among this population, a survey strategy is employed. The survey strategy is easy to perform, but it is also possible to reach the whole population. There is a full range of methods for data collection using a survey strategy, including questionnaires, interviews, documents, and observation (Saunders et al., 2016). Alternatively, the research strategy could be done as a case study strategy; however, a case study may need longer to conduct and may not be able for generalization.

4.2.4 Methodological Choice

The choice of method to be used in the study rely on the research questions and context (Azorín & Cameron, 2010; Saunders et al., 2016). Whether the researcher wants to utilize a mixed method or mono method, in the end, the method should be able to answer the research question and provide a solution to the research problems (Saunders et al., 2016). There is no single method that is superior to the other. Some researchers prefer using only a single method, whether to go with the quantitative or qualitative design, while others choose the mixed-methods design in conducting research. Nonetheless, the methodological choice should be guided by the problems that a researcher intend to solve (Saunders et al., 2016). This study employs a quantitative method as the dominant method and a qualitative as the complementary method. Creswell (2013) named the said approach as the exploratory sequential mixed-methods design. In this design, the qualitative method aims to enhance the findings from the quantitative method. In the latest development of the mixed-methods design, Schoonenboom and Johnson (2017) for the approach is "quantitatively driven sequential mixed-methods design". This methodological choice is due to the study advocating rigour procedures before each research objective can be achieved. The study started with a qualitative approach in the phase that is called the preliminary study. In this phase, the researcher conducted a series of interviews to establish the research problems and gather initial factors of OGD in the post-adoption phase. The quantitative approach was applied in the main study in which a survey was disseminated to gather data from the government agencies as the respondents. The data collected from the survey is analysed in a quantitative data analysis method using the Structure Equation Modelling technique. The results of the analysis produce the OGD post-adoption framework. The qualitative approach is applied once again for framework validation purposes. In the framework validation procedure, four field expert reviewers were appointed to review and validate the findings of the framework. In this way, the OGD post-adoption framework can be claimed as validated internally and externally. In summary, this study's paradigm choice of method can be represented using a system suggested by Morse (2016) as qual → QUAN → qual. The details of each methodological choice will be explained in section 4.3, Research Design.

4.2.5 Time Horizon

A researcher can choose two types of time horizon approach in their study: cross-sectional and longitudinal (Saunders et al., 2016). A cross-sectional study is the study of a phenomenon or more at a particular time, while a longitudinal study captures data from the same subject at different time points (Saunders et al., 2016; Sekaran & Bougie, 2009). Both approaches must be designed in such a way as to answer the research questions. Due to time restrictions, this study employs the cross-sectional approach in terms of selecting the time horizon of data collection. The cross-sectional study's selection is driven by the aims of this study to find factors of OGD in the post-adoption phase among government agencies at a single point in time. Unlike the longitudinal approach, where most of the aim of the approach is to observe differences in the subject under study over a period of time.

4.2.6 Techniques and Procedures

Data collection is one of the most crucial stages of conducting research. Data collection begins with the decision of what sort of data (qualitative or quantitative) is required and then is followed by sampling the data from a defined population. The main data for this study is using the primary data collected through a survey questionnaire. The data is later analysed in both descriptive statistics and inferential statistics. Descriptive statistics are methods for organising and summarising data into a simple form, for instance, tables or graphs. The objective of descriptive statistics is to explain the characteristics of the data. Inferential statistics are methods for using sample data to make general conclusions (inferences) about populations. The inferences can be made through hypothesis testing and finding the relationship among the variables that transformed from the primary data.

4.3 Research Design

A research design can be related to the overall strategy or master plan that a researcher chooses to combine the various components of the thesis cohesively and rationally; thereby, the research questions are answered (Saunders et al., 2016). Most of the time, the research problems determine the type of design the researcher will use. As such, the research design is essential because it facilitates the smooth sailing of the various research operations from the research problems to the final data analysis (Kothari, 2015). Solving the research problems may entail the whole method of study, from the conceptualization of the issue to writing research questions and data collection, data analysis, and writing the results (Creswell, 2013). What makes the best research design is when it can be repeatable and generalizable. Repeatable in which the design specifications are laid out so that another researcher could design and implement the study using the same approach. The research design is claimed to be generalizable when another group replicates the study design to study the same population; the findings would be identical (Kothari, 2015).

To achieve repeatable and generalizable criteria, this study's research design generally adapts mostly the designs from the previous studies. However, there is a modification at some parts of the research design to tailor with the aims of the study. The research design for this study is dissected in three main phases. The first phase is called the preliminary study or 'explore' phase, in which the research problems, literature review, and the initial factors of OGD in the post-adoption phase were gathered from a preliminary study. The second phase is the empirical study also refers to the 'develop' phase, which is where the researcher develops the OGD post-adoption framework and the research instrument. The main works of the study are performed throughout the empirical study. The last and third phase is the validation study or the 'validation' phase, in which the OGD post-adoption framework is taken to the experts' review for validation procedures. Figure 4.2 illustrates the research design of this study. This diagram dissects the research design into three phases: i) Explore, ii) Develop, and iii) Validate. Each phase has its specific method, output and research objective this study try to achieve. At the same time, Figure 4.3 portrayed the methodological choice for each phase in the research design. While Figure 4.3 presents the methodological choice as explained in section 4.2.4. The details of each phase are explained in the next subsection.

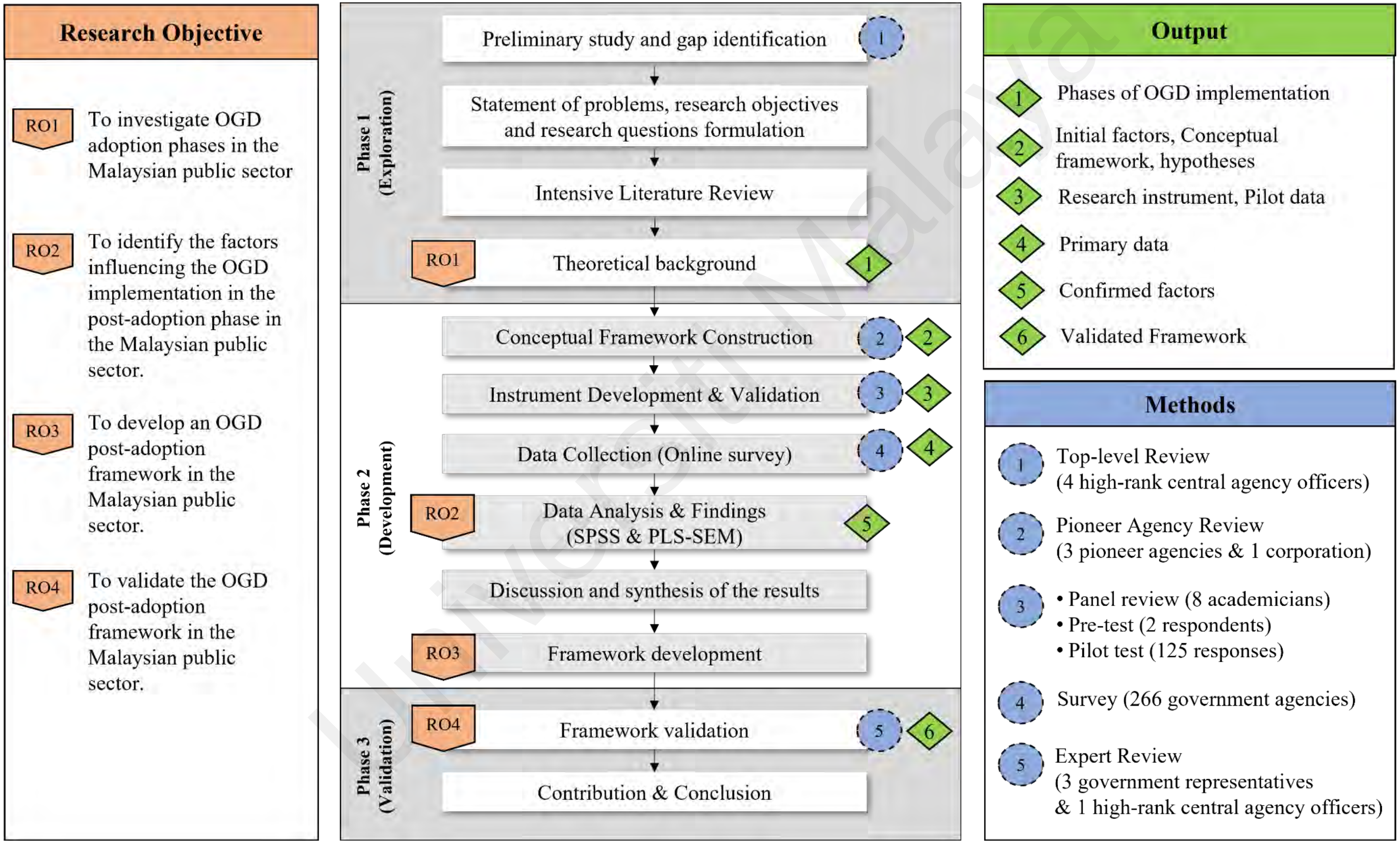

Figure 4.2: Research Design

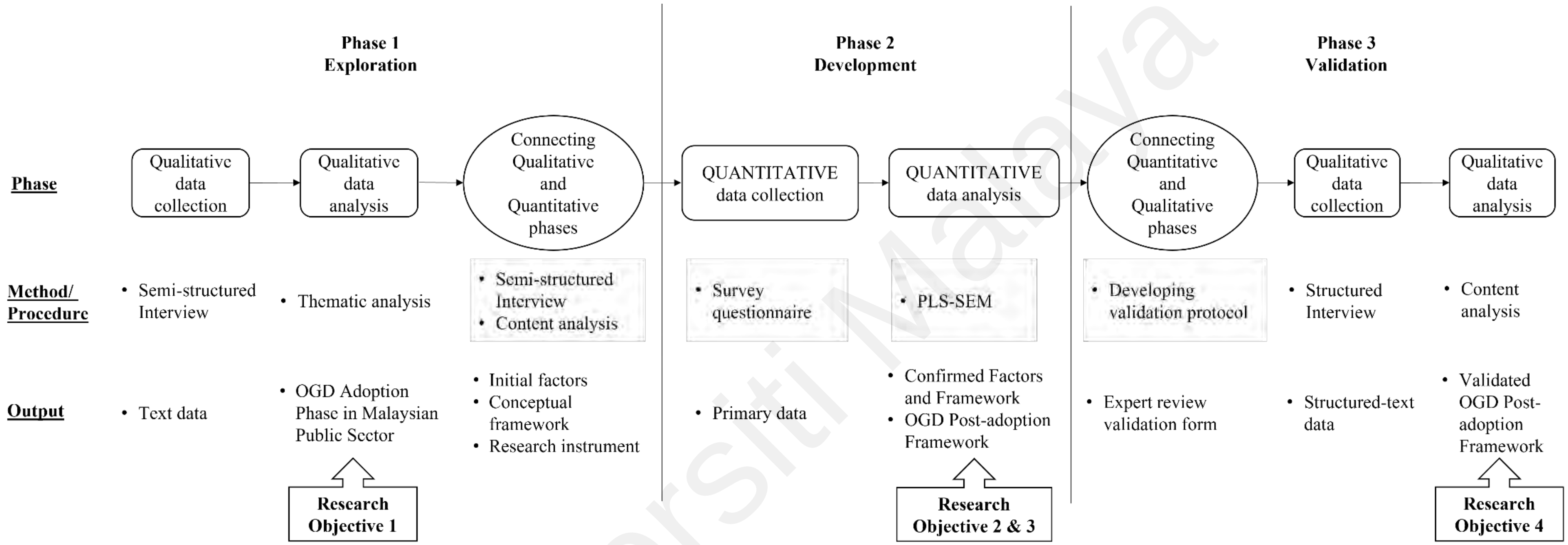

Figure 4.3: Quantitatively-driven sequential mixed methods design adopted from Ivankova et al. (2006).

4.3.1 Phase 1 (Exploration)

The first phase of the research design is known as the exploration phase. In this phase, the preliminary study was conducted by employing a semi-structured interview with four high-ranked government officials from the central agency. The goals of the semi-structured interview were to explore the current state of OGD implementation and to determine the OGD adoption phases in the Malaysian public sector. The interview session was also intended to identify the issues and gaps of the research problems.

Thereafter, the study conducted another round of semi-structured interviews with the pioneer agencies that have been implemented OGD since its inception in Malaysia in 2014. The semi-structured interview question set is presented in Table A.4 in Appendix A. The question set is divided into two parts; the first part is the interview questions, and the second part is the list of possible constructs extracted from IT innovation post-adoption in organisation literature. The semi-structured interviews recordings have been transcribed, and the interviewees' choice of constructs was consolidated. The complete list of all potential constructs identified from the literature is presented in Appendix B. After careful consolidation, the final constructs for the conceptual framework were selected based on two judgments. Firstly, the construct is relevant and perceived as most significant and aligned with the literature on the phenomenon under study. Secondly, the constructs are matched with the constructs extracted from the interviews' feedback with pioneer agencies in OGD implementation in the Malaysian public sector. Through a thematic analysis, a set of initial factors have been identified to help the study construct the research instrument, which is the survey questionnaire. The survey questionnaire is used in Phase 2 for the development phase that will be explained in the next section. The preliminary study's output is the confirmed phase of the OGD adoption process in the Malaysian public sector, which also marked the achievement of the first research objectives.

4.3.2 Phase 2 (Development)

In this phase, the key work includes developing two essential components of this study, the conceptual framework and the research instrument. The conceptual framework development is explained in the previous section 3.4. Prior to developing the research instrument, another round of semi-structured field interviews was conducted with pioneer agencies that have implemented OGD since 2014. Three government agencies and one corporation were selected for the pioneer agencies interview. The aim of performing the semi-structured interviews was to grasp the initial factors that determine the OGD implementation. It also helped the researcher gain insight to form the general idea of the study's research instrument. The initial factors found from the pioneer agency interviews study were scrutinized and integrated with the conceptual framework. Along with the conceptual framework, the hypotheses of the study were formulated. This phase recorded three outputs, the study's initial factors, conceptual framework, and hypotheses. The conceptual framework is vital as it drives the subsequent task, which is to formulate the hypotheses of the study. Numerous potential theories can be described and predict how an organisation adopts innovation adoption and eventually diffuses in the organisation. Among the organisation theories explored, the Technology-Organisation-Environment (T-O-E) theory is the most substantiated theory to explain the OGD implementation in Malaysia's public sector. This study embraces the scale development procedure advocates by MacKenzie, Podsakoff, and Podsakoff (2011) to further develop the research instrument.

Two random individuals were recruited for the face validity procedure, and eight academicians were engaged for the content validity procedure. Some amendments were made based on the face validity procedure's comments, including the clarity of the words, the aesthetic features, and the questions' coordination. The amended version of the research instrument was printed and brought to eight assessor panels from different universities in Malaysia for content validity procedure. The background of the assessor panels is presented in Table A.2 in Appendix A. Specific instructions were written for the experts to guide them to give a score for each of the questions in the survey. Using the Content Validity Index (CVI) analysis, the validation procedure results have proved that the research instrument had an excellent score. The Content Validity procedure of this study is described in section 5.3.2.1.

In Step 4 of the scale development procedure, a pilot test was conducted to evaluate the feasibility of the survey questionnaire with the real respondents. Selected respondents will be excluded from the actual study to avoid biases. A printed copy of the survey questionnaire was distributed to the selected government agency at two ministries in Putrajaya. At this point, the research instrument and the pilot data are added to the list of outputs that this study entails. In Step 5, the survey instrument is refined through a statistical technique called the Principal Component Analysis (PCA). The PCA is analysed using the Statistical Package for Social Sciences (SPSS) software from IBM. PCA is one of the statistical techniques used by researchers to minimise the broad number of observed variables to a smaller number of factors and outline trends of correlation between observed variables (Tabachnick & Fidell, 2012). In these techniques, the researcher will be able to identify variables that are truly robust and unique to measure in the actual study. The output from the pilot test contributed to the development of the conceptual framework. Details of the pilot test are explained in section 5.3.2.3. The next section will explain the conceptual framework and the hypotheses development.

The main data was collected mainly through an online version of the research instrument, designed in a paid online questionnaire tool called Survey Monkey. In this data collection step, the online survey was disseminated to the target government agency via email invitation. This actual data collection was held for two months, starting from

October 2019 until December 2019. The data collection step produces the fourth output of the study, which is the primary data.

In the data analysis step, the primary data was first harmonized through a data cleaning process, which involves removing incomplete data to prepare the data before the data analysis procedure. Once the primary data is ready, data analysis steps using SPSS and Smart PLS software are performed. A set of validated factors was obtained from the results of comprehensive data analysis using the Partial Least Square-Structural Equation Modelling (PLS-SEM) method. In consequence, the second research objective, which is to develop the OGD post-adoption framework in the Malaysian public sector is achieved within this development phase.

The results from the data analysis led the researcher to build a discussion of the findings. At this step, the empirical finding was critically discussed to emphasize the contribution of the study. Among other arguments debated includes evaluating any conflicting results or unexpected findings. The output of the discussion and synthesis of the results step is the confirmed factor influencing the OGD implementation in the post-adoption phase. In this step, the development of the OGD post-adoption framework is complete with confirmed factors and tested hypotheses. Hence, it indicates that the third research objective of the study has been achieved.

4.4 Conceptual Framework and Hypotheses Development

A framework is a structure, set, or system of ideas or concepts. A conceptual framework is a logically structured representation of the concepts, variables, and relationships involved in a scientific study with the purpose of identifying what will be explored clearly, examined, measures, or described (Imenda, 2014). The conceptual framework is essential to provide a descriptive representation of the theory use and the relationship between variables in the conceptual framework. Any characteristic or attribute of an individual or organisation that has varying values and can be measured or observed is called a variable (Creswell, 2013; Sekaran & Bougie, 2013). The conceptual framework or model also provides a context for examining a problem or phenomenon, therefore constructing the rationale for developing the hypothesis (Sekaran & Bougie, 2013). Some scholars postulated that it is essential to combine more than one theoretical model in order to comprehend the phenomenon of IT adoption from a different angle (Oliveira, 2011; Van de Ven & Poole, 1995). In addition, innovation theorists have suggested that the creation of a unifying innovation theory might not be feasible due to the intrinsic variations across innovation types (Thong, 1995). The innovation adoption in organisation research has thus combined adoption and implementation theories with frameworks from various contexts to assess innovation's adoption.

OGD is regarded as new government innovation and can be conceptualized using the innovation adoption process (Ruijer & Meijer, 2019). Driven through previous study, documents analysis, and consultations with field experts, this study resort to the T-O-E framework for actively modelling the OGD post-adoption implementation attentively. Researchers have combined the DOI and innovation adoption process with different contextual frameworks to address OGD post-adoption in the public sector. This study employs a deductive approach in developing the conceptual framework. The explanation of the deductive approach is presented in sub-section 4.2.2. Deductive research is concerned with developing a hypothesis on existing theory and thus relies heavily on the conceptual framework to validate the hypothesis (Sekaran & Bougie, 2013). Although there is no prescribed approach for building a theoretical framework offered by deductive scholars, this study follows the main procedures taken by most of the literature. In determining the conceptual framework's independent and dependent constructs, this study has employed a combination of the literature reviews and semi-structured interview methods to consolidate all the potential constructs. Some of the initial independent constructs are adopted from the extant literature while some are discovered during the preliminary study.

Through the pilot test, the initial independent constructs were reduced from ten to nine final constructs. In developing the hypotheses, the suggestions by Kothari (2015) is applied by reviewing the available evidence and material, including similar study, and getting the opinions from experts through field interviews. The details of the independent and dependent constructs for the conceptual framework and the hypothesis of each construct are described in the next sub-sections.

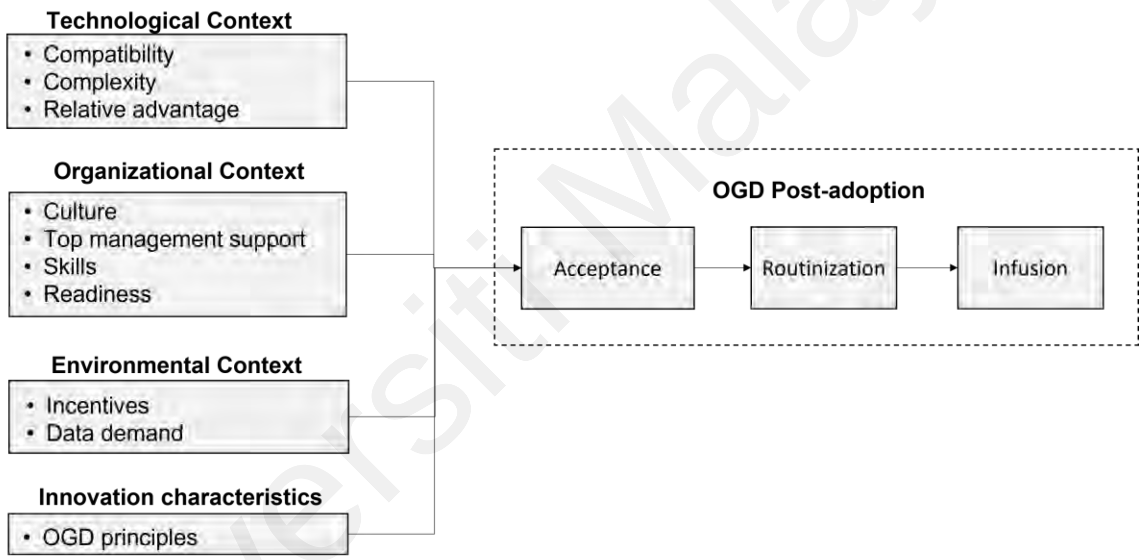

Figure 4.4: Proposed Conceptual Framework for the Post-adoption Framework for Malaysia Open Government Data.

4.4.1 Independent Constructs

The independent constructs are placed at the left side of the proposed conceptual framework, as depicted in Figure 4.4. Based on the literature reviews, a number of potential independent constructs that can represent the current attributes surrounding OGD implementation have been extracted. The literature was selected from Web of Science core collections ranging from the year 2010 to 2020. The reason for filtering the year is to get the most recent studies as possible so that the constructs are still relevant for current studies. Next, the screening criteria are set to get literature that adopts the T-O-E as the framework of their research model. The scope is narrowed down to only literature that studies IT innovation at an organisational level of analysis. All independent constructs discovered from the literature are presented in Table B.1 in Appendix B.

Table 4.1: Summary of The Constructs Extracted from Semi-structured Interview and Literature review.

Context/ Constructs	**Semi-structured Interview**	**Literature review**
Technology		
Compatibility	✓	✓
Complexity	✓	✓
Relative advantage	✓	✓
Organisational		
Top management support	✓	✓
Skills	✓	✓
Readiness		✓
Culture	✓	✓
Environment		
Incentives		✓
Data demand	✓	
Others		
OGD Principles	✓	

4.4.1.1 Technological Context

The technological factors consist of crucial constructs that have been found as the most significant characteristics in many works of literature on innovation adoption in organisations. In the area of information system research, Roger's (1983) DOI theory of innovation adoption model is notably recognised and has been adapted by an abundance of research. Rogers (1983) outlines five crucial innovation's characteristic which affects its adoption: compatibility, complexity, relative advantage, observability, and trialability. However, between these characteristics, compatibility, relative advantage, and complexity have congruous correlations with innovation behaviours (Tornatzky & Klein, 1982).

As hardly a new initiative that barges into the existing government data management practices, it can sometimes be surprised if the government agency regards the OGD as a complex innovation and challenging to implement. Besides, recognising the comparative benefit that emerging technology provides compared to current innovations is highly important for the government since the government often takes careful consideration of investing in new technology. Therefore, under the large dimension of technological context, the three key technological constructs for the research model of this study research are compatibility, complexity, and relative advantage. The following subsection explains each of the constructs.

(a) ***Compatibility***

Compatibility can be defined as the extent to which the innovation is compatible with its business process, culture, and belief system (Rogers, 1995). In OGD, certain government agencies perceived that the OGD definition is not aligned with the agency's business procedure since all data are treated as classified data. However, some government agencies generate data that is supposed to be exchanged with the public, such as evidence relating to consumerism. The combined understanding of OGD compatibility by these government agencies is thus a very important aspect to be further investigated. Hence, the next hypothesis is suggested:

H1: Compatibility positively influences OGD acceptance in the public sector.

(b) ***Complexity***

Complexity may be referred to as the degree to which innovation is viewed as challenging to use and comprehend (Junior et al., 2019; Rogers, 1995). Previous work in

Mustapa et al. (2019) highlighted that due to certain criteria prior to data release, the government agencies viewed the task of publishing OGD as tediously complicated, such as the data need to be in high granularity, execute data anonymization process to prevent privacy concerns, and adjust the data format to be practicably in machine-readable. The study is consistent with the study from Junior et al. (2019) and Çaldağ et al. (2019). Choosing the appropriate data as an OGD is already a complex challenge for certain governments agencies because they risk releasing incorrect data. Hence, the next hypothesis is proposed:

H2: Complexity of OGD negatively influence OGD acceptance in the public sector.

(c) ***Relative Advantage***

Relative advantage has been established as a major factor in multiple innovation adoptions research at the organisational level (Çaldağ et al., 2019; Zhu, Kraemer, et al., 2006). By definition, the relative advantage is the degree to which innovation is considered beneficial and may offer advantages to the organisation (Rogers, 1983). The relative benefit is generally expressed as the degree of perceived benefits that innovation may bring to the company, and thus the relative advantage and perceived benefits are used synonymously in the literature of innovation adoption (Iacovou, 1995; Junior et al., 2019; Oliveira, 2011). In view of the multitude of public benefits of OGD, it will therefore be anticipated that the government agencies will want to incorporate OGD initiatives into their task repository. Thus, the next hypothesis is formulated:

H3: Relative advantage of OGD positively influence OGD acceptance in the public sector.

4.4.1.2 Organisational Context

The organisational context refers to the organisation's characteristics and resources, including the association between workers, internal communication systems, the business scale, and the number of resources and capabilities (Baker, 2012). The organisational context can also reflect the intra-organisational ecosystems and defines the organisation's characteristics that promote or limit the implementation of innovation technologies (Tornatzky & Fleischer, 1990). In this study, three factors in the organisational context are employed in the research model. The description of the factors and the hypotheses are presented next.

(a) ***Culture***

To evaluate the efficacy of OGD in the post-adoption phase, it is important to understand the organisation culture, especially the public sector as a data provider within the OGD ecosystem. Organisational culture applies to a group of individuals who have the same convictions and awareness of challenges inside and beyond the organisation (Çaldağ et al., 2019). In this study, the culture refers to the government agency openness culture that revolves around how they respond to publicly managing and sharing data. As described by (Ke & Wei, 2008), the relationship between organisational culture and information system acceptance is so vital as it can lead to either resistance or modification of the information system to suit the organisation's culture.

Studies by Ruijer and Huff (2016) and Yang and Wu (2016a) suggested that the government's openness culture would be easier to encourage once the government agencies are prepared to exchange knowledge and data outside of the agency itself. However, there are cases where government agency was seeming to be receptive to OGD but implicitly disregarded the initiative due to the long-standing risk-avoidance culture instilled in the organisation (Janssen et al., 2012; Peled, 2011; Zuiderwijk et al., 2012).

This suggest that the OGD implementation can also be influenced by the openness culture of the agency. Hence, the next hypothesis is formulated:

H4: Organisational culture positively influences OGD acceptance in the public sector.

(b) ***Top Management Support***

Numerous research has shown that top management support is one of the most critical factors contributing to the effective introduction of IT/IS innovation in an organisation in all adoption phases (Hameed et al., 2012b; Rai et al., 2009). Top management support is essential in OGD post-adoption for three main reasons. First, top management support is important to increase the effort and resources to build an atmosphere more favourable for the adoption of OGD (Hwang, 2019). A lack of resources is a common issue for any innovation deployment in the government agency, and this is where the top management roles are crucial to making important decisions on allocating the necessary resources (Zhu et al., 2010).

Secondly, in the change management process, the top management has the ability to override opposition from subordinates to enforce the OGD initiatives. In most situations, top management is capable of monitoring opposition and inspiring stakeholders of the organisation to support innovation in IT/IS. Third, top management is responsible for constructing an effective communication mechanism in promoting innovation adoption in the organisation (Baker, 2012). Weak coordination regarding the strategic advantages of innovation will also contribute to resistance within the organisation's stakeholders to consider the adoption of innovation (Chandra & Kumar, 2018). A study by Wang and Lo (2016) has explored the top management factor as the most influential factor in the OGD adoption phase. It is essential to investigate if the top management factor continues to provide the same contribution in the post-adoption of OGD. Therefore, the following hypothesis is proposed:

H5: Top management support positively influences OGD acceptance in the public sector.

(c) Information Technology (IT) Competency

The Information Technology (IT) competency construct is an integrative concept that combines the human capital and physical resources of the organisation (Chandra & Kumar, 2018). In this regard, the human capital dimension described the organisation's members' experience, skills, and knowledge (Hameed et al., 2012b). Simultaneously, the physical resources refer to the IT infrastructure used to implement OGD, such as a personal computer, servers, internet connection, and whatnot. The human capital and physical resources dimensions complement each other to portray the organisation's capacity to adopt innovation. Other terms used to reflect the same meaning of IT competency that has been adopted by other literature are IT expertise (Nguyen, 2017), technical competence (Chandra & Kumar, 2018; Zhu, Dong, et al., 2006), technical capacity (Zhao & Fan, 2018), technological competence (Wang et al., 2016), and IT sophistication (Rai et al., 2009). According to the previous study, technology competency that usually relates to the technological infrastructure and human IS/IT capacity of an organisation has been found to be a significant factor in the adoption of innovation (Chandra & Kumar, 2018; Hameed et al., 2012b; Li et al., 2011).

In the case of OGD, the technical skills that should be equipped among government agencies members are basic skills they possess in completing their daily tasks using a personal computer such as spreadsheet software, internet, and whatnot. However, Ubaldi (2013) suggests that having basic IT knowledge is insufficient to empower civil servants with OGD initiatives. Instead, civil servants have to learn more advanced knowledge, including data science, web 2.0 technologies, predictive analytics, social engagement tools, and cybersecurity. The same view is expressed by Maccani et al. (2018), in which the researchers found that among the skills and knowledge that is essential to learn by OGD adopters are data analytics, data management, programming, graphic design skills, and even communication skills. Communication skills are helpful mostly to convince the stakeholders to commit to OGD publishing (Maccani et al., 2018).

Nevertheless, the IT competency factor has been highlighted as part of the key characteristics for successful OGD implementation (Luna-Reyes & Najafabadi, 2019). Furthermore, as posited by (Janssen et al., 2012), insufficient knowledge and skills and unsuitable data infrastructure can cause many datasets to continue to be out of sight.

The IT competency in this study is intended to examine the government agency's capacity in terms of IT infrastructure readiness and the technical skills, experiences, and knowledge of the government agency personnel in operating OGD initiatives. Based on the interview with the government agency representatives, having competent personnel in IT gives more motivation to the government agency to implement OGD in the post-adoption phase. Hence, the following hypothesis is formulated:

H6: IT competency of the government staff positively influence OGD acceptance in the public sector.

4.4.1.3 Environmental Context

The environmental factors for this study were derived by mostly from the semi-structured interview session with the pioneer government agency in OGD implementation in Malaysia. The next subsection describes both the data demand and incentives factor in the environmental context.

(a) Data Demand

Data requirement is a new element learned during the meeting with government agency representatives. Data demand carries the meaning of data request by the public for particular datasets that is related to the organisation. Provided that the data is non-confidential, the public is allowed to request datasets through the government data portal by submitting a data request form. In the case where the data consumer already knows which government agency provides the data they want, an email for data request is sent directly to the government agency. The response from the semi-structured interview with the pioneer agencies towards data demand was mixed. On the one hand, some agencies feel encouraged to publish more data. On the other hand, some agencies were dubious regarding their advantages by committing themselves to OGD publishing. Furthermore, government agencies that choose to commit to OGD initiatives consider meeting data demands to be part of more effective government services delivery to the people.

OGD ecosystem in Malaysia's public sector is highly supply-driven (World Bank Group, 2017). No doubt that sometimes meeting the data demand from the stakeholders can be quite challenging. Although sometimes the requested data is categorized as open, the process of aligning the data to the OGD requirements is tiresome, thus hampering the government agency to fulfil the request. However, a different narrative is manifested if the government agency feels that releasing their data will benefit them. Until it is proven by empirical analysis, the data demand is perceived as a positive influence on OGD implementation in the post-adoption phase. As a consequence, the following hypothesis is proposed:

H8: Demand for OGD from the public positively influences OGD acceptance in the public sector.

(b) ***Incentives***

Incentives can be defined as any kind of recognition provided to a person or social system to encourage an explicit shift in behaviour (Kulkarni et al., 2006; Lu et al., 2020; Rogers, 1983). The incentives factor has been identified by Rogers (1983) and Lu et al.

(2020) as a positive antecedent on innovation adoption in the organisation and increasing the rate of innovation adoption. In one of the findings in Rogers (1983), providing incentives was also one of the organisation's strategies to secure adoption at a certain rate, but once the desired rate of adoption is achieved, the incentives were discontinued. However, Rogers (1983) also warned about ethical issues and risks about providing the incentives for adopting an innovation. On one side, providing the incentives may invite the pro-bias adoption in which adopters is using the innovation for the sake of the incentives rather than accepting the innovation naturally. Thus, creating low quality of adoption that led to some hindrances to achieve the objectives of adopting the innovation. On the other side, the adopters may later feel demotivated to use the innovation if the incentives are no longer provided and this may cause to the discontinuance use of the innovation.

Meanwhile, a study by Shkabatur and Peled (2016) has revealed that a lack of incentives has caused a poor institutionalization of OGD in four developing countries, namely, the Philippines, Morocco, Moldova, and Kenya. The findings convey the impression that when prizes such as cash money, national recognition, or awards are offered as an appreciation for their involvement, government agencies appear to be more driven by some government initiatives. The incentives may not necessarily be in the form of money, but sometimes getting recognition from the organisation's top management is enough to endorse the employees' efforts. In addition, the involvement of government agencies in OGD programs is focused on a voluntary basis; it is therefore very pleasing to offer an acknowledgement of their contributions. There are five common forms of incentives that can be provisioned, as outlined by Rogers (1983):

i. *Adopter versus diffuser incentives*. The incentive is awarded directly to the adopter or to another party to convince a potential adopter.

ii. *Individual versus system incentives*. The incentive is rendered to particular adopters, agents of reform, or social systems to which they adhere.

iii. *Positive versus negative incentives*. An undesired incentive in the form of a penalty is imposed on the adopter due to withdrawing or not adopting an innovation.

iv. *Monetary versus nonmonetary incentives*. A commodity-like incentive or any form of item that is desirable to the adopter.

v. *Immediate versus delayed incentives*. An incentive that is given at a later time after the adoption.

The incentives factor is listed in this analysis as an environmental context as an incentive may be provided by an internal or external party or by any unit not within the government agency's social structure. The aim of the incentives factor is to investigate whether the incentives are having a positive influence on OGD implementation in the Malaysian public sector. Therefore, the following hypothesis is formulated:

H9: Incentives positively influence OGD acceptance in the public sector.

4.4.1.4 OGD Principles

The concepts of OGD principles are a series of recommendations from the 2007 Open Government Working Group meeting in Sebastopol, California, to advise the government about the sort of data that should be deemed open. (Ubaldi, 2013). The guidelines contain eight principles for a dataset to be published as OGD, namely, complete, machine-processable, license-free, timely, non-proprietary, non-discriminatory, primary, and accessible. The guidelines include eight standards, namely open, primary, non-discriminatory, timely, license-free, complete, non-proprietary, and machine-processable, for a dataset to be released as OGD. However, the OGD principles were later revised by a few parties, and various version was released to amend the OGD principles to suit the organisation's preferences. For example, the open data definition by the Open Knowledge Foundation (OKF) is intended for any data type; thus, the open data requirements of the OKF are not as strict as the Open Government Working Group and the International Open Data Charter (IODC). For the purpose of this study which focuses on government data, the eight OGD principles from the Open Government Working Group are employed as one of the independent constructs in the conceptual framework.

Following many years of implementing OGD concepts in the country, it is necessary to check that government agencies are motivated to make more data accessible. In the study model, the OGD principles are isolated as innovation features because the OGD principles have their particular characteristics and need to be explored as variables leading to the post-adoption of OGD. Furthermore, the OGD principles serve as a novel factor for OGD adoption research. This is the first study that attempted to evaluate OGD principles as the influence factor to the post-adoption phase of OGD implementation. Ergo, the next hypothesis is proposed:

H9: OGD principles positively influence OGD acceptance in the public sector.

4.4.2 Dependent Constructs

The dependent constructs for the conceptual framework of this study are derived from the six stages of the IT implementation process by Cooper and Zmud (1990). The stages and descriptions are provided in section 2.5.3. However, only the last three stages, which are the acceptance, routinization, and infusion stages, are adapted as the dependent variables. This study focuses on the post-adoption phase of innovation. The model from Cooper and Zmud (1990) helps establish a more profound knowledge of IT and operational problems throughout the implementation process. The model also forms the mechanism of IT-enabled organisational change and is relevant to the kind of IT innovation (OGD) and implementation background (public sector organisation) in this particular research. Some may argue on the similarity of the acceptance, routinization, and infusion stage with continued use of the IT/IS innovation stage; well, the difference lies in the aims of the stages. Unlike the continued use that refers to whether the user keeps using the IT/IS innovation, the acceptance, routinization, and infusion stage in comparison is about the breadth and depth of the user implement the IT/IS innovation.

The acceptance, routinization, and infusion are strong dependent variables for innovation implementation in the post-adoption phase that can also be studied separately as single-stage. For instance, the study from Chen (2020) uses the routinization phase from Cooper and Zmud (1990) to investigate the factors that influence a tax department to routinize tax analytics and automation (TAA) technologies in their work's system. A study by Fadel (2012), through the Coping Model of User Adaptation (CMUA), explores the assorted adaptation behaviours that influenced the IS users to reach the infusion stage in their work. Last but not least, several studies are conducting systematic reviews to explore the level of infusion more deeply (Hassandoust et al., 2016; Lu & Gallupe, 2016; Marakhimov & Joo, 2016).

Considering the post-adoption of OGD implementation has not been explored in Malaysia, and due to the need to find a way to apply 'Open by Default' culture, this study exerted acceptance, routinization, and infusion as the dependent variables for the conceptual framework. With this approach, this study will be able to understand whether the OGD implementation is progressing towards embedding the OGD in the public sector work's system.

4.4.2.1 Acceptance

Acceptance is defined as the effort to bring the organisation members to commit use or practice of an IT/IS innovation (Kim & Kim, 2020; Saga & Zmud, 1993). In this report, OGD adoption is a decision made by the federal government system from the higher management level; hence, the OGD initiative is eventually expected to be adopted by government agencies at all levels. The acceptability of OGD policies is significant since it defines the conduct of the government agencies in the next post-adoption phase. Acceptance of technologies within organisations is crucial since the desirable results cannot be realized without support from the target audience (Frambach & Schillewaert, 2002; Lu et al., 2020). Therefore, the following hypothesis is formulated:

H11: Acceptance of OGD positively influence government agency intention to OGD routinization.

4.4.2.2 Routinization

Routinization is referred to as the extent where the innovation has established and become part of the organisation's work systems (Fichman, 2000; Kim & Kim, 2020; Pennington et al., 2020; Rogers, 1983; Saga & Zmud, 1993). At this stage, the innovation will also lose its identity and become a regular activity in the organisation. Routinization is pursued after the acceptance stage in the post-adoption phase, which implies that the OGD cannot be in the normal practice of the public sector task function if it is not well received. A study by Zhu, Kraemer, et al. (2006) has exhibit the routinization of innovation as a significant construct for the IS success factor. Hence, the next hypothesis is suggested:

H12: Routinizing of OGD positively influence government agency intention to OGD infusion.

4.4.2.3 Infusion

As defined in section 3.2.3, the infusion is the process of embedding the IS/IT application in the organisation's work system (Fichman, 2000; Joo, 2019; Kim & Kim, 2020; Saga & Zmud, 1993). A number of researchers have employed infusion as the highest degree step in the implementation of innovations; this indicates that infusion could be the final stretch of active adoption of innovations. In the context of this study, the infusion of OGD is viewed as embedding the OGD publication in the government agency work's system. One of the infusion processes that could be practised is perhaps to foster the open-by-default ethos of government agencies such that OGD is no longer viewed as a side mission but more as part of the everyday activity of the government service. In fact, Barry and Bannister (2014) highlight in their findings that the organisation must put a firm policy to make OGD part of the organisation's plan to expedite the implementation. The infusion stage has a strong relationship with the routinization stage. A high level of OGD infusion can only be achieved if OGD manages to attain a high level of routinization (Cooper & Zmud, 1990). Thus, the study of acceptance, routinization, and infusion for the post-adoption stages of OGD is justified.

4.5 Phase 3 (Validation)

In phase three, also called the validation study, the main task is to validate the OGD post-adoption framework. In this phase, the conceptual framework is finalized and ready to be validated by field experts. The purpose of the conceptual framework validation procedure is to get expert opinions on whether the framework is feasible to be implemented in the public sector. The validation procedure is conducted by employing four government agency personnel to be the expert reviewers. The experts are selected based on their experiences in the government data management scope of work with at least fifteen years of experience. One of the government personnel is from the same central agency which was engaged during the preliminary study. The reason to engage with the same agency is to close the loop of the research problems discovered in the initial stage of the study. Three different government agencies are added to the list of expert reviews with the purpose of adding organic opinions on the developed OGD post-adoption framework. Through this procedure, the OGD post-adoption framework development is complete, and thus the fourth research objective of the study is achieved.

4.6 Summary

The key questions discussed in this thesis is: what are the factors that influence the OGD implementation in the post-adoption phase. To address this question, a research paradigm consists of stages to achieve the goals that were strategised. This study enfolds the positivism philosophy due to the potentiality of the research problems to be solved using a quantifiable method. This stance leads the researcher to embrace a deductive approach by developing hypotheses based on the theory of innovation adoption in an organisation and post-adoption of innovation. The research design was presented in three phases; exploration, development, and validation, which significantly reflects the overall effort taken to conduct this study. In the exploration phase, the research problems and literature review were the main focuses. Findings from the explore phase facilitate the development phase in which the conceptual framework and research instrument were developed. The conceptual framework for the study was developed by utilizing the input from the author's previous works in Mustapa et al. (2020) and several semi-structured interview sessions with pioneer government agencies in OGD implementation. The initial factors were derived from the interview analysis and were later contrasted with the factors analysed from the literature on OGD adoption, post-adoption of various IT innovations, and the TOE framework-based model. The dependent variables were synthesized from the literature review of the innovation adoption process in an organisation. A questionnaire survey is chosen as the research instrument to gather evidence from the government agencies in the Malaysian public sector that have implemented OGD. These government agencies also have been defined as the study's population. The validation phase from the research design is aimed to add the value of the empirical findings.

CHAPTER 5: DATA ANALYSIS & FINDINGS

As the research design and conceptual framework have been established and justified in Chapter 4, this chapter presented the execution of Phase 1-Exploration and Phase 2-Development study. The focal point of this chapter is the data analysis and findings from Phase 1-Exploration and Phase-2 Development, which bring the study closer to answer the second and third research questions. A three-phased approach to the study's research design allows for separate data collection, analysis, and findings for each of the three stages. Data analysis and findings during the Phase 3-Validation study will be presented separately in Chapter 6.

5.1 Introduction

Phase 1-Exploration comprises the qualitative analysis, and Phase 2-Development comprises the dominant method, which is the quantitative analysis. The study is structured so that the findings from one phase complement the deliverables from the following phase to achieve the research objectives. Further elaboration for both phases is presented next.

5.2 Phase 1-Exploration

This section presented the procedure for the preliminary study (Phase 1-Exploration). The preliminary study, as mentioned in the research design was utilised the qualitative method. This preliminary study aims to explore as much as possible about OGD adoption in the Malaysian public sector from its inception to the current status. Much of the information about OGD implementation was scattered in many forms. The central agency sometimes released OGD adoption statuses in slides presentations, minutes of meetings, and unofficial reports. The results from the qualitative method are crucial to help construct the next steps in the quantitative study. Without the qualitative results from the preliminary study, the steps planned for main data collection and analysis may not happen as expected, thus, undermining the validation phase in this study. This chapter also accomplished the first research objective.

5.2.1 Semi-structured Interview with Top-level Reviewer

In Phase 1 of the research design, the study employed the qualitative method to achieve the first research objective. The qualitative method is chosen as the suitable method because the data is not measurable, but rather it has to be elicited from limited sources. The next sub-section described the data collection procedure, data analysis, and findings from the semi-structured interview session.

5.2.1.1 Data Collection Procedure

As the first step in this research, a semi-structured interview with the central agency that spearheads the OGD implementation in the Malaysian public sector was conducted. The semi-structured interview sessions were performed with four top-level officers in a central agency called the Malaysia Modernization and Management Planning Unit (MAMPU). MAMPU is in charge of spearheading the OGD implementation in Malaysia. The background of the high-rank officers referred to as top-level reviewers (TLR) is presented in Table A1, Appendix A. These officers were also sitting at the top post of the Public Sector Open Data Coordination Committee, as depicted in the OGD Governance Structure (Section 2.4.1). These respondents' position is solitary in the government structure; therefore, these experts stand with high integrity and credible information.

The semi-structured interviews session was conducted from January 2019 to March 2019 at the respondent's office. On average, each semi-structured interview session lasted about one hour and was tape-recorded with the permission of the respondents. The semi-structured interviews session was conducted in Malay and English languages interchangeably to allow the respondents to articulate the information at their convenience. Apart from exploring the adoption process of OGD in the government, the semi-structured interview was also intended to gain insights into the barriers and challenges faced in publishing OGD. Some government documents were also referred to support the arguments by the respondents. Having multiple methods in collecting the research findings would assert the research findings at a significant level of realism (Yin, 2018).

5.2.1.2 Data Analysis

Qualitative data have traditionally been gathered through research interviews, as they give researchers the opportunity to better understand how people interpret the world (Fernandez, 2018). The majority of the information gathered from interviews is in the form of texts, either oral or written. Other data can be used when the interview is video recorded or is mediated by another communication channel, such as a video call interview; however, the analysis of text remains one of the focal elements of interview analysis (Vaismoradi et al., 2016).

In this study, a thematic analysis technique was employed to analyse the data from the interview with the central agency. Thematic analysis is a technique for detecting, analysing, and reporting patterns (themes) in data (Braun & Clarke, 2006). A theme unifies views about the issue under investigation and is rather general (Bradley et al., 2007; Vaismoradi et al., 2016). The themes can be extracted by first chunking and clustering the data into a code. A code is a construct created by researchers that symbolises and assigns interpretive meaning to every single datum for subsequent use in pattern identification, categorization, theory development, and other analytic procedures (Miles et al., 2014).

Using ATLAS.ti as the CAQDAS (Computer Assisted Qualitative Data Analysis Software), the interview recordings were transcribed for further analysis procedure. Once the transcribing was done, the transcripts were translated into English as the interviewees were responding in Malay. Various computer-assisted tools for grammar and language checking were used to check the language consistency of the transcripts. The interview transcripts were thereafter analysed using the qualitative content process, which has four phases: initialisation, construction, rectification, and finalization, as advocated by Vaismoradi et al. (2016). Figure 5.1 summarise the phases and stages involved in qualitative content and thematic analysis.

Phases	Stages
Initialization	Reading transcriptions and highlighting meaning units; Coding and looking for abstractions in participants' accounts; Writing reflective notes.
Construction	Classifying; Comparing; Labelling; Translating & transliterating; Defining & describing.
Rectification	Immersion and distancing; Relating themes to established knowledge; Stabilizing.
Finalization	Developing the story line

Figure 5.1: Phases and stages of theme development in qualitative content and thematic analysis adopted from Vaismoradi et al. (2016).

During reading the transcript, important words or data were highlighted for an initial coding process. The important information or data that were coded refers to the activities associated with the innovation adoption process in section 2.5. Although there have been various methods available, there is no perfect coding method for any particular study, thus choosing the best coding method is subjective (Saldaña, 2013). Therefore, for the purpose of this study, elaborative coding was used to code the interview transcripts and documents analysis. Elaborative coding is also known as the top-down approach because the initial theory of the study, which is the innovation adoption process, has been developed in the previous study (Saldaña, 2013). The activities mentioned above completed the 'Initialisation' phase (Vaismoradi et al., 2016).

Next, the initial coding performed earlier was grouped into the pre-defined concept from the innovation adoption process: pre-adoption, adoption, and post-adoption. In the construction step, the codes were organized and compared in terms of the definition. It is important to use the same terms and keywords as this will create consistency across all interview transcripts. The third step in the qualitative content analysis is called rectification. Rectification is described as the process of verifying the defined codes. The codes were also associated with the theoretical model to create a meaningful interpretation (Vaismoradi et al., 2016). According to Vaismoradi et al. (2016), the last step in the qualitative content analysis is the finalizing phase. In this step, the codes are usually articulated to become a narrative story that connects all the codes coherently. However, for presentation purposes, this study decided to convey the narratives in a simple description manner. Table 5.1 presents the organizing themes, codes, and some quotes that illustrate the activities carried during the pre-adoption, adoption, and post-adoption phase. The extracted codes later were elaborated to longer-phrase themes as a meaningful input for this study. Due to very long answers from the transcript, the findings only present excerpts that are related to the theme defined.

Table 5.1: Codes for adoption process activities.

Excerpt extracted from the transcripts	Codes	Organizing theme
• "*Initially, open data was new to us. It is not developing software, it is not establishing an infrastructure, it is not a methodology, but it is a combination of all that.*" • "*We form a unit in the central agency to lead the Open Data initiative.*" (Top-Level Reviewer 1) • "*Open Data initiative in Malaysia started in 2014. At the early stage, the open data portal simply was made internally*" (Top-Level Reviewer 3)	• Awareness program • Engagement program • Finding resources (Cost, infrastructure, staff, etc.)	Pre-adoption (Initiation)
• "*The Prime Minister mandated the mandate to embark on the open data initiative in a series of high-level meetings such as the Government IT & Internet Committee (GITC) and Panel Meeting on Public Services.*" (Top-Level Reviewer 2) • "*In 2015, we drafted a circular for open data. Fortunately, we have good cooperation with the Malaysian Digital Economic Corporation (MDEC) to form the circular*" (Top-Level Reviewer 1)	• Decision made/mandated by whom • Receiving support • Resources allocation • Management/governance structure Stakeholders' involvement	Adoption-decisions
• "*As of today, I can say that the open data initiative in the Malaysian public sectors are currently in the implementation phase*" (Top-Level Reviewer 2) • "*In 2017, we had international cooperation with the World Bank Group. In this cooperation, the World Bank Group performed an assessment called Open Data Readiness Assessment (ODRA)*" (Top-Level Reviewer 3) • "*As an ongoing effort to accomplish the data-driven government idea, we conducted a program called the Malaysian Open Data User Group (MODUG)*" (Top-Level Reviewer 1)	• Acceptance • Implementation effort/ program • Incorporated • Planning for future direction/program • Work-process • Routinization of the initiatives • Achievements • Impact	Post-adoption (Implementation)

5.2.1.3 Findings: OGD Adoption Process in the Malaysian Public Sector

This section presents the findings from Phase 1 (Exploration) conducted using a semi-structured interview method. Using the codes defined in the previous section, the theme that the study aims to achieve can be easily recognized and categorized. As simplified in Table 5.2, the OGD adoption process in the Malaysian public sector starts with the pre-adoption phase, followed by the adoption decision phase and eventually, the post-adoption phase.

The study defined the pre-adoption or initiation phase started from 2014, in which the Malaysian government started to get the awareness of OGD. The adoption decision phase inaugurates from 2014 to 2015 when the top management of the Malaysian government mandated the decision to implement OGD in the Malaysian public sector. Finally, the post-adoption phase commences from 2016 onwards when ongoing implementation efforts have taken place to ensure the OGD is incorporated into the government agencies' work norm. Details of challenges and activities involved in each phase will be deliberated accordingly in the next sub-sections.

Table 5.2: OGD adoption phases in the Malaysian public sector.

Phases	Pre-adoption (Initiation)	Adoption decision	Post-adoption (Implementation)
Year	**2014**	**2014 – 2015**	**2016 - Present**
Activities	• Creating awareness of open data in the public sector. • Planning for resources (funding, staff, IT infrastructure) • Engagement with the government agency to encourage data publication.	• Top-management meeting to award the mandate. • Allocating resources. • Developing government open data platform (data.gov.my) • Establishing Open Data governance structure. • Introducing General Circular for Open Data implementation. • Appoint Open Data champion in key government agencies. • Data publication.	• Organising hackathon. • Global open data assessment (ODB, ODIN, etc.) • Setting Key-performance-indicator (KPI) for the agency's data publication. • Collaboration with international bodies (ODI, World Bank, etc.) • Providing the Application Programming Interface (API) for certain datasets. • Improve the quality of the data publication. • Establishing Malaysia Open Data User Group (MODUG).
Documents	• Minutes of meetings: o 2013 25th ICM Meeting o JITIK Bil. 1/2014 o 2014 Cabinet Meeting o MPA Meeting Bil. 1/2016	• General Circular No. 1/ 2015 (Open Data Implementation). • Eleventh Malaysia Plan 2016-2020.	• Malaysia Open Data Readiness Assessment (ODRA) 2017. • Open Data Barometer report (2015, 2016, 2017) • OECD eGovernment Survey 2018, 2020.

(a) Pre-adoption Phase

In early 2014, the government of Malaysia, through series of top management meetings, has decided that all government agencies prepare and act to identify data set for the implementation of open data as part of the agency services. The central agency, MAMPU, is given the responsibility to lead the initiative throughout the country. Subsequently, a lot of awareness engagement was carried out amongst principal government agencies to disseminate knowledge about OGD. In due course, a central government data portal was in the preparation stage by MAMPU to allow all government agencies to publish datasets from a single platform which can be accessed through https://www.data.gov.my.

During the pre-adoption phase of OGD adoption in the Malaysian government sector, challenges that the government faced includes putting the trust among the government agency about the OGD innovation:

"Talking about resistant from government agencies, it was challenging for us to introduce open data at the early stage." (Top-Level Reviewer 2)

The government agencies' doubts were coupled with the fact that the OGD initiative would burden the agency's daily tasks. Furthermore, the agency's lack of resources to handle new initiatives aggravates the situation at that time.

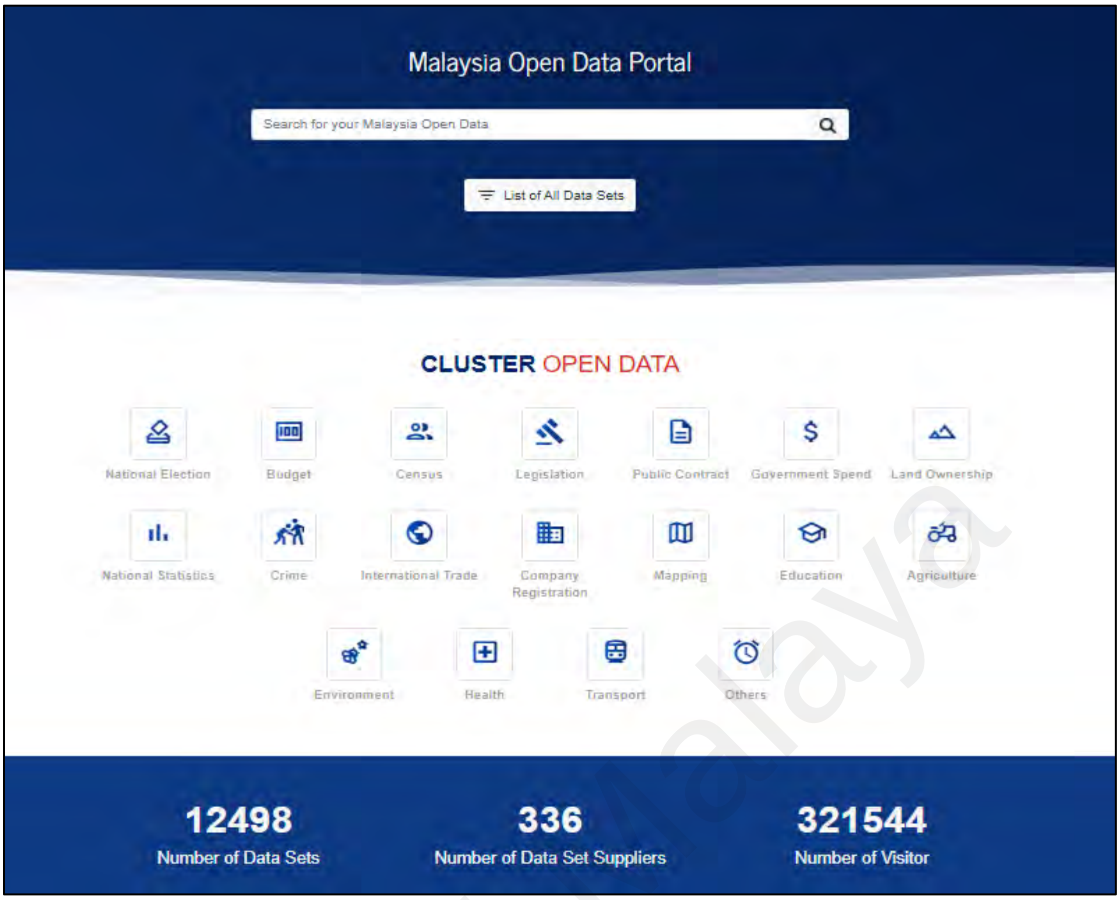

Figure 5.2: The Front Page Malaysia Open Data Portal. (Url: www.data.gov.my, access date: 1st July 2021)

(b) Adoption Decisions Phase

Upon acquiring the mandate from top-level management, the central agency began to educate the government agency on selecting, compiling, cleaning, and publishing data in the government data portal. At this point, the government agencies had gradually shown their commitment to the OGD initiative. At the time the data portal was to be launched in August 2014, a total of 115 datasets were successfully published. The government officially endorsed the OGD implementation through the directive in General Circular No. 1, 2015. Among other imperative contents in the directive, governance structured was established to spearhead the Malaysian public sector's open data policy implementation. The governance structure of Open Data implementation at the federal level is headed by a committee called Government IT and Internet Committee (GITIC). The GITC

Committee comprises several high-level government officers at the federal level and is chaired by the minister. Under the GITIC supervision is another level of management called the Public Sector Open Data Coordination Committee. This committee is set up at the central agency level and monitors the OGD implementation as a whole while at the same time reporting the progress to the GITIC. A specialized task force was set up under the Public Sector Open Data Coordination Committee to execute the OGD implementation at the ground level, including an engagement at the state level, local authorities, civil society organisations, private businesses, academia, and the community at large.

Despite the adoption activities, the adoption challenges continued as the government agencies had trouble finding the correct data to be published as open data. Findings from the interview expose the concern of some of the government agencies:

"Among primary concerns from government agencies is the risk of the data being released does not comply with the government's Official Secrecy Act (OSA). This is due to the lack of clear legal and policy guidelines to steer government agencies in releasing the right dataset" (Top-Level Reviewer 2)

Although government agencies are rich in digital data, many were still confused by the data classification because of the fear that they might publish the classified data. The lack of knowledge of open data among government agencies results in only data that was easy to prepare or already on the agency's web portal was published as open data, and this includes aged data from previous years.

(c) ***Post-adoption Phase***

According to the analyzed documents, Malaysia is regarded as a high-income country by the World Bank index and recorded a 'high' score in the E-Government Development

Index (EGDI) 2020 (United Nations E-Government Survey, 2020). One of the EGDI sub-components, which is the Online Services Index (OSI) which saw Malaysia's scored 'very high' index. These indexes showed that Malaysia is very well established in utilizing ICT in public services delivery. Hence, innovation such as OGD should be penetrated amongst the government agency at a significantly fast pace. Findings from the semi-structured interview confirmed that the OGD initiative in Malaysia had reached the post-adoption phase, as mentioned in the interviews:

"*We have been doing a lot of implementation activities since 2014, starting the from the data portal, we then develop the Open Data Circular in 2015 and some collaboration with international bodies in 2016 to 2018. Moving forward, we will produce more granular data and Application Programming Interface (API) in the data portal."* (Top-Level Reviewer 1)

"For us, open data is a journey; the open data initiatives in the Malaysian public sector are currently in the implementation phase. Considering the initiatives started in 2014, the maturity level is an ongoing process towards the acculturation of open data initiatives in the public sector." (Top-Level Reviewer 2)

*"The open data implementation in Malaysia public sector has been progressing well. With help from the Open Data Institute, we have been training some of the selected government personnel to learn about open data best practices. Apart from that, every year, we have organized a hackathon event to encourage open data usage." (*Top-Level Reviewer 3)

Moreover, many activities are being conducted and planned towards making the OGD one of the government's primary digital services. Nearly six years after the adoption decision, the OGD initiative in Malaysia has spread to government agencies' knowledge at all levels, including the state government and local authorities. In 2018, the central agency convinced government top management to put OGD publication as a Key Performance Indicator (KPI) for every ministry. After conducting a series of engagement sessions with the government agencies at all levels, the number of datasets published in the government data portal sparked tremendously in 2018, as portrayed in Figure 5.3. However, a decreasing trend has been detected starting from 2019. To add to the agitation, the rate of data publication has recently dropped to a negative percentage, which is unprecedented in recent history. There is no doubt at least some of the government's data has been retracted from publication.

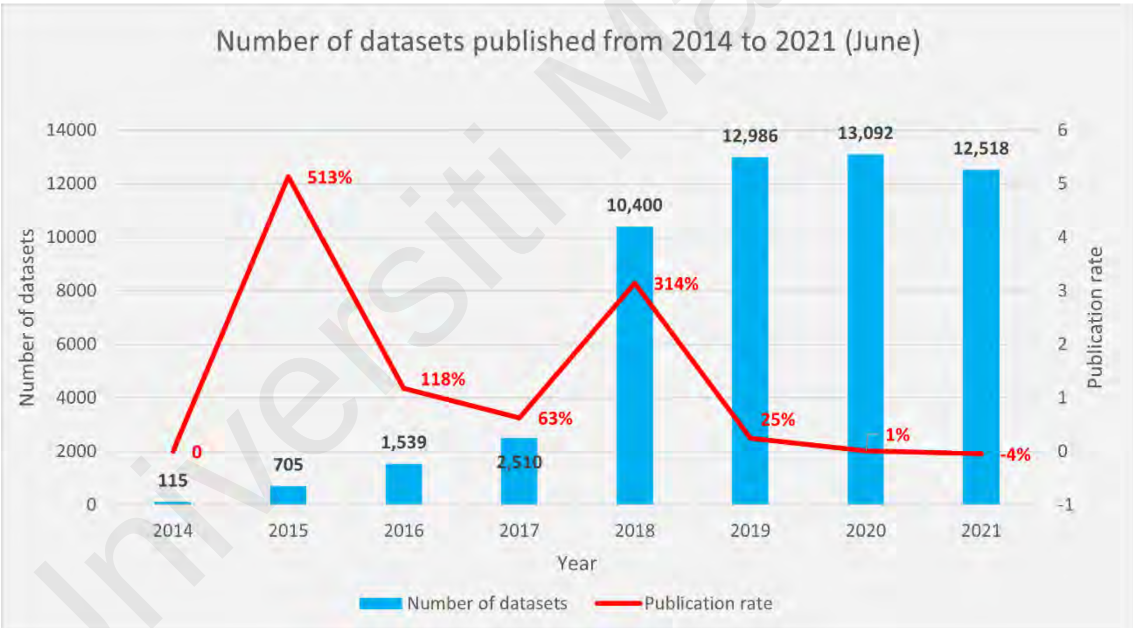

Figure 5.3: Number of datasets published in the government data portal. (Source: www.data.gov.my)

Malaysian government efforts in the post-adoption phase of the OGD are further globalized. In agreement with the global open data assessment, Malaysia has shown some mixed achievements. The assessments were done by independent bodies that evaluated the OGD achievements of a country or city based on their open data portal or national statistic portal. For instance, the Open Data Inventory (ODIN) assesses the coverage and transparency of government statistics so that deficiencies can be detected, transparent data can be promoted, access is enhanced, and dialogue between the national statistical offices (NSOs) and data users is facilitated. The Open Data Inventory (ODIN) is the database collected by Open Data Watch, offering an evaluation of official statistics coverage and transparency in 178 countries. ODIN assists in identifying critical gaps, promoting open data policies, enhancing data access, and fostering two-way communication between the national statistical office and data user. There are three major data categories accessed by ODIN, namely, social, economic, and environmental. The recent data openness report by ODIN in 2020 has placed Malaysia at 78th rank out of 178 countries, a slight decrease compared to the previous edition in 2018, where Malaysia's rank was at 69th out of 178 countries (Open Data Watch, 2020). Overall, the 2020 report shows that Malaysia scores better than the regional median in all three main data categories, implying that only 53 per cent of OGD in Malaysia is genuinely open (Open Data Watch, 2020). Internally, economic statistics are the highest levels of coverage, and social statistics are the lowest.

Another established body in evaluating OGD is the Open Data Barometer (ODB) produced by the World Wide Web Foundation, a non-profit organisation based in the United States of America. The ODB seeks to expose the real incidence and effect of open data projects around the world. Using in-depth methods incorporating qualitative data, a self-assessment survey, and secondary data from various global reports, the ODB analyses global patterns and offers comparable data on participating governments (World Wide Web Foundation, 2018). The rank of ODB is based on achievements of open data in three areas: i) readiness, ii) implementation and iii) impact. The first edition of the ODB report was released in 2013, the second edition was released in 2015, the third edition was released in 2016, and the most recent is the fourth edition which was released in 2018. The methodology in the fourth edition, however, the recent report has been updated to include only leaders in open data initiatives which are currently 30 countries around the world. The countries were chosen based on their commitment to the Open Data Charter or a member of the G20 country list that has signed up for the G20 Anti-Corruption Open Data Principles (World Wide Web Foundation, 2018). Malaysia's achievements in open data only appear in the second and third editions because the Malaysian government has not yet agreed on the Open Data Charter nor been a member of the G20 Anti-Corruption Open Data Principles.

A more comprehensive evaluation of OGD is conducted by the United Nations (UN) through the UN E-Government Survey. The UN E-Government Survey report has been tracking the OGD development trends since 2014. Until the year 2020, 80% of the country worldwide has been identified to have an OGD portal (United Nations E-Government Survey, 2020). Due to its growing significance to E-Government development, the Open Government Data Index (OGDI) is introduced in the 2020 UN E-Government Survey using the data from 2018 (United Nations E-Government Survey, 2020). The 2020 survey report has seen Malaysia achieve a 'Very High OGDI' with the highest score of 1.000. OGDI is a subindex of the Online Service Index (OSI) that evaluates government commitment to providing digital government services to citizens.

Another involvement for Malaysia in the international assessment includes the Global Open Data Index (GODI) by the Open Knowledge Foundation. GODI is an independent assessment body that looks at the open data implementation from the civic point of view. GODI allows various OGD stakeholders to give feedback by evaluating the OGD progress in the country. Unlike Open Data Barometer, which covers the usage and the impact, GODI only assesses the available data and publishes it in the open data portal. However, the GODI assessment was discontinued starting in 2016. Subsequently, since 2019, most of these international open data assessments have not been updated. Although these rankings may not reflect the actual condition of OGD in Malaysia, they can be used as a benchmark to compare the OGD implementation performance from other countries. Moreover, these assessment bodies use different methodologies and perspectives to assess open data initiatives from the participating country; hence, there is room for improvement from both parties, the assessors, and the participating country. Table 5.3 presents Malaysia's achievements in the global OGD assessments.

Table 5.3: Malaysia Open Data achievements from global assessment bodies.

Assessment Body	2014	2015	2016	2017	2018	2019	2020
Open Data Inventory[a]	-	98 /115	95 /173	64 /180	69 /178	-	78 /178
Open Data Barometer[b]	41 /86	51 /92	53 /115	-	-	-	-
Global Open Data Index[c]	112 /122	87 /94	-	-	-	-	-

Source: [a] https://odin.opendatawatch.com/;
[b] https://opendatabarometer.org/;
[c] https://index.okfn.org/

Nevertheless, there are major international data commitments Malaysia has yet to fulfil. International membership in data commitments is not mandatory; however, it demonstrates a country's attentiveness to provide transparency through data. The 2020 ODIN report has indicated that Malaysia is yet to have strategic planning to develop a national statistical capability. The Malaysian government also has yet to adopt the Open Data Charter (ODC). The ODC, as mentioned in section 2.2.2, is a partnership of more than 100 governments and institutions seeking to open up data based on a common collection of seven principles. Lastly, as a non-member of the Organisation for Economic Co-operation and Development (OECD) country, Malaysia is not a participant in the Open Government Partnership (OGP) program. The OGP is a multilateral project aimed at achieving specific commitments from national and sub-national governments to encourage open democracy, inspire people, combat corruption, and utilise emerging technology to improve governance. Despite that, Malaysia is a subscriber to Standards for Data Dissemination (SDDS) by the International Monetary Fund (IMF). The SDDS criteria improve the availability of timely and accurate statistics that lead to sound macroeconomic policies and capital markets' effective operation.

5.2.2 Semi-structured Interview with Pioneer Agencies

The second data collection in Phase 1 is another semi-structured interview with four pioneer agencies that have implemented OGD. These agencies were regarded as the pioneer agencies because they are among the earlier government agencies that have implemented OGD since its inception in the Malaysian public sector in 2014. This semi-structured interview session was aimed to understand the challenges these agencies face during OGD implementation. At the same time, the session was also intended to gather the initial factors that influenced these agencies to stick to the OGD initiatives for the last few years.

5.2.2.1 Data Collection Procedure

The data collection was conducted much like the previous semi-structured interview with the central agency. Several pioneer government agencies were invited via email for the semi-structured interview session, but four agencies volunteered to be the interviewee. The background of the interviewees is presented in Appendix A1. The semi-structured interviews were later arranged at interviewees' offices and their convenience time. To assist interviewees with preparation, the interview protocol (Appendix A4) was distributed before the interview session. The semi-structured interviews were conducted in Malay and recorded with the permission of the respondents. The recordings were later transcribed and translated to English for data analysis purposes.

5.2.2.2 Data Analysis

The data analysis for the semi-structured interview with the pioneer agencies was performed using a content analysis technique. Unlike the thematic analysis from the previous section, the targeted output for this section is a set of initial factors of OGD post-adoption that can be quantified in terms of its appearance instead of a narrative storyline. Content analysis is a systematic examination of material in which the frequency with which specific words, images, ideas, themes, or concepts emerge in a set of data is counted; used to determine the material's latent and manifest meanings (Kleinheksel et al., 2020; Miles et al., 2014; Saldaña & Omasta, 2016). Content analysis is also a flexible technique to qualitative analysis that enables researchers to produce new insights and concepts from data by focusing on certain themes (Vaismoradi et al., 2016). Figure 5.4 presents the content analysis process employed in this study.

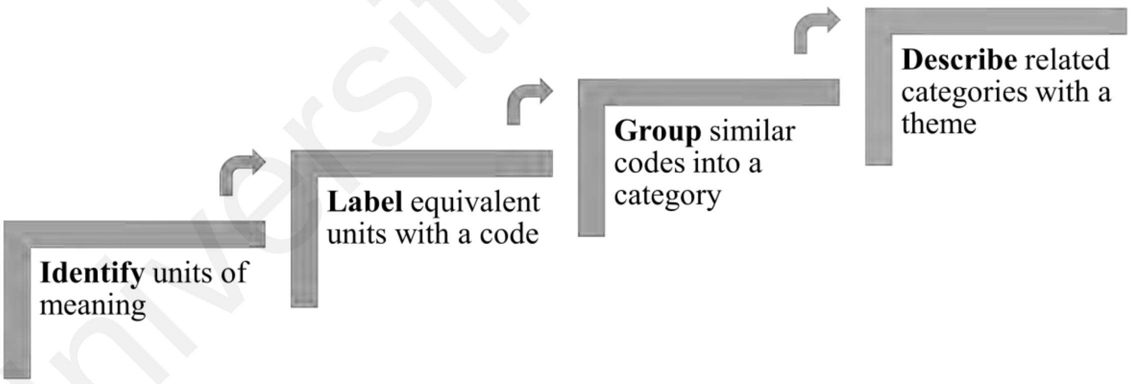

Figure 5.4: The Qualitative Content Analysis Procedure Adopted From Kleinheksel et al. (2020)

The data analysis started with transcribing the interviews' recordings. The interview transcripts were sent to the interviewees to confirm all the statements they had made during the interview session. Once the interviewees confirmed their transcript, the transcripts were loaded into the Atlas.ti computer-assisted tools. The 'identify' step was conducted for every transcript by focusing on important points that have been pre-defined in the interview protocol. The participants' statements were analysed, and if their statements mentioned anything about the pre-defined codes, the statement would be highlighted. Once researchers have assigned codes to condensed units of meaning, they then classify the codes to lend more structure to the data. This is the second step depicted in Figure 5.4 as the 'Label' step. A conceptual word such as 'label' conveys something significant about what is being provided by the participant in a simple and straightforward way (Vaismoradi et al., 2016).

A variety of new codes emerged from the interviews, which were then organised, classified, compiled, and summarised. This step is marked as the third step, which is the 'Group' step. The 'group' step was meant to give a common meaning to many different types of codes by using the researchers' creativity in organising the codes. Finally, in the 'Describe' step, the codes were associated to construct a theme. If a code has attributes from more than one theme group, it is only assigned to the one that best suits, according to the mutual exclusiveness principle (Vaismoradi et al., 2016). Figure 5.5 illustrates one example of how the content analysis was performed for each transcript in the case of the 'Top management support' code and 'Organisation' theme.

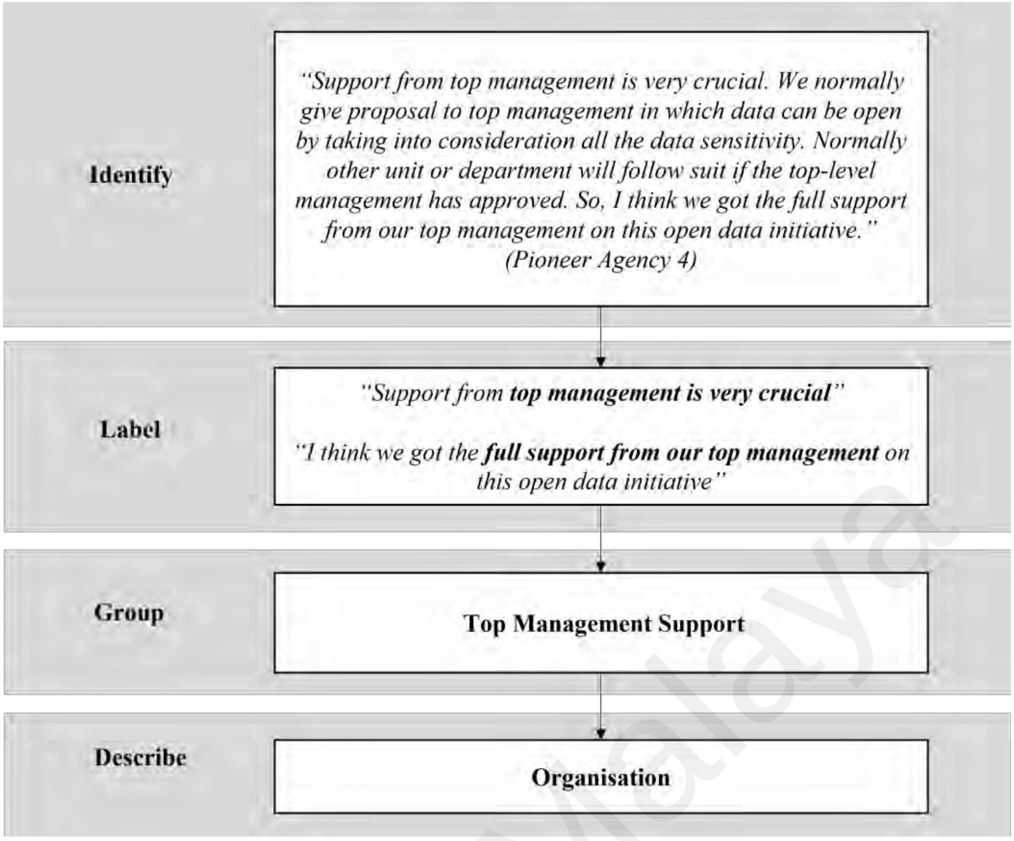

Figure 5.5: An example of content analysis performed with the transcript data in the case of the 'Top management support' code.

Content analysis is always quantitative in nature, and the nature of truth is always objective, observable, and measurably defined by the positivist manifest content analysis (Kleinheksel et al., 2020). This content analysis use frequency counts to help explain a phenomenon. It assumes that the data contains objective truth, which may be exposed with minimal interpretation. Hence, the frequency with which a target (i.e., code) appears in the text is used to determine its prevalence (Kleinheksel et al., 2020). The number of participants mentioned the pre-defined codes and the number of the pre-defined codes mentioned by the participants as agreeable statements were counted to present the prevalency. This calculation was performed using the ATLAS.ti software, as depicted in a sample screenshot in Figure 5.6. The software calculates each pre-defined code that the researcher determined by applying the procedure as shown in Figure 5.4 and Figure 5.5.

The most mentioned pre-defined codes were considered to be included in the instrument development. These codes are translated as the initial factors in the instrument development. On top of that, the selection of the initial factors was made to ensure the initial factors were coherently aligned with the literature study.

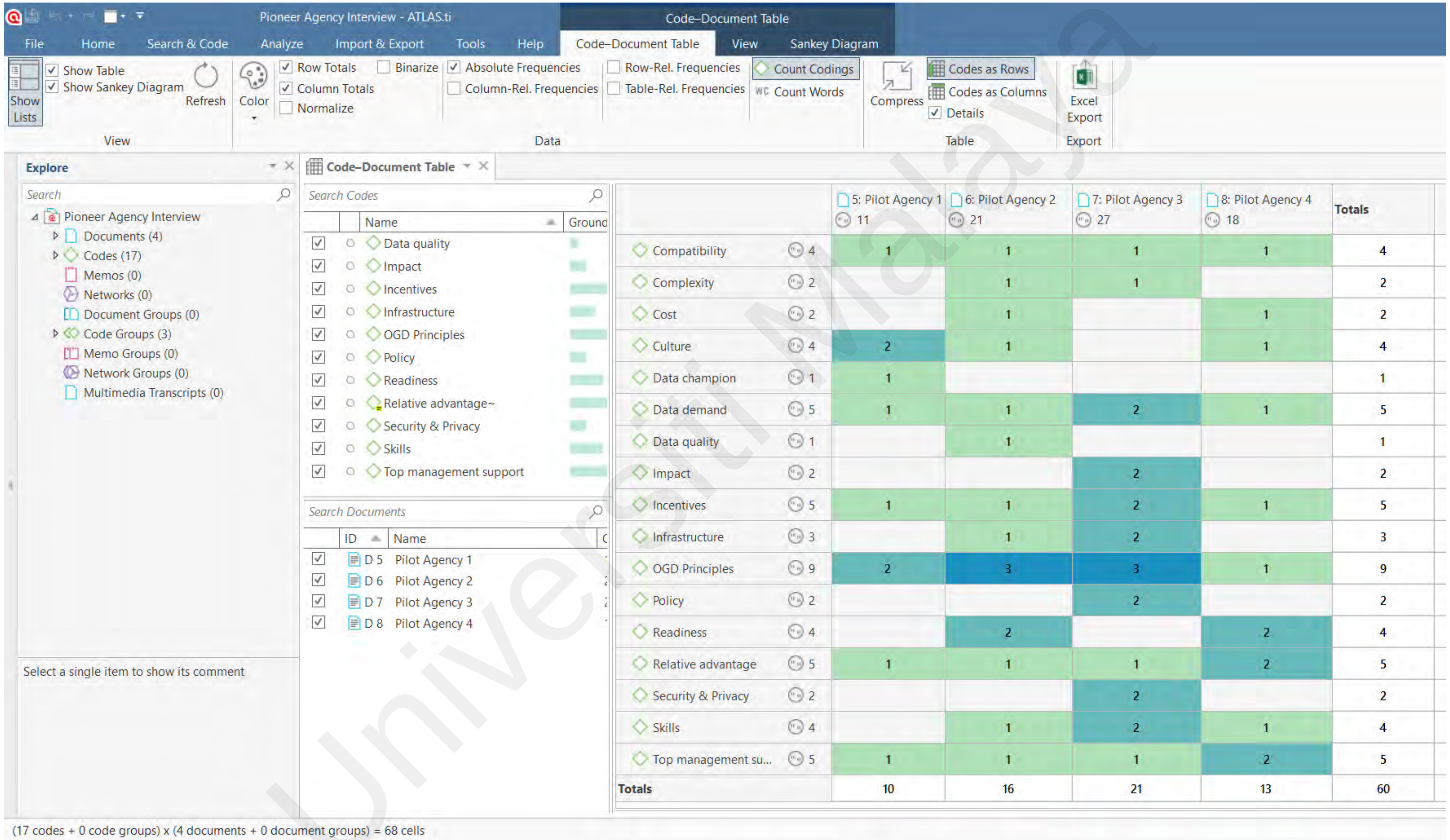

Figure 5.6: A screenshot from the ATLAS.ti software for the content analysis procedure.

5.2.2.3 Findings

The findings from the content analysis were summarised as a list of the themes and codes names and the number of times mentioned by the participants, as depicted in Table 5.4. The themes are translated to a category, and the codes are translated to initial factors. Altogether, there are sixteen initial factors identified from the semi-structured interview with the pioneer agencies. Initial factors reported by at least three participants during the interview were taken into account for the instrument development phase. The initial factors that had less than three participants mentioned were excluded in the instrument development phase. As depicted in Table 5.4, ten initial factors (technical skills, relative advantage, compatibility, complexity, top management support, readiness, culture, data demand, incentives, OGD principles) were advanced to the research instrument development step, whilst six initial factors (data quality, cost, policy, data champion, impact, security and privacy) were excluded.

Table 5.4: Themes Name and Number of Times Mentioned By the Participants

Category	Initial Factors	Number of times mentioned	Number of participants mention it
Technology	Infrastructure	3	2
	Technical Skills	4	3
	Data quality	1	1
	Relative advantage	5	4
	Compatibility	4	4
	Complexity	3	3
	Cost	2	2
Organisation	Top management support	5	4
	Readiness	5	3
	Culture	4	3
	Policy	2	1
	Data champion	1	1
	Impact	2	1
	Security & Privacy	2	1
Environment	Data demand	5	4
	Incentives	5	4
Others	OGD Principles	9	4

5.3 Phase 2-Development

Phase 2 aims to achieve the second and third research objectives. The primary task includes performing the empirical analysis on the quantitative data collection. There are two stages for the empirical analysis; the first stage is the analysis from the pilot test, and the second stage presents the main data analysis. The research instrument had to be designed first using the output from the Phase 1-Exploration before the pilot test could be carried out. Once the pilot test had been conducted, the research instrument was further refined by considering the findings from the pilot test analysis. Thereafter, the main data collection was commenced using the refined research instrument and designed in the online survey tools.

Following the completion of the main data collection, the main data analysis started with a preliminary analysis to harmonize the data from any errors and biases. Subsequently, the descriptive analysis was conducted to get the background of the respondents. Finally, the multivariate analysis using the PLS-SEM technique was performed to analyse the structural relationship of the variables and hypotheses defined in section 4.4 Conceptual Framework and Hypotheses Development. Also included in this section is the explanation of the criteria for selecting PLS-SEM multivariate analysis techniques.

5.3.1 Instrument Development

The research instrument for this study was developed using the procedure advocated by MacKenzie et al. (2011). The instrument development process by MacKenzie et al. (2011) contains ten steps; however, MacKenzie and colleagues are aware that other researchers may not observe all steps due to time and resources constraints. Therefore, this study adopts five steps from MacKenzie's scale development. Figure 5.7 presents the instrument development process for this study. The rest of the steps was continued in the actual study or main data collection steps, as illustrated in the research design in Figure 4.2 (Section 4.3).

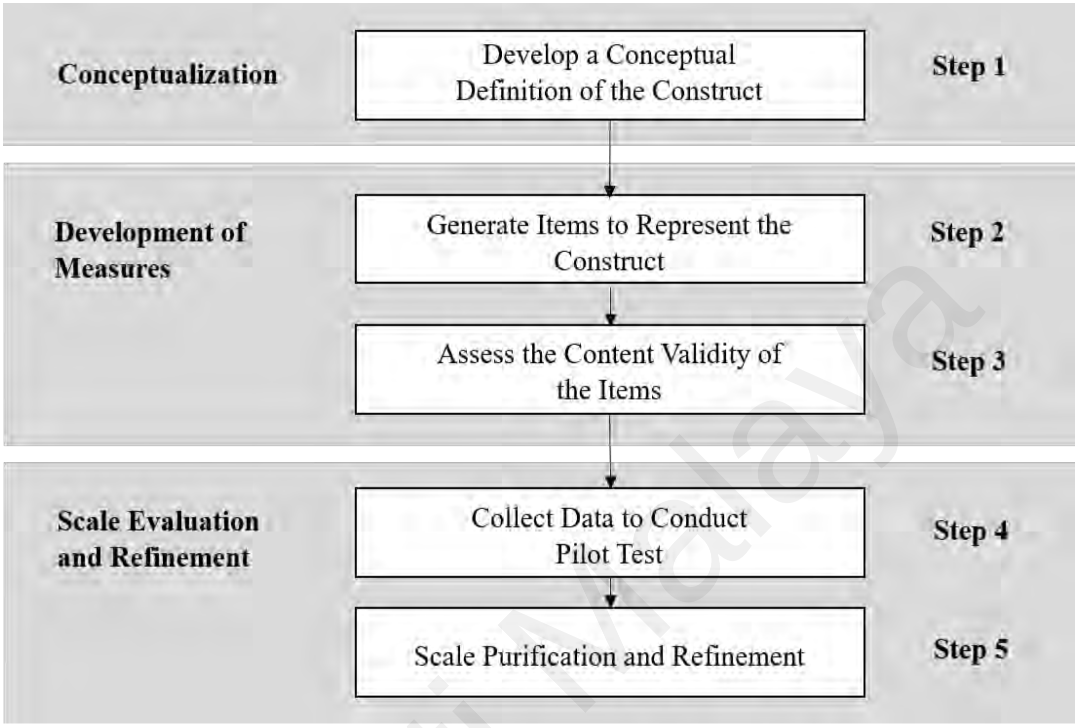

Figure 5.7: Instrument Development Procedure adapted from MacKenzie et al. (2011)

In Step 1 of the instrument development procedure, the constructs were carefully defined to differentiate from other constructs (MacKenzie et al., 2011). The researcher is required to discuss the essence of the constructs and their conceptual theme in a simple and compatible manner that relates to prior study (MacKenzie, 2003). Furthermore, MacKenzie (2003) posits that poor construct definition would lead to a misconception of the construct's meaning that some researchers often skewed to suit their hypothesis. Referring to the previous section, the initial factors or constructs were shortlisted from the content analysis conducted with the pioneer agencies. On top of the semi-structured interview, a literature review was also conducted to investigate the common constructs used in the innovation adoption in an organisation study. After reviewing each construct, a total of ten independent constructs and three dependent constructs were considered to be investigated in the research instrument. Table 5.5 summarises the construct's operationalization definition.

Table 5.5: Construct's Operationalization Definition

Constructs	Definition
Compatibility	The degree to which IT/IS application is compatible with an organisation's business processes, distribution channel, corporate culture, and value system (Junior et al., 2019; Zhu, Kraemer, et al., 2006)
Complexity	The level to which an innovation is viewed as hard to grasp and to use (Çaldağ et al., 2019; Junior et al., 2019)
Relative Advantage	The degree to which using the innovation is perceived as being better than using its precursor (Junior et al., 2019; Venkatesh et al., 2003).
Culture	The pattern of simple universal assumptions that a community learns to overcome internal unification and exterior adaptation problems (Çaldağ et al., 2019; Yang & Wu, 2016b)
Top Management Support	The level of resource involvement and the encouragement of top management for innovation adoption (Çaldağ et al., 2019; Wang & Lo, 2016)
Readiness	The availability of organisational resources (e.g. financial, staff, infrastructure) that is needed for implementation (Iacovou, 1995; Wan Ismail & Mokhtar, 2016; Wang & Lo, 2016).
Skills	Technology skills can be broken down into three subcomponents: IT infrastructure, Internet fluency, and business acumen (Nguyen, 2017; Park & Choi, 2019).
Data Demand	Submission by any individual or entity for unique data sets applicable to the data provider.
Incentives	Formal recognition is given to an individual or organisation to recognize the efforts that have been made (Kulkarni et al., 2006; Lu et al., 2020; Rogers, 1983).

Table 5.5: Construct's Operationalization Definition (Continue)

Constructs	Definition
OGD Principles	OGD principles are a series of specifications from the Open Government Working Group to advise a government about the form of data that should be deemed open. The principles include eight standards for releasing an OGD dataset: open, principal source, license-free, prompt, non-discriminatory, software processable, non-owned and complete.
Acceptance	Efforts were undertaken to induce organisational members to commit to the use of IT applications (Lu et al., 2020; Saga & Zmud, 1993).
Routinization	The alterations that occur within work systems to account for IT application such that this application is no longer perceived as new or out-of-ordinary (Junior et al., 2019; Saga & Zmud, 1993)
Infusion	Embedding an IT application deeply and comprehensively within an organisation's work systems, which an innovation's features are used in a complete and sophisticated way (Fichman, 2000; Hassandoust et al., 2016; Saga & Zmud, 1993).

Step 2, as suggested by MacKenzie (2011), refers to the Development of Measures phase, which is where the items of each construct were generated. The items have mostly been modified from previous research that has been developed and cited by many. Items for the new constructs that are introduced in the conceptual framework were created based on the input from a field study with the pioneer agencies. All items are designed in close-ended questions with brief and precise words. In developing a survey, a few factors were contemplated to enhance the responses' accuracy and minimize biases and errors (MacKenzie et al., 2011). The language structure is one of the factors that was considered while designing the survey questionnaire form. The questionnaire form was developed in dual language (English and Malay) to aid the respondents in the language they understand the most. Some words may best be interpreted in English, and some are easier in the Malay language. Each question was composed in a short, brief, and precise sentence to avoid the respondent becoming fatigued while answering the questionnaire. The questionnaire's grammar and vocabulary in both languages were checked among the researcher's supervising committee before moving further.

Each of the constructs built in the research model reflects unobservable latent variables which could not be explicitly evaluated. Hence, these unobservable variables ought to be operationalized into potentially important and observable variables (also known as measurement items). In order to create coherence with previous studies, the traditional method is by leveraging the established scales. Nearly all of the constructs used in this study used measurement items that were also proposed and evaluated from prior IS/IT adoption research. However, some modifications were adjusted to ensure that the measurement items were suitable for this study's context.

There are also constructs developed from the interview sessions with the government agency representatives, particularly for environmental constructs. Relating to OGD, the interview session reveals that there are possibilities for the government agency to continue publishing OGD if there is a public demand. Therefore, data demand was included in the environmental constructs as it comes from the external part of the government environment. Another factor discovered during the interview session with the government representatives is the incentive factor which is regarded as any reward system, whether from the internal or external part of the government environment, that could influence the government agency to infuse the OGD publication in the work system. The novel variables developed specifically for this research are the OGD principles in which is the unique factor that represent the characteristics of OGD innovation. The items for OGD principles are developed from the eight OGD principles delineated by the Open Knowledge Foundation.

As mentioned earlier, an organisation's adoption of technology is a sequentially evolving stage-based operation (Frambach & Schillewaert, 2002; Rogers, 1995; Zaltman et al., 1973). According to Tornatzky and Klein (1982), the ideal organisational innovation adoption study should fully account for this process, which Saga and Zmud (1993) define as post-adoption. Whereas diffusion is the process by which an innovation or technology is spread across a population of organisations. Post-adoption refers to implementing an innovation or technology until it becomes an integral part of the organisation's activities. Hence, drawing upon the innovation adoption in organisation literature, OGD post-adoption is defined in terms of the sequence stages from initial acceptance of the OGD to routinize the OGD publication until it becomes a regular activity in the organisation work's system.

In Step 3 from the instrument development procedure, a validation protocol consisting of face validity and content validity was pursued towards the research instrument. Section 5.3.2 describes the instrument validation procedure. The final measurement items of the survey questionnaire can be seen in Table 5.6.

Table 5.6: Final measurement items.

Constructs	**Code**	**Items**	**Adapted from**
Complexity	CPX1	Our agency finds that the Open Government Data initiative is difficult to implement.	Rogers (1995), Thong (1999), Kamal (2006), Jeyaraj (2006), Çaldağ, Gökalp et al. (2019)
	CPX2	Our agency faces difficulty in categorizing data that can be published as Open Government Data.	
	CPX3	Our agency finds that the Open Government Data publication is a complex process.	
	CPX4	Our agency finds it is difficult to integrate Open Government Data implementation in our agency's work practices.	

Table 5.6: Final measurement items (Continue)

Constructs	Code	Items	Adapted from
Compatibility	CPB1	Open government data initiative is compatible with the data captured at our agency.	Rogers (1995), Nguyen (2017), Agarwal (1997), Thong (1999), Jeyaraj (2006),
	CPB2	Open government data initiative is suited to our agency's existing operating practices.	
	CPB3	Open government data initiative is compatible with our agency's IT infrastructure.	
	CPB4	Open government data initiative is consistent with our agency's values and beliefs.	
Relative Advantage	RAD1	Open Government Data implementation increases the performance of our agency's operation.	Zhu & Kraemer (2006), Junior (2019), Caldag (2019), Yang & Wu (2016)
	RAD2	Open Government Data implementation raises the efficiency of our agency's operation.	
	RAD3	Open Government Data implementation enhances the effectiveness of our agency's operation.	
	RAD4	Open Government Data provides our agency with valuable information to make decisions.	
Culture	CUL1	Our agency is willing to share information and data with the public.	Yang (2016), Çaldağ, Gökalp et al. (2019), Puklavec et al. (2014)
	CUL2	Our agency encourages the practice of information and data sharing with the public.	
	CUL3	Our agency is open to innovative policies such as sharing information and data with the public.	
	CUL4	Our agency has implemented the open government data sharing policy in accordance with General Circular no. 1/2015 (Public Sector Open Data Implementation).	
Top Management Support	TMS1	Top management in our agency is articulating a vision for Open Government Data implementation.	Hameed (2012), Wang et al. (2006), Çaldağ, Gökalp et al. (2019), Puklavec et al. (2014), Rai (2009), Wang & Lo (2016)
	TMS2	Top management in our agency is formulating a strategy for Open Government Data implementation.	
	TMS3	Top management in our agency is deploying the efforts of the Open Government Data initiative implementation.	

Table 5.6: Final measurement items (Continue)

Constructs	Code	Items	Adapted from
	TMS4	Top management in our agency is giving attention to the performance of the Open Government Data initiatives implementation.	
IT Competency	ITC1	Our agency is committed to ensuring that the staff is familiar with the Open Government Data initiative.	Nguyen (2017), Hameed (2012), Liang et al. (2007), Kamal (2006), Jeyaraj (2006)
	ITC2	Our agency has a sound knowledge of Open Government Data initiatives.	
	ITC3	Our agency has the technological resources to manage Open Government Data implementation.	
	ITC4	The staff at our agency is able to use their experience and knowledge to operate Open Government Data implementation.	
Data Demand	DAD1	Our agency regards that the data request from the public is part of the government service to the people.	Self-developed
	DAD2	Our agency feels that data requests from the public influence us to publish Open Government Data.	
	DAD3	Our agency only accepts data requests for the datasets that are already available to be published.	
	DAD4	Our agency finds that fulfilling the demand for Open Government Data by the public is a satisfying task.	
Incentive	INC1	Our agency's commitment to the Open Government Data initiative is recognized at a superior level.	Kulkarni (2006), Rogers (1995), Hameed (2012)
	INC2	Our agency is motivated to implement Open Government Data initiatives if the incentive is provided.	
	INC3	Providing incentives is essential in encouraging government agencies to implement Open Government Data.	
	INC4	There is recognition provided by third parties (non-governmental/private bodies, etc.) for government agencies implementing the Government Open Data initiative.	
OGD Principles	OGD1	Our agency publishes Open Government Data from the primary data source.	Self-developed
	OGD2	Our agency publishes Open Government Data as soon as the data is available.	

Table 5.6: Final measurement items (Continue)

Constructs	Code	Items	Adapted from
	OGD3	Our agency Open Government Data is freely accessible by the public through an online platform.	
	OGD4	Our agency prepares the datasets for Open Government Data in a machine-readable format (csv, json, xml, etc.).	
	OGD5	Our agency allows anonymous access to our Open Government Data.	
	OGD6	Our agency prepares data into a generic format (non-proprietary) before being released as Open Government Data.	
	OGD7	Our agency has imposed a license-free for each of our Open Government Data datasets.	
	OGD8	Open Government Data from our agency is complete and available in bulk.	
Acceptance	ACC1	Our agency publishes Open Government Data voluntarily.	Saga & Zmud (1993)
	ACC2	Open Government Data initiative is well accepted in our agency.	
	ACC3	Our agency is satisfied with the Open Government Data implementation in our agency.	
	ACC4	Our agency published Open Government Data as frequently as possible.	
Routinization	ROU1	Our agency is publishing Open Government Data on a regular basis.	Fichman (2001), Junior (2019), Sundaram (2007)
	ROU2	Open Government Data publication has become a standard operation in our agency.	
	ROU3	Open Government Data publication is regarded as a regular activity in our agency.	
	ROU4	Our agency's work system is adapted well with Open Government Data initiatives.	
Infusion	INF1	The Open Government Data policy has been fully adopted by our agency.	Gallivan (2001), Fadel (2012), Fichman (2001)
	INF2	Our agency has utilized Open Government Data initiatives to its full potential.	
	INF3	Open Government Data publication has been integrated into our agency's work system.	
	INF4	Open Government Data publication has been deployed to support our agency's task.	

5.3.2 Instrument Validation

The validity and value of research conclusions are based upon the reliability and validity of the instrumentation chosen for a quantitative study. An instrument's reliability refers to the consistency of the measurement; in other words, does the instrument consistently measure variables or constructs it is intended to measure (Brinkman, 2009; Taherdoost, 2016). On the other hand, the instrument's validity refers to the accuracy of the measurement results; it is how the instrument measures what it is supposed to measure (Brinkman, 2009; Taherdoost, 2016). An instrument's validation process is a very critical step that must be completed before submitting any survey to the population sample (Mora et al., 2016). There are many types of validity to establish whether the study is valid. Scholars have asserted that no specific test can be considered a concrete method to determine a research instrument's validity and reliability. However, researchers are encouraged to use as many methods as possible to prove the instrument reliability and validity (Boudreau et al., 2001). This study takes three steps to ensure the research instrument has established validity and reliability, namely, content validity, pre-test, and pilot test.

5.3.2.1 Content Validity

Content validity is defined as "the degree to which items in an instrument reflect the content universe to which the instrument will be generalized" (Boudreau et al., 2001). In the field of Information Systems (IS), it is highly recommended to apply content validity while the new instrument is developed to ensure that identified constructs are legitimate, clear and reflect their contents (Taherdoost, 2016). According to Straub (1989), it is challenging to develop and maybe much more complicated to validate a content-valid instrument since the universe of available content is nearly limitless. In order to find the balance of the instrument's content validity, a judgmental approach has been established that involves literature reviews and follow-ups with several expert panels for evaluation. The selected panel of experts should be involved and experienced in the related domain and have expertise in instrument development. As suggested by Lynn (1986), a minimum of five experts is needed to run the content validity procedure. This study recruits eight (8) panels consisting of academicians from various universities in Malaysia for the research instrument's content validity procedure. These panels were selected based on their knowledge of IS quantitative research or experiences in conducting survey research.

There are two types of Content Validity Index (CVI); the first type is intended for individual items, also known as I-CVI and the second is for the scale or the overall items, also known as S-CVI. The panels were asked to evaluate each item in the research instrument based on a 4-point ordinal scale proposed by (Davis, 1992). The 4-point scale can be interpreted as 1=not relevant, 2=somewhat relevant, 3=quite relevant and 4=highly relevant. Question items that get 3 or 4 points are considered relevant, while questions with 1 or 2 points are considered nonrelevant. Thereafter, the number of experts giving 3 or 4 points is counted and divides by the total number of experts to get the I-CVI. The accepted value for I-CVI value depends on the number of experts. For five or fewer number of experts, all items must score 1.0, while for six or more experts, the I-CVI value should not be less than 0.78 (Lynn, 1986).

The results of the reviewer evaluation are shown in Appendix B. The calculation started by counting the number of experts that give a score of 3 or 4 points for each item (which is referred to as *A*). The item level content validity index (I-CVI) was then calculated by dividing *A* by the number of experts (which is referred to as *N*). The formula is presented below:

$$I\text{-}CVI = \frac{N\ (Number\ of\ experts\ score\ 3\ or\ 4)}{A\ (Total\ number\ of\ experts)}$$

The next computation is the probability of chance occurrence (ρ_c) in which computed using the formula for a binomial random variable:

$$\rho_c = \left(\frac{N!}{A!\,(\,N - A)!}\right) \times 0.5^N$$

The overall item or the S-CVI value is calculated by finding the total number of scoring 3 or 4 for each item and divide by the total number of items. The S-CVI value is further calculated to find the proportion of items that score 3 or 4 from all the experts or refers to S-CVI/UA (universal agreement) (Polit & Beck, 2006). Referring to Table C.1 in Appendix C, the S-CVI/UA value is 0.83 and is calculated as below:

$$\frac{S\text{-}CVI}{UA} = \frac{45\ (Total\ number\ of\ items\ with\ score\ 3\ or\ 4\ from\ all\ experts)}{54\ (Total\ number\ of\ items)}$$

The second type of S-CVI is finding the average of the proportion of items that get 3 or 4, referred to as S-CVI/Ave (average). The S-CVI/Ave can be calculated by finding the mean of I-CVI (Polit & Beck, 2006).

The final calculation is the kappa designating agreement on relevance (which is called k*). Kappa statistic is a consensus index of inter-rater agreement that adjusts for chance agreement and is an important supplement to CVI because Kappa provides information about the degree of agreement beyond chance. The Kappa (k*) can be determined with the formula:

$$k^* = \frac{I\text{-}CVI - \rho_c}{1 - \rho_c}$$

The item is evaluated through the k* value using guidelines as described by Fleiss et al. (1981): Fair = k* of 0.40 to 0.59; Good= k* of 0.60 – 0.74; and Excellent= k* > 0.74. Based on the results in Table C.1 and Table C.2 in Appendix C, all items of the research instrument are excellent, with a value between 0.87 to 1.0. Therefore, all 54 items in the research instrument were retained and fit for the pre-test.

5.3.2.2 Pre-test

A pre-test is the preliminary test of the measures used on a small sample of the population to be studied (Sekaran & Bougie, 2013, p. 155). A pre-test of a questionnaire may demonstrate that some of the questions are unintelligible to respondents. Lehman (1979) has pointed out that the pre-testing stage in the research process is "most likely to be squeezed out due to cost and time pressures." The criteria for a questionnaire to be pre-tested include length, layout, the format for the questions used, and the questions' sequencing. The purpose of conducting the pre-test procedure is to identify problematic items and further improve the survey. The pre-test allows the researcher to get a first-hand experience on how the potential respondent reacts to the survey instrument and estimate the response time to answer the survey. This includes the respondent's ability to understand the survey, the respondent's time to answer the survey, and the respondents' overall impression of the survey instrument.

An email invitation was sent to several government representatives to ask their permission to participate in the pre-test procedure. Two government representatives agreed to participate in the pre-test procedure. A meeting session was then arranged separately with the agreed respondents to perform the pre-test procedure. The respondents were asked to answer the paper-based questionnaire, and the time respondent took to complete the survey was recorded. These respondents are randomly selected from amongst government representatives to capture the targeted respondents' expectations. The respondents' average time to answer the survey was about 12 minutes, which is acceptable, considering that the respondents have to read each question carefully. Study shows that respondents who have already invested 5 to 10 minutes addressing the questionnaire are less inclined to quit even possibly offensive questions are raised at that point (Dillman et al., 2014).

5.3.2.3 Pilot Test

A pilot study is a small-scale, preliminary study aiming to investigate whether the main study's crucial components, usually a randomized controlled trial, will be feasible (Kothari, 2015, p. 63). This study conducted the pilot test to evaluate the components' feasibility from the OGD post-adoption research model before performing the full-scale study. Some other objectives of conducting this pilot test are to check whether there were problems with collecting the data needed for future analysis and whether the collected data are highly variable (Yin, 2011).

The pilot test is performed after the pre-test. The survey instrument is refined to the final touch by considering some of the pre-test respondents' comments. The survey instrument for the pilot test was later printed and distributed to selected government agencies. This pilot test aims to further refine and reduce items in the questionnaire to measure what is intended to be measured as defined by the research theory. This procedure is also called the instrument reliability and validation test. The pilot test was conducted with a sample of government of agencies that already implemented OGD. These government agencies cannot be considered in the main study, as doing so might compromise the genuine responses in the main study. The number of targeted samples were suggested in different opinions from scholars. Nevertheless, Isaac and Michael (1995) suggested 10 – 30 participants; Hill (1998) suggested 10 to 30 participants for pilots in survey research; However, the analysis for the pilot test is using Principal Component Analysis (PCA), which requires more than 100 samples size. In this pilot study, a total of 125 samples were collected to run for PCA. The results of the PCA test are discussed in section 5.3.5.

5.3.3 Population and Sample

To find things out about the population of interest, it is common practice to take a sample. A population is the set of data of all possible measurements (or observations) of individuals or items. Whilst a sample is a selection of objects and observations taken from the population of interest. The sampling process makes the study of a large and heterogeneous population possible. Thus, inferences can be made to generalize the population under study.

5.3.3.1 Sampling Frame

This study's population is defined as the government agencies in the Malaysian public sector that have implemented OGD initiatives. Therefore, under the purposive sampling methods, a total population sampling technique is asserted as the sampling method employed in this study. Such a sampling method is regard suitable because the total population of OGD adopters is considered small and collecting responses from the entire population is possible (Etikan et al., 2016). The type of government agency involved in this population includes the federal, state government, local authorities, statutory bodies from federal and state levels, and government link companies. According to the Public Service Department of Malaysia, there are over one thousand government agencies of all types, both at the federal and state governments. However, the number of government agencies that implemented OGD cannot be entirely determined as there may be a case in which the government agency does not register as a user in the government data portal. This is because the government agency may be comfortable having their own way of data sharing. For this study, the context for the population is specified as government agencies registered in the centralized government data portal, which is the data.gov.my. The reason for this selection process is because the study seeks to understand the influence factors of the existing OGD adopter among government agencies. Therefore, the government agency must be a user of the government data portal as they have been acknowledged to adopt the OGD initiatives. A total of 671 government agency representatives from all types of government agencies were listed as a user in the government data portal and furnished with full name and email address. The government data portal user is regarded as the respondent for this study as the person is responsible for OGD implementation in their respective agencies. He/she should ideally be a senior officer such as a Chief Information Officer (CIO), Manager or Head of IT units or a member of the IT Steering/Implementation committee or appointed open data champion or open data agent or person in charge and therefore would have knowledge of their agency's practice and routine of adopting and implementing OGD initiatives. Some agencies appoint an open data champion to be the corresponding personnel of matters pertaining to OGD initiatives. Therefore, these 671 government agencies representatives were chosen to be the population of the study. According to Taherdoost (2017) for the population around 600 to 700, the estimated sample size is 234 to 248 with a 95% confidence level and 5% margin error.

Another method to determine the ideal sample size for quantitative study is by using the power analysis tool called the G*Power 3.1 (Faul et al., 2009). A power analysis is typically conducted a priori, meaning before a study is started. There are four important parameters needed to determine the sample size for linear multiple regression statistical test: i) the effect size f^2, ii) alpha (α) value, iii) power, described as 1 - β, and iv) the number of predictors (Mayr et al., 2007). The effect size is a quantitative measure of the strength of a phenomenon (Cohen, 1988). The standard effect size f^2 guidelines proposed by Cohen (1988) are 0.02 for small effect size, 0.15 for medium effect size, and 0.35 for large effect size.

The alpha (α) value is also known as the probability of Type I error. Type II error probability is represented by Beta (β); thus, the power of the statistical test is calculated as 1 - β (Mayr et al., 2007). The number of predictors is the number of the independent variables of the research. In order to calculate this study ideal sample size, the effect size is set to 0.15, the alpha (α) value is set to 0.05, the type of error is 5%, the Beta (β) is normally set to 0.2 (Cohen, 1988), that brings the power as 0.8 (1 – 0.2) and the number of predictors is nine as defined in the conceptual framework (Section 4.4). The results of the G*Power 3.1 analysis are shown in Figure 5.8. The output indicates that the minimum sample size for this study is 114.

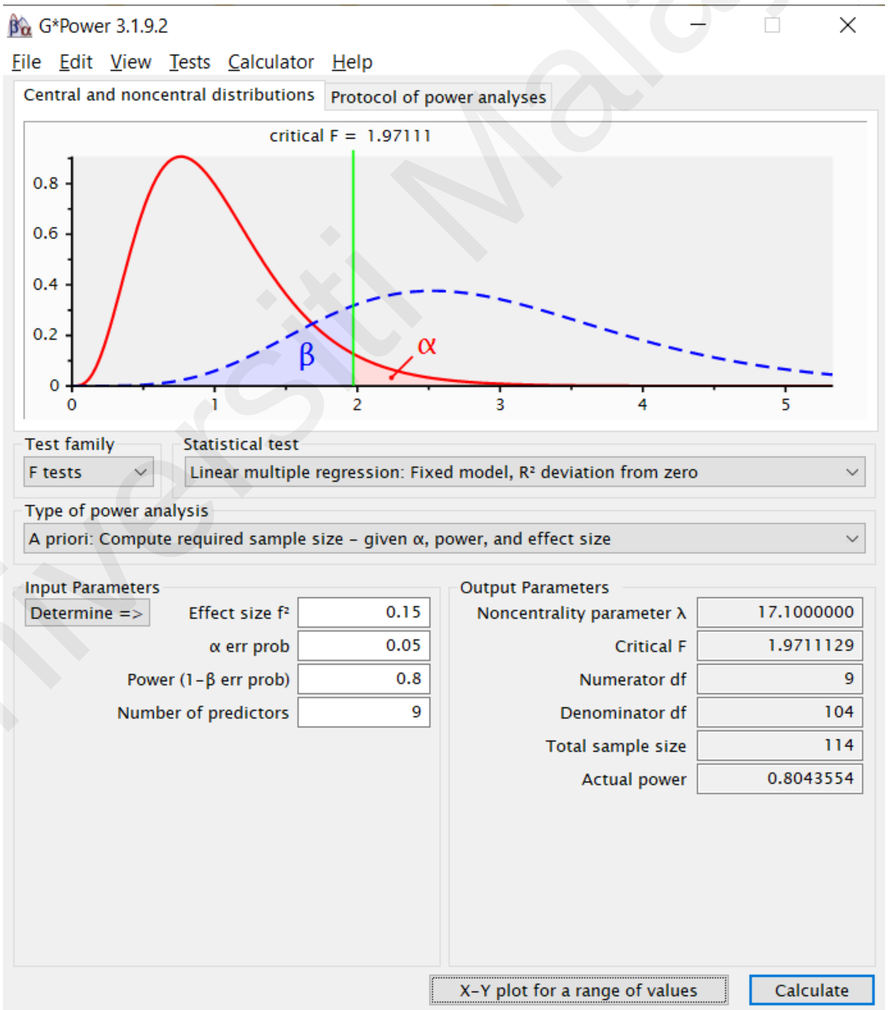

Figure 5.8: The G*Power 3.1 Analysis for Sample Size Calculation.

5.3.4 Data Collection

This study's research instrument is the survey questionnaire built using paid online tools provided by Survey Monkey. Due to the proliferation of internet usage in daily lives, the online survey is the most convenient solution for the respondent to answer at any time and anywhere (Dillman et al., 2014). While on the other hand, the online survey is more efficient for the researcher to collect responses in a quick and less inconvenient way. Furthermore, being a user of the government data portal requires the respondents to be computer literate and use the internet most of the time at work. Therefore, there should be minimal concern for the respondent to volunteer to answer the online survey. Apart from the online survey, a printed copy version of the survey was also distributed to the selected government agency in Putrajaya, the federal administration area. The survey scope was intended for a Malaysian government agency that has already adopted the OGD initiative.

5.3.4.1 Tools

There are a lot of tools that can help researchers to collect information and data. Surveys that are entirely electronic and dependent on email contacts to receive internet responses are the most rapidly increasing type of survey in most parts of the world (Dillman et al., 2014). As an independent data collection mode, the Web is particularly attractive due to its distribution speed and economically practical. However, researchers have to make a careful judgment on selecting the appropriate tools for the data collection, not according to their preferences. Most of the time, the nature of the research and the number of participants play crucial factors in selecting the research tools. This study resorts to collect data using an online questionnaire survey due to the respondents' availability that is easier to reach electronically, and there are quite a number of participants involved in the sampling frame.

The digital government transformation aspiration has made the Malaysian government propel a lot of its services digitally. This situation has prompted government employees to cultivate the use of ICT in their daily tasks. According to the 2020 United Nations E-Government Survey, Malaysia is categorized among the country with a very high E-Government Development Index (EGDI) (United Nations E-Government Survey, 2020). The achievement was contributed by the three EGDI indicators, namely Online Service Index (OSI), E-Participation Index (EPI), and Telecommunication Infrastructure Index (TII). With 81.2 per cent of the overall population being internet consumers, Malaysians are well ICT literate users (United Nations E-Government Survey, 2020). Hence, using an online survey is deemed suitable to distribute the survey questionnaire to the government agencies in the Malaysian public sector.

A questionnaire is a series of written questions that are given to a participant in order to collect information. The questions item can be either closed-ended or open-ended. The questionnaire of this study is developed in the close-ended type of questions. The questionnaire set is divided into sections; Section A contains eight categorical demographic questions. Section B contains fifty-six Likert-scale questions, including four questions for the Social Desirability Scale. The structure of the final survey instrument is summarized in Table 5.7.

Table 5.7: The initial structure of the questionnaire

Section	Section's Name	No. of items	Response type
A	Demographics	8 items	Multiple choice
B	Factors of OGD in Post-adoption		
	Technological Factors	12 items	5-point Likert scale
	Organisational Factors	12 items	5-point Likert scale
	Environmental Factors	8 items	5-point Likert scale
	OGD Principles	8 items	5-point Likert scale
	Post-adoption phase	12 items	5-point Likert scale
	Social Desirability Scale	4 items	5-point Likert scale
	Total questions	**64 items**	

5.3.4.2 Procedure

The data collection period using the online survey was held for about eight weeks, starting from 31st October 2019 to 27th December 2019. A pre-defined email was crafted in the Survey Monkey web software and later was sent to all respondents simultaneously containing a link to the online survey on 31st October 2019. After the period of 4 weeks, the first email reminder was sent to the respondents who have partially or have not been totally responsive to the survey. The second round was held for another four weeks, starting from 22nd November 2019 to 27th December 2019. A second email reminder was sent to respondents on 9th December 2019 to remind the respondents to answer the survey as the survey is closed on 27th December 2019. At the end of the survey period, a total of 294 (44%) government agencies responded to the online survey. However, after a data screening process, a total of 28 respondents did not complete the survey, making the total number of data that can be considered complete and eligible for further analysis to 266, which bring to 40%. Therefore, a valid N number for this study is 266 (N=266). According to Uma Sekaran in Research Method for Business 4th Edition, Roscoe (1975) proposed the rules of thumb for determining sample size where sample sizes larger than 30 and less than 500 are appropriate for most research, and the minimum size of sample should be 30% of the population. Thus, the study hit a minimum of 40 per cent of the population for sample size or 251 as estimated in section 4.6.2. The sample size also exceeded the minimum sample size of 114 as estimated by the G*Power 3.1 power analysis tool (Faul et al., 2009). This result justifies the rationale to perform the data analysis as the next procedure in this study.

5.3.5 Pilot Test Analysis

The pilot test was conducted to test the initial research instrument with the actual respondents. In line with the pilot test's aim, the principal component analysis (PCA) techniques are deemed appropriate to observe whether the constructs are independents of each other. The fundamental principle of PCA is to decrease the dimensionality of a data set composed of a vast number of interrelated variables while preserving the variance present in the data set to the greatest degree possible (Hasan & Abdulazeez, 2021; Schreiber, 2021; Tabachnick & Fidell, 2012). By analysing the correlation among the observed variables, the components that are to be retained or reduced can be determined. The other main advantage of PCA is that once the data pattern has been recognized, the data can be compressed, for instance, by reducing the number of dimensions without much loss of information (Jolliffe, 2002; Schreiber, 2021). Thus, the pilot data analysis output helps confirm the components, also known as the constructs in the research instrument, to be used in the main data collection.

PCA is considered an exploratory technique that can be used to understand the interrelationships between variables better. In the simplest term, PCA transforms the original interrelated variables into a new set of uncorrelated variables called Principal Component (Schreiber, 2021). PCA is also a suitable test for the normality of the data distribution. If the principal components are not normally distributed, then the original data is not normal. Whilst on the researcher's side, an important decision that the researcher must make when using PCA is to determine the number of principal components to use. The decision has no hard-set rules, and it may seem subjective at times. However, by understanding PCA's concept and roles, the decision can be made based on a visual inspection and statistical analysis. The scree plot test offers visual observation of the number of components loads while finding the eigenvalues, total variance, and pattern matrix offered from the evidence's statistical point. With data of high dimensions, where graphical representation is difficult, PCA is a powerful multivariate statistical tool for analysing data and finding patterns in it.

However, PCA does have some disadvantages as it depends on the researcher's ability to develop a complete and accurate set of attributes. If important attributes are missed, the precision of the procedure is reduced accordingly. The naming of the factors (independent variables) could also contribute to the drawbacks of PCA. This is due to multiple attributes being highly correlated with no apparent reasons. On the other hand, if the observed variables are completely unrelated, PCA analysis is unable to produce a meaningful pattern. The following subsection explains the principal component analysis conducted in this study.

5.3.5.1 Sampling Adequacy

Sampling adequacy is a prerequisite criterion that should comply with before the PCA test. There are two methods employs in this study for determining sampling adequacy:

(a) ***Kaiser-Meyer-Olkin (KMO) Measure the Sampling Adequacy for the Entire Dataset.***

The KMO measure is used as an index of whether there are linear relationships between the variables and, thus, whether it is appropriate to run a principal components analysis on the current data set. Its value can range from 0 to 1, with values above 0.6 suggested as a minimum requirement for sampling adequacy, but values above 0.8 are considered good and indicative of principal components analysis being useful according to Kaiser's classification of measure values.

Table 5.8: Kaiser's (1974) classification of KMO measurement values

KMO Measure	Meaning
KMO >= 0.9	Marvellous
0.8 <= KMO < 0.9	Meritorious
0.7 <= KMO < 0.8	Middling
0.6 <= KMO < 0.7	Mediocre
0.5 <= KMO < 0.6	Miserable
KMO < 0.5	Unacceptable

The overall KMO's measure for the survey instrument items is 0.863, which is considered 'Meritorious' according to Kaiser's (1974) classification in Table 5.8. The KMO result is provided in the SPSS result's in Table 5.9 below:

Table 5.9: KMO and Bartlett's Test.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.863
Bartlett's Test of Sphericity	Approx. Chi-Square	3353.858
	df	630
	Sig.	.000

(b) ***Bartlett's test of sphericity***

Bartlett's test is used to test whether the correlation matrix has adequate and significant correlations (Ho, 2014; Shrestha, 2021). The Bartlett sphericity test checks whether the identity matrix represents the correlation matrix by testing the null hypothesis (Hadi et al., 2016). An identity matrix includes value one (1) on the diagonal and 0 on all off-diagonal elements. Effectively, it means that there are no correlations between the factors. This assumption is necessary to note that the variables would not reduce the components to a smaller number if there were no correlations between the variables. A significant value below 0.05 is needed to accept that the data has no identity matrix and is adequate for further analysis (Ho, 2014; Shrestha, 2021). As shown in Table 5.9, Bartlett's test of sphericity is statistically significant ($\rho < 0.5$), represented as 'Sig' as value 0.000 which indicates that $\rho < 0.0005$. Based on the three tests shown in Table 5.9, the variable Measure of Sampling Adequacy (MSA) value is satisfactory; therefore, the data set is suitable for principal component analysis (Cerny & Kaiser, 1977). All the extracted principal components will now be determined whether to retain for rotation and interpretation. The principal component is retained based on four criteria: a) Eigenvalue-one criterion, b) Proportion of total variance, c) Scree plot test, and d) Interpretability criterion (Denis, 2021; Tabachnick & Fidell, 2012; Yong & Pearce, 2013).

The understanding of PCA can be strengthened by rotation because unrotated components are vague (Denis, 2021; Yong & Pearce, 2013). The aim of rotation is to obtain an optimum basic structure to provide as least variables as possible in each component but enhances the number of loads for each variable (Shrestha, 2021; Yong & Pearce, 2013). There are two common rotation procedures: orthogonal and oblique (Shrestha, 2021; Tabachnick & Fidell, 2012). Oblique rotation is used as the rotation technique in this study because the items are assumed correlated (Yong & Pearce, 2013). In contrast, orthogonal rotation is used if the items are assumed uncorrelated (Hadi et al., 2016). Based on previous studies, most established items are correlated.

5.3.5.2 Component Retention

The following subsection presents the steps taken to retain the component in the principal component analysis.

(a) ***Eigenvalue***

The eigenvalue-one criterion is the most well-known method in determining how the components would be retained in principal components analysis. A value below one shows that the component has less variance to explain, and therefore, the variable should not be retained (Kaiser, 1974). The benefit of this technique is that it can be analyzed seamlessly. The eigenvalue-one criterion will retain components with an eigenvalue of more than 1.0. Hence, nine components are retained in the snippet in Figure 5.9 of the Total Variance Explained results. The full results of the PCA result are presented in Table C.3 in Appendix C.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	14.312	34.075	34.075	14.312	34.075	34.075	4.789	11.401	11.401
2	3.437	8.183	42.258	3.437	8.183	42.258	4.328	10.305	21.707
3	3.144	7.487	49.745	3.144	7.487	49.745	3.528	8.401	30.108
4	2.306	5.491	55.236	2.306	5.491	55.236	3.399	8.092	38.200
5	2.112	5.029	60.265	2.112	5.029	60.265	3.277	7.802	46.002
6	1.751	4.169	64.434	1.751	4.169	64.434	3.212	7.646	53.648
7	1.562	3.719	68.153	1.562	3.719	68.153	2.950	7.024	60.673
8	1.326	3.158	71.310	1.326	3.158	71.310	2.878	6.852	67.525
9	1.119	2.665	73.975	1.119	2.665	73.975	2.709	6.450	73.975
10	.965	2.298	76.273						
11	.860	2.047	78.321						
12	.776	1.849	80.169						
13	.742	1.767	81.937						
14	.639	1.521	83.458						
15	.604	1.438	84.896						

Figure 5.9: Total Variance Explained Result from SPSS.

(b) ***The proportion of total variance***

The proportion/percentage of total variance described by each variable is analysed according to two parameters.: (1) The proportion of variation that each variable describes individually; and (2) The total percentage of variation described by the number of components listed. This detail is classified in the Total Variance Explained table under the "Initial Eigenvalues" section as the "% of Variance" and the "Cumulative %" columns, as shown in Figure 5.9.

Each subsequent factor describes less of the total variance as the component number grows. Therefore, the first variable describes 34.1% of the total variance, while the second component just explains 8.1% of the total variance. Subsequently, this pattern continues with the increasing component number. Some scholars proposed that a component can only be retained if it describes at least 5% to 10% of the overall variance. In this scenario, only the first four components will be kept. Another criterion is to preserve all components that can describe at least 70 per cent of the total variance (Denis, 2021; Yong & Pearce, 2013). As the sixth to the ninth component is eligible to explain 64.4% of the total variance, this led the retention to include the sixth, seventh, eighth, and ninth components as well. Overall, nine factors are extracted, explaining 74% of the total variance.

(c) ***Scree plot test***

As mentioned previously, the third criteria for component retention are the scree plot test. The SPSS® software is used to run the scree plot test. A scree plot shows the eigenvalues on the y-axis and the number of factors on the x-axis. It always displays a downward curve. The point where the slope of the curve is clearly levelling off (the "elbow) indicates the number of factors that should be generated by the analysis. The scree plot can be viewed as a line graph, as shown in Figure 5.10. The number of the components extracted in the scree plot is the same number of components extracted in the Total Variance extracted table. As presented in Figure 5.10, the components to retain are the components plotted before the inflexion point in which the eigenvalue at Y-axis is 1. The red line in the scree plot represented the value 1, which explained the cut-off point of components to be retained. In the scree plot, the number of components to retain also starts from component one to the ninth component, which has a value of more than 1. The rest of the components are left out as these components contribute the least to the total variance.

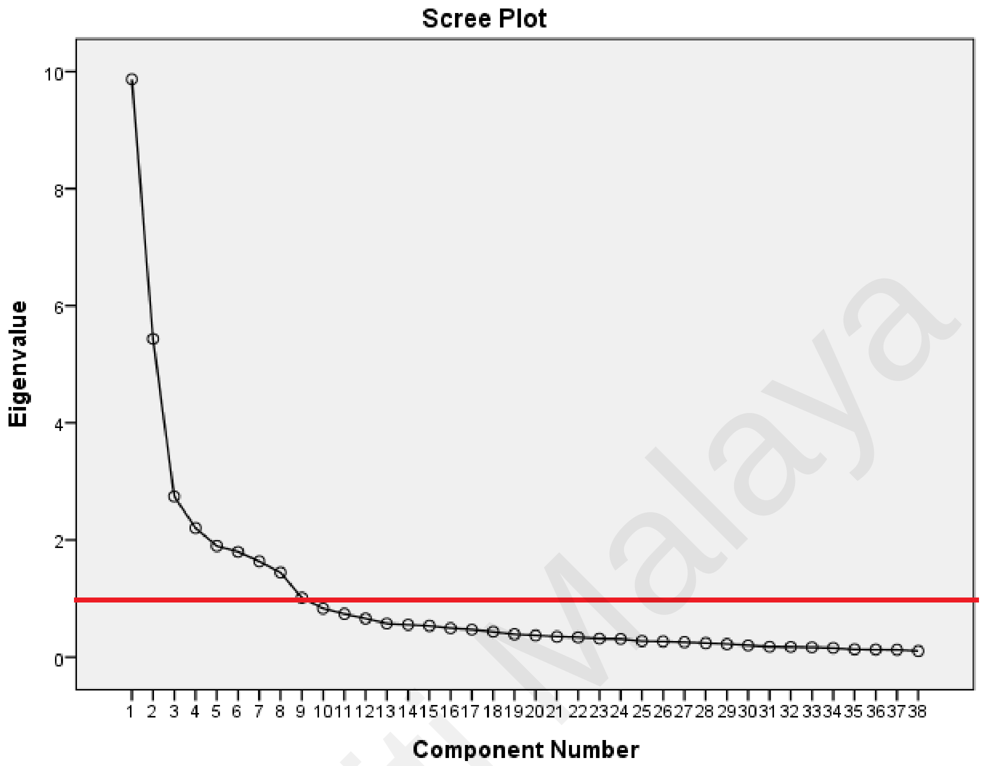

Figure 5.10: Scree Plot Test

(d) ***Interpretability criterion***

The most significant parameter is arguably the interpretability criterion, which focuses mostly on the definition of "simple structure" and whether the final answer makes sense. A simple structure is an extent where each variable is loaded heavily by just one component while each component loads heavily on at least three variables. The rotated matrix is shown as Pattern Matrix in Table C.4 in Appendix C. A direct-oblimin is chosen as the oblique rotation as the variables are expected to be correlated. Table C.4 in Appendix C clearly explains which variables belong to which component.

5.3.5.3 Retention Decisions

Prior to analysis, the suitability of the PCA was assessed. By looking at the correlation matrix in Table C..4 in Appendix C, it can be observed that all variables had at least one correlation coefficient with a value above 0.3. At the same time, the aggregate Kaiser-Meyer-Olkin (KMO) measure is 0.862, with individual KMO measures all greater than 0.7. The KMO value is classified between 'middling' to 'meritorial' by referring to the Kaiser (1974) classifications scheme. Bartlett's sphericity test is the next criteria accessed, which shows a statistically significant ($p < .0005$). Bartlett's sphericity test also suggested that the data was likely to be factorable. The total variance explained results (Table C.3, Appendix C) disclosed nine components that had eigenvalues greater than one and which explained 35.0%, 8.2%, 7.4%, 5.5%, 5.0%, 4.2%, 3.7%, 3.2% and 2.7% of the total variance, respectively. Overall, the nine-component solution explained 74% of the total variance. The visual analysis of the scree plot showed that nine components are eligible to be retained. All the aforementioned assessments contribute to the justification that the solution met the retention criterion; as such, nine components were retained.

The oblique (Direct Oblimin) rotation was employed to aid interpretability. The rotated solution exhibited a 'simple structure' (Thurstone, 1947). The details analysis was compatible with the post-adoption characteristics of the OGD in which the questionnaire was supposed to measure. A strong loading was captured for OGD principles items on Component 1, incentives items on Component 2, complexity items on Component 4, top management support on Component 5, data demand on Component 6, culture on Component 7, relative advantage on Component 8, and compatibility on Component 9. Two constructs (Readiness and Skills) were loading on the same Component 3; this suggests both items should be combined as single constructs. All component loadings and communalities of the rotated solution are presented in Table C.4 in Appendix C. As the components load accordingly to the pre-defined factors, the name of the components remains the same except for Component 3, which is combined and renamed to IT Competency as the new factors in the conceptual theory. The decision to rename IT Competency was derived from the previous constructs Readiness and Skills that represent the organisation's competency to prepare for resources that blend IT infrastructure and technical capacity. Two items from both Readiness and Skills were removed due to low loadings and renamed for the new construct. The final items left for the independent constructs after retention decisions are 42, as shown in Table 5.10

Table 5.10: The Constructs and Items Before and After Retention Decisions

	Constructs	Items	Decisions	Final Constructs	Final Items
1.	Complexity	CPX1	Retained	Complexity	CPX1
		CPX2	Retained		CPX2
		CPX3	Retained		CPX3
		CPX4	Retained		CPX4
2.	Compatibility	CPB1	Retained	Compatibility	CPB1
		CPB2	Retained		CPB2
		CPB3	Retained		CPB3
		CPB4	Retained		CPB4
3.	Relative Advantage	RAD1	Retained	Relative Advantage	RAD1
		RAD2	Retained		RAD2
		RAD3	Retained		RAD3
		RAD4	Retained		RAD4
4.	Culture	CUL1	Retained	Culture	CUL1
		CUL2	Retained		CUL2
		CUL3	Retained		CUL3
		CUL4	Retained		CUL4
5.	Top Management Support	TMS1	Retained	Top Management Support	TMS1
		TMS2	Retained		TMS2
		TMS3	Retained		TMS3
		TMS4	Retained		TMS4
6.	Readiness	RED1	Retained	IT Competency	ITC1
		RED2	Removed		-
		RED3	Retained		ITC2
7.	Skills	SKL1	Retained		ITC3
		SKL2	Reworded		ITC4
		SKL3	Removed		-

Table 5.10: The Constructs and Items Before and After Retention Decisions (Continue).

	Constructs	Items	Decisions	Final Constructs	Final Items
8.	Incentive	INC1	Retained	Incentive	INC1
		INC2	Retained		INC2
		INC3	Retained		INC3
		INC4	Retained		INC4
9.	Data Demand	DAD1	Retained	Data Demand	DAD1
		DAD2	Retained		DAD2
		DAD3	Retained		DAD3
		DAD4	Retained		DAD4
10.	OGD Principles	OGD1	Retained	OGD Principles	OGD1
		OGD2	Retained		OGD2
		OGD3	Retained		OGD3
		OGD4	Retained		OGD4
		OGD5	Retained		OGD5
		OGD6	Retained		OGD6
		OGD7	Retained		OGD7
		OGD8	Retained		OGD8
	No. of items	**44**		**No. of items**	**42**

5.3.6 Main Data Analysis

The main data analysis comprises of two parts, the preliminary analysis and the main data analysis. In the preliminary analysis, the dataset was the first screen to identify whether the dataset fits for main data analysis. Once the dataset has been tested as fit, the main data analysis is performed. The following sections detail the techniques taken in preliminary and main data analysis.

5.3.6.1 Preliminary Analysis

Before the data analysis proceeds to the main data analysis, the data is run for preliminary analysis. This procedure is to ensure that the data is reliable to perform advanced data analysis (Denis, 2016; Ho, 2013). The output from the data analysis is used to make inferences and thus contribute to the conclusions of this study. The following subsection explains four preliminary data analyses: i) data screening, ii) non-response bias, iii) data distribution, and iv) common method variance.

(a) Data Screening

Data screening is the process of verifying that the data is clean and ready to go before doing additional statistical analysis. Data must be screened to ensure that it is usable, reliable, and valid for testing causal theory. One of the activities in the data screening is to identify the pattern of missing data. Table 5.11 presents the number of data that was captured during the first and second waves of data collection. The incomplete responses indicate that the respondents did not complete the questionnaire until the last question. After removing the incomplete responses, the total valid number of responses in the sample, N is 266 (N=266).

Table 5.11: Data screening results

	First wave	Second wave	Total
A. Returned responses	187	107	294
B. Incomplete	18	10	28
C. Valid responses (A-B)	169	97	266

(b) Non-response Bias

Non-response bias appears to be one of the difficulties in extrapolating the research findings, which is carried out on the functional response after data collection. In observational surveys, the non-response bias happens in most statistical surveys when responses to a survey vary from those that did not answer regarding demographic or attitudinal variables of the potential respondents (Sax et al., 2003). When a non-response bias occurs, there is an unrepresentative sample. A common method to assess a non-response bias test is called the extrapolation method (Armstrong & Overton, 1977; Brown & Churchill, 2009). As proposed by Armstrong and Overton (1977), the general principle is focused on the assumption that people who react less readily or late returns most frequently have non-respondent characteristics. The distinctive features of the early and late returns of the questionnaire allow comparison of their responses to be carried out in a non-response bias test.

Prior to the non-response bias test, a normality test was performed to determine the data distribution, and this will lead to a suitable non-response bias test to run for. Based on the normality test in the previous section, the data distribution is assumed to be not normal. Hence, an independent samples *t*-test was performed to inspect whether there is a statistically significant difference in the non-response group. In order to run this test, the data is separated by the time of the respondents completing the survey. The first response group (first wave) is defined when the respondents completed the survey in the first email invitation. The non-response group (second wave) is defined when the respondents completed the survey after a reminder email was sent. However, there was an unequal sample size between the first wave responses (N=169) and the second wave responses (N=97). As suggested by scholars, it is not advisable to run an independent sample *t*-test with an unequal sample size between groups with different variances.

Due to this situation, a random sample size (N=97) was picked from the first wave to be as equal as the second wave before running the independent sample *t*-test. The independent samples *t*-test was performed in SPSS software, and the results are shown in Table D.1 in Appendix D. The test was run with a total of N=194 sample size for equal distribution between the first (N=97) and second wave (N=97) of response. Table 5.12 summarizes the *t*-test results of an equal sample size. The complete results are presented in Appendix D.

Table 5.12: Summary of the Independent Sample T-Test Results.

Variables	Early ($N_1 = 97$)		Late ($N_2 = 97$)		t-value	Sig. (2-tailed)
	Mean	Std. Deviation	Mean	Std. Deviation		
Position	2.67	0.688	2.62	0.822	0.474	0.636*
Gender	1.54	0.501	1.53	0.502	0.143	0.886
Age	3.80	0.702	4.01	0.770	-1.949	0.530
ServiceTerm	3.44	0.803	3.46	0.879	-0.171	0.865
OGD Involvement	3.32	0.670	3.33	0.554	-0.117	0.907
Agency Type	1.68	1.160	1.61	1.186	0.428	0.669
Number of IT	3.51	1.535	3.58	1.657	-0.315	0.753

*Note: *p<0.05*

The assumption of variance was checked prior to assessing the mean differences of the Early and Late groups. These demographic items violate the assumption of homogeneity of variances via Levene's F test with $\rho > 0.05$, therefore, the variances between the Early and Late groups are the same (Pallant, 2016). Only one demographic item (Position), satisfied the homogeneity of variance where equal variances not assumed with F (192) = 4.24, $\rho = 0.041$. The value distinctions for statistically significant effect (Position) with $t(192) = 0.47$, $\rho = 0.636$ is quite small and generally would not affect the overall interpretation of the results (Pallant, 2016).

The mean differences between the groups are assessed by looking at the significance value of the t-test of Equality Means. The output in Table 5.12 indicates that all significance values at the column **Sig. (2-tailed)** are larger than 0.05 ($\rho > 0.05$). Therefore, there was no statistically significant difference of the mean for demographic items (Position, Gender, Age, Service term, OGD involvement, Agency type, Number of IT personnel) between the Early and Late groups. The findings suggest that the independent samples t-test was associated with a statistically significant effect, implying that non-response bias is not a concern for this sample. The results also mean that these data should accurately reflect the opinions of the public sector in Malaysia.

(c) ***Common Method Variance***

Common method variance or common method bias is referred to as variance due to the measurement process rather than the structures represented by the measurements (Podsakoff et al., 2003). Common method variance can be a concern when self-administered survey questionnaires are used to collect data at the same time from the same respondent. Due to the said reason, common method variance makes it more difficult to determine whether the strength of an observed relationship is representative of reality.

The possible remedies for the common method variance can be performed before the data was collected (ex-ante), also known as procedural and after the data was collected (*post-ante*) or referred to as the statistical remedy. There are a variety of actions that can be taken before for procedural remedy, particularly while developing the survey questionnaire. Once the survey is disseminated, a number of factors can contribute to biased reactions, thus reducing the respondents' willingness to respond appropriately. A number of issues are linked to method bias have been highlighted in a study by Podsakoff et al. (2003). One of the highlighting issues is the measurement context effects. The measurement context effects are caused by knowing that the survey's criterion and predictor constructs are responded to by the same person simultaneously, location, and using the same medium of the survey. The measurement context effects are inevitably exposed in this study as the respondents of this study, the government agency representatives, may have answered the survey at once using the medium provided. Other common issues of CMV include the complexity of the questions, double-barrelled questions, and item ambiguity (MacKenzie & Podsakoff, 2012).

Concerning the respondent's apprehension that their evaluation might be scrutinized by the researcher, it is essential to offer an assurance that the anonymity and confidentiality of the responses are in place. This procedure will add the respondent's confidence level to respond with honesty (Podsakoff et al., 2003). Due to this reason, the first page of the survey for this study was designed to briefly explain the objective of the survey and ensure the respondent's anonymity by completing the survey. The respondents have been assured that there are no right or wrong answers, and the respondents are encouraged to give a fair answer that best represents their agency. Having the anonymity protection remedy in place indicates that separating the criterion and predictor responses from a different source is not possible. This is due to the reason that the researcher has to synchronize the response between criterion and predictor, which will violate the respondent's anonymity (Podsakoff et al., 2003).

Another vital factor to consider in order to avoid method bias is the survey structure itself. The survey structure includes the length of the survey, the number of items per page, the order of the questions, the grouping items, and the aesthetic factor. Considering the survey for this study was designed in dual language (English and Malay), each page's questions limit to five questions for the paper-based survey. The paper-based survey was designed in two columns, in which the questions were arranged at the left column while the Likert-scale was arranged at the right column of the page. The design was intended in such a way to ease the respondents to read the question items. The survey was designed conventionally for the online survey, which means each question was ordered in sequence with the Likert scale below it. There was no specific number of questions for each page as the respondent could scroll the survey page until the end. Using the common scale format or the same Likert-scale type for all questions is another possible trigger to CMV as it can cause an artificial covariation (Podsakoff et al., 2003). As a procedural remedy to reduce the common scale format issue, a variation of the Likert-scale type is used to answer some of the survey questions.

Nevertheless, apart from the procedural remedy, this study has been prepare for statistical remedy by having a marker variable known as the Social Desirability Scale (SDS) in the survey (Podsakoff et al., 2003). Besides assuring the questionnaire is free from the common issues, adding the Social Desirability Scale is another preventive measure to avoid method bias for self-reporting surveys (Reynolds, 1982). The Social Desirability Scale was developed by Douglas P. Crowne and David Marlowe and is mostly known as the Marlowe-Crowne Social Desirability Scale (MC-SDS). The MC-SDS contains 33-items of a self-report questionnaire that evaluates an individual interest in social approval (Crowne & Marlowe, 1960). However, due to its lengthy and wordy questions, Strahan and Gerbasi (1972) suggest a shorter and homogeneous version that is more comprehensible than the original version. For the purpose of this study, only four SDS questions were added to the survey questionnaire. The four questions were intended to identify whether the respondents were influenced by their own personality traits while answering the survey. The SDS questions that were added in the survey is referred at Table 5.13.

Table 5.13: Social Desirability Scale (Crowne & Marlowe, 1960)

1. I like to gossip at times.
2. I have never intensely disliked anyone.
3. I am always willing to admit it when I make a mistake.
4. I have never deliberately said something that hurt someone's feelings.

For *post-hoc* remedies, it is found that an abundance of studies uses Harman's single factor test as the most common method to assess CMV (Tehseen et al., 2017). As the first statistical remedy for CMV, this study employs Harman's single-factor test. Figure 5.11 represents the results from the SPSS software indicated that a single factor is extracting 25.65%; it is far lesser than 50%; therefore, it can be claimed that CMV is not present in this study.

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	13.97[illegible]	[illegible]	26.865	13.339	25.651	25.651
2	5.653	10.871	37.736			
3	2.922	5.619	43.356			
4	2.658	5.112	48.467			
5	2.026	3.897	52.364			
6	1.801	3.464	55.828			
7	1.597	3.072	58.900			

Double-click to activate

Figure 5.11: Snippet of Harman's Single Factor Test from SPSS for Common Method Bias Assessment

However, albeit that Harman's single factor test is easy to perform, it is insufficient for a *post-hoc* remedy for CMV (Podsakoff et al., 2003; Tehseen et al., 2017). Harman's single-factor test's inability to control and correct the CMV are the main reasons why Harman's single-factor is an incomplete statistical remedy for CMV (Podsakoff et al., 2003). Despite the issues, Podsakoff et al. (2003) suggest partialling out a marker variable as an alternative solution for CMV. The marker variable is partialling out on the endogenous constructs in the PLS model, and the R^2 value is observed. The R^2 value before and after adding the marker variable is compared to look for any difference. Table 5.14 captured the R^2 value of the endogenous constructs before and after partialling out the marker variable. The PLS model that is drawn in SmartPLS software is presented in Appendix E.

Table 5.14: Comparison of R^2 Values in the PLS Model with and without Marker Variable.

Constructs	R^2 in the PLS model (Without marker variable)	R^2 in the PLS model (With marker variable)
Acceptance	0.478	0.480
Routinization	0.430	0.431
Infusion	0.505	0.508

The difference of R^2 value for each construct between both models is calculated (Acceptance: 0.480 – 0.478=0.002, Routinization: 0.431 - 0.430 = 0.001, Infusion: 0.508 - 0.505 = 0.003) and as a result no significant difference is found. Thus, the result renders another proves that CMV is not an issue to be a concern in this study.

5.3.6.2 Descriptive Analysis

The characteristics of the complete sample (N=266) are summarized in Table 5.15 to Table 5.21. The tables present respondents' demographic profiles, including information of their gender, age, position in their organisation, organisation type, tenure, years of experiences in OGD, and the number of IT staff. The descriptive analysis is run in the SPSS software.

Table 5.15 presents the gender information of the respondents. The figure indicates almost a balance of respondents, both from the male with 128 respondents (48.1%) and female with 138 respondents (51.9%).

Table 5.15: Respondents' Gender Information.

Demographic Information		Frequency (N)	Percentage (%)
Gender	Male	128	48.1
	Female	138	51.9
	Total	**266**	**100.0**

Table 5.16 presents the respondents' age group. The age group of 30 to 39 years old represents most of the respondents, with 52.3%. One plausible explanation is due to that most of the tasks for OGD implementation were assigned to middle-level management officers.

Table 5.16: Respondents' Age Group.

Demographic Information		Frequency (N)	Percentage (%)
Age	60 years old and above	0	0
	50 – 59 years old	14	5.3
	40 – 49 years old	64	24.1
	30 – 39 years old	139	52.3
	20 – 29 years old	49	18.4
	Total	**266**	**100.0**

The respondent's position in the agency is presented in Table 5.17. Middle-level management (41.4%) and lower-level management (42.1%) represent two of the most groups of respondents' positions in the government agency.

Table 5.17: Respondents' Position.

Demographic Information		Frequency (N)	Percentage (%)
Position	Executive Level Management	10	3.8
	Middle-Level Management	110	41.4

Demographic Information		Frequency (N)	Percentage (%)
	Lower-Level Management	112	42.1
	Operational Level	34	12.8
	Total	**266**	**100.0**

The breakdown of the respondents' years in government service is presented in Table 5.18. The majority of respondents have been served in the government for between eleven to twenty years (45.1%). In comparison, 30.8% have been serving between five to less than ten years in the government sector.

Table 5.18: Respondents' Years of Service

Demographic Information		Frequency (N)	Percentage (%)
Years of service	More than 30 years	3	1.1
	Between 21 to 30 years	30	11.3
	Between 11 to less than 20 years	120	45.1
	Between 5 to less than 10 years	82	30.8
	Less than 5 years	31	11.7
	Total	**266**	**100.0**

More than half of the respondents (54.9%) have two to less than five years of experience in OGD implementation, as depicted in Table 5.19. The figure shows that the maturity of the respondents in OGD implementation has grown in tandem with the advent of OGD in the Malaysian government since 2014. While 38% of the respondents have less than two years of experience, it indicates the second highest group of respondents have experience in OGD implementation. Only 5.6% of the respondents have between five to less than ten years of experience in OGD implementation. The analysis also shows that only 1.5% of the respondents have more than ten years of experience in OGD implementation.

Table 5.19: Respondents' Years of Involvement in OGD Implementation.

Demographic Information		Frequency (N)	Percentage (%)
Years of involvement on OGD	More than 10 years	4	1.5
	Between 5 to less than 10 years	15	5.6
	Between 2 to less than 5 years	146	54.9
	Less than 2 years	101	38.0
	Total	**266**	**100.0**

A significantly high percentage of the respondents are represented by the federal agency, with 66.5% as presented in Table 5.20. The federal statutory body represents 11.7% of the respondents' organisations. Another 11.3% of the respondents come from the state government. A small portion of the respondents come from state statutory bodies (6.4%), local authority (1.5%), corporation (1.9%) and others (0.8%).

Table 5.20: Respondents' Organisation

Demographic Information		Frequency (N)	Percentage (%)
Type of organisation	Federal	177	66.5
	Federal Statutory Body	31	11.7
	State Government	30	11.3
	State Statutory Body	17	6.4
	Local Authority	4	1.5
	Corporation	5	1.9
	Others	2	0.8
	Total	**266**	**100.0**

The number of IT personnel in the respondents' agency indicates a balance in all sizes from zero to more than fifty IT personnel in the office. The bigger the number of IT personnel normally is related to the bigger size of the organisation. Table 5.21 depicts the number of IT personnel in the respondents' agency.

Table 5.21: Number of IT Personnel in the Respondents' Agency

Demographic Information		**Frequency (N)**	**Percentage (%)**
Number of IT personnel in the agency	More than 50 persons	42	15.8
	Between 31 to 50 persons	35	13.2
	Between 11 to 30 persons	68	25.6
	Between 5 to 10 persons	34	12.8
	Between 1 to 4 persons	54	20.3
	None	33	12.4
	Total	**266**	**100.0**

5.3.6.3 Introduction to Structural Equation Modelling (SEM)

The primary data analysis was conducted by applying the Structured Equation Modelling (SEM) analysis technique. SEM techniques are known as second-generation data analysis techniques. SEM allows for the modelling and testing of the relationship among multiple independent and dependent constructs, all at once. As of today, there are two main SEM analysis techniques, namely Covariance-based SEM (CB-SEM) and Partial Least Square SEM (PLS-SEM) or also known as variance-based SEM. The main difference between these two techniques can be seen from the outcome of the analysis; for instance, CB-SEM analyses whether the observed and theoretical covariance matrix is fit, while the PLS-SEM focuses on prediction and estimation of the variance between independent variables and dependent variables (Ramayah et al., 2018). In short, CB-SEM is primarily used to confirm or reject theories, while PLS-SEM is used to develop theories in exploratory research or for predicting purpose in a study (Ramayah et al., 2018). Therefore, in line with the objectives of this study, PLS-SEM analysis is the preferred analysis technique to use in the main data analysis phase. Together with this reason, other several factors made PLS-SEM the best analysis techniques for this study. The comparison between PLS-SEM and CB-SEM in terms of different salient criteria is depicted in Figure 5.12.

Criteria	**PLS-SEM**	**CB-SEM**
A. Research Goals	1. If the goal is predicting key target constructs or identifying key driver. 2. If the research is exploratory or an extension of an existing structural theory.	1. If the goal is to test theory or to compare a theory with an alternative theory.
B. Measurement Model Specification	1. If formative measured constructs are a part of the structural model.	1. If error terms require additional specification, such as co-variation.
C. Structural Model	1. If the structural model is complex (many constructs and many indicators).	1. If the model is non-recursive.
D. Data Characteristics and Algorithm	1. If CB-SEM cannot be met(i.e. model specification, non-convergence, data distributional assumptions) 2. If sample size is relatively low. 3. If data to some extent non-normal.	1. If data meet the CB-SEM assumption exactly.
	1. With large data sets, CB-SEM and PLS-SEM results are similar. PLS-SEM results are a good approximation of CB-SEM results.	
E. Model Evaluation	1. If latent variable scores are required in subsequent analysis.	1. If a global goodness-of-fit criterion is required. 2. If a test for measurement model invariance is required.

Figure 5.12: Criteria to select between PLS-SEM and CB-SEM analysis adapted from Hair Jr, Hult, et al. (2017).

5.3.6.4 Composition of the Path Model

Researchers who employ SEM analysis would normally present their visual hypotheses and variables in a diagram called the path model (Hair Jr, Hult, et al., 2017). The basic path model consists of constructs, indicators, and relationships (paths) of the constructs. The constructs or latent variables is a variable that cannot be measured directly. The indicator is the observed value that can be used to measure the latent variables. The constructs are drawn in an oval shape, while the indicators or items are drawn in a rectangle shape in the path model. The relationships between constructs or between constructs and indicators are represented as a single arrow-headed.

Another important element in a PLS-SEM path model is the sub-models. The PLS-SEM path model is formed by two sub-models, namely the measurement model and the structural model. The measurement model or the outer model represents the relationship between latent variables (unobserved variables) and the indicators (observable variables). The structural model or the inner model describes the relationships between constructs. Figure 5.13 depicts the path model of this study.

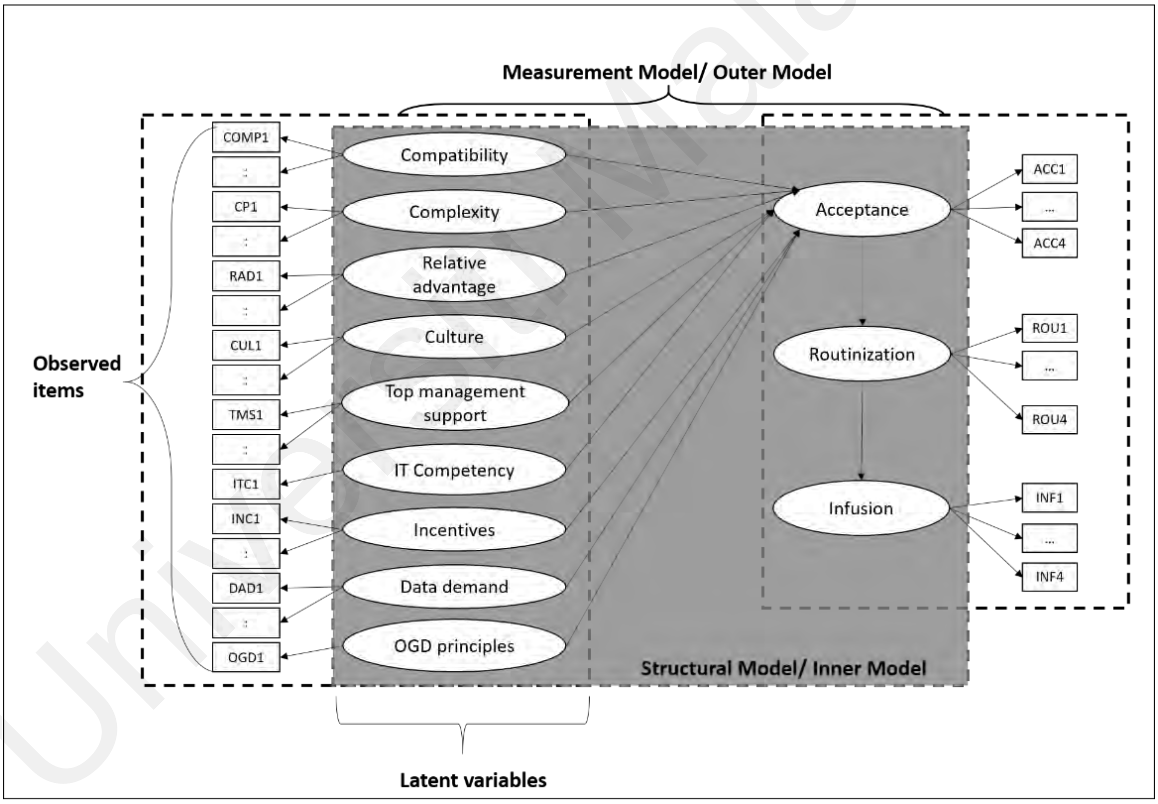

Figure 5.13: Composition of the path model

The path model is drawn in SmartPLS version 3.2.9 (Ringle et al., 2015) software for PLS-SEM analysis. The path model diagram is illustrated in Figure 5.14.

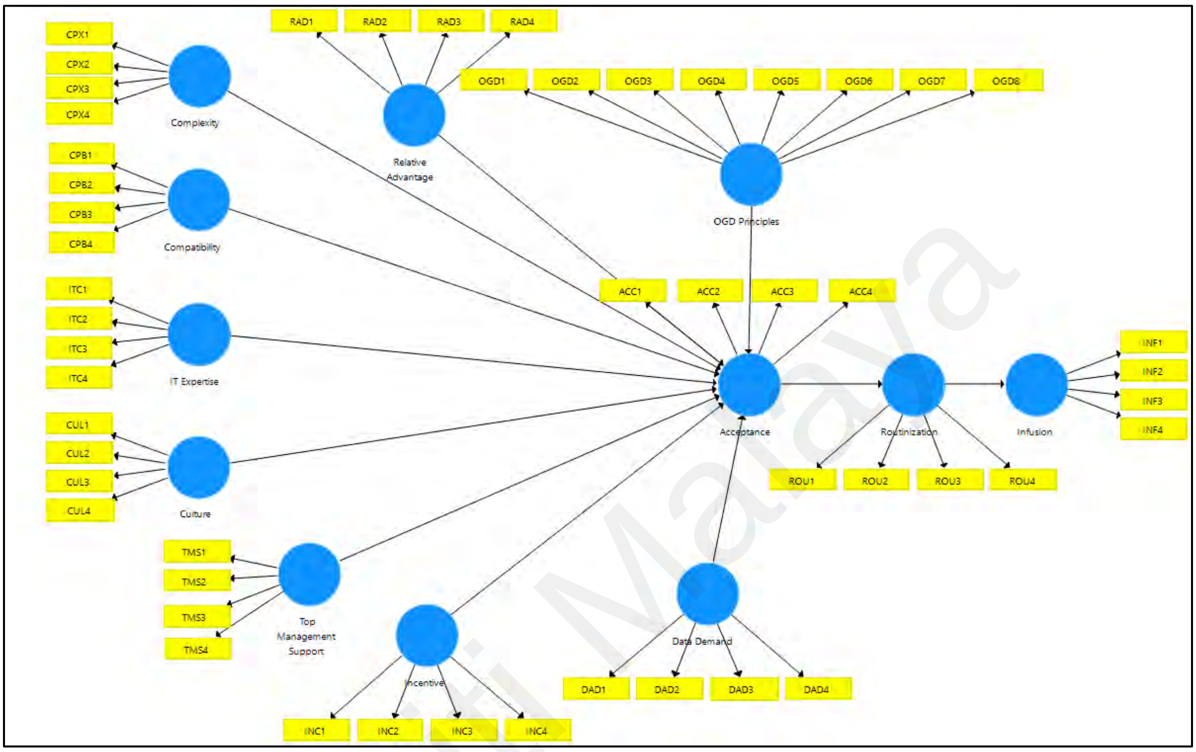

Figure 5.14: The SEM-PLS research model for OGD post-adoption framework in the Malaysian public sector.

5.3.7 Measurement Model Assessment

The measurement model specifies how the latent variables are measured. There are two different ways to measure latent variables, either by reflective measurement or formative measurement. In the reflective form of measurement, paths connecting constructs to indicators are directed toward the indicators. The associations between the reflective construct and measured indicator variables are referred to as outer loadings. In the formative form of measurement, paths connecting constructs to indicators are directed towards the constructs. The relationship between the formative constructs and measured indicator variables are referred to as weights.

5.3.7.1 Data Distribution

Data quality is an essential prerequisite criterion prior to analysing data using PLS-SEM. Having quality data means that no missing values and incomplete data are present before running the data in the Smart-PLS software. Although data distribution is not the main concern in structural equation modelling, determining the data distribution is essential to help researchers understand the data pattern. Basically, there are varieties of ways to assess the data distribution visually and statistically. One can observe the histogram and normal Q-Q plot for visual inspection of the normality of the data. Statistically, there are tests designed to determine the data normality, such as the Kolmogorov-Smirnov[a] and Shapiro-Wilk test, but these tests require a null hypothesis of the normal data distribution to be formulated before the null hypothesis should be accepted or rejected. Furthermore, due to the Kolmogorov-Smirnov[a] and Shapiro-Wilk test's limited capability to accurately determine the data distribution, most scholars suggest not to rely on these tests, instead use other normality tests. Nonetheless, Hair Jr et al. (2016) suggested researchers who are doing PLS-SEM analysis to examine the data distribution by observing the skewness and kurtosis values. For this reason, a tool from a webpage WebPower statistical analysis tools is used to determine the data distribution (Zhang & Yuan, 2018). Figure 5.15 depicts the results of the normality test using Webpower analysis tools. Due to the long list of the variables tested, only half of the result's portion is displayed on this page. The Mardia's multivariate skewness (β=725.03, $p < 0.05$) and kurtosis (β=2991.98, $p < 0.05$) indicates that the data is not normal based on p-value < 0.05.

Output of skewness and kurtosis calculation

```
Sample size:  266
Number of variables:  52

Univariate skewness and kurtosis
           Skewness   SE_skew     Kurtosis   SE_kurt
ITC1 -0.5931918396 0.1493501  0.531432942 0.2976129
ITC2  0.2940832306 0.1493501 -0.847299962 0.2976129
ITC3 -0.8710547670 0.1493501  2.213865381 0.2976129
ITC4 -0.0924517923 0.1493501 -0.220981709 0.2976129
CUL1 -0.4567360995 0.1493501  0.299945360 0.2976129
CUL2 -0.0009086509 0.1493501 -0.098277142 0.2976129
CUL3 -0.3382172504 0.1493501  0.215888028 0.2976129
CUL4 -0.5007078193 0.1493501  0.940217239 0.2976129
[illegible]

OGD4  0.4244252310 0.1493501 -0.664897552 0.2976129
OGD5 -0.0053317642 0.1493501 -1.075050718 0.2976129
OGD6  0.2458895890 0.1493501 -0.509843993 0.2976129
OGD7  0.0069733722 0.1493501 -1.194818106 0.2976129
OGD8  0.1803908848 0.1493501 -0.514135317 0.2976129

Mardia's multivariate skewness and kurtosis
                 b           z p-value
Skewness  725.0342 32143.18293       0
Kurtosis 2991.9768    20.01982       0
```

Figure 5.15: Normality test from Webpower analysis page (https://webpower.psychstat.org/models/kurtosis).

The skewness evaluates the degree of symmetrical distribution of the variables. The distribution is considered skewed if the variable's response stretches toward the right or left tail of the distribution. The kurtosis assesses whether the dissemination of the variables is excessively peaked, which also indicates the extremely limited distribution with the majority of responses in the central point. When both skewness and kurtosis are close to zero, the pattern of responses is considered a normal distribution.

5.3.7.2 Reflective Measurement Model Assessment

Once a PLS measurement model is operationalized as reflective, each indicator is exposed to an error-afflicted estimation or measurement error (Vinzi et al., 2010). There are two parts of measurement error, random and systematic. Random measurement error refers to all factors that unsystematically impact the outcome of a construct estimation. In contrast, the systematic measurement error exists at any degree of repetition and often at the same degree of the measurement of the construct (Churchill, 1995). In order to achieve a total reliable measurement, the random and systematic measurement error must be estimated as close to zero as possible. There are four basic evaluations for the reflective measurement model, as discussed in the next subsections.

5.3.7.3 Internal Consistency

The first criterion in assessing the reflective measurement models is internal consistency reliability. The internal reliability consistency measures whether all the indicators of a construct measure the same element. There are two tests for the internal consistency reliability test: Cronbach's alpha and composite reliability (CR). The following subsection explains the measurements.

(a) ***Cronbach's Alpha***

An abundance of studies has been using Cronbach's alpha (α) traditionally to measure internal consistency reliability of the data. However, many scholars suggest refraining from using Cronbach's alpha test as it tends to provide a conservative measurement (McNeish, 2018). However, using the SmartPLS software, the Cronbach's alpha value is calculated along with other assessments; thus, the result is presented in Table 5.22 to add to the variety of internal consistency tests conducted. The result in Table 5.22 shows that the Cronbach's alpha value for each construct is between 0.70 to 0.90, hence is regarded as satisfactory (Ramayah et al., 2018).

(b) ***Composite Reliability***

Composite reliability (CR) is an alternative measurement of internal consistency reliability to Cronbach's alpha (Bagozzi & Yi, 1988). This is due to the Cronbach's alpha's limitations that underestimate the true reliability of the constructs. The acceptable value of CR must be 0.7 or higher (Bagozzi & Yi, 1988). The result from Table 5.22 has indicated that the internal consistency reliability of all reflective latent variables has been established.

Table 5.22: Internal Consistency Assessments

Constructs	***Cronbach's Alpha***	**Composite Reliability**
Acceptance	0.828	0.886
Compatibility	0.848	0.898
Complexity	0.820	0.88
Culture	0.866	0.918
Data Demand	0.820	0.894
IT Competency	0.855	0.900
Incentive	0.760	0.844
Infusion	0.845	0.896
OGD Principles	0.904	0.911
Relative Advantage	0.851	0.898
Routinization	0.842	0.895
Top Management Support	0.837	0.891

5.3.7.4 Indicator Reliability

The indicator reliability refers to the size of the outer loading, and it demonstrates the proportion of indicator variance that is explained by the latent variable (Vinzi et al., 2010). The objective of indicator reliability assessment is to examine how compatible an indicator or a group of indicators is with what it aims to measure (Urbach & Ahlemann, 2010). There are a few guidelines to be followed for evaluating the factor loading from the PLS model. As a basic rule of thumb, the uniform outer loading for an indicator should be 0.708 or higher to be retained in the PLS model (Hair Jr, Hult, et al., 2017). The reason for the standard value of 0.708 is that the square of the indicator's outer loading should contribute to the variance of the latent variable at least by 50%. Calculation of a squared 0.708 will results in 0.50 (50%), and for that reason, the outer loading should be higher than 0.708 to get more significant reliability.

On the other hand, indicators are suggested to be eliminated from measurements models if their outer loadings within the PLS model are smaller than 0.4 (Hair Jr, Hult, et al., 2017; Hulland, 1999). The first iteration results for indicator reliability for this study is shown in Table 5.23.

Table 5.23: First Iteration Result for PLS Algorithm Analysis

Constructs	Items	Loadings > 0.7	Decisions
Acceptance	**ACC1**	0.704	
	ACC2	0.866	
	ACC3	0.870	
	ACC4	0.804	
Compatibility	**CPB1**	0.850	
	CPB2	0.889	
	CPB3	0.772	
	CPB4	0.803	
Complexity	**CPX1**	0.829	
	CPX2	0.812	
	CPX3	0.857	
	CPX4	0.714	

Table 5.23: First iteration result for PLS algorithm analysis (continue)

Constructs	Items	Loadings > 0.7	Decisions
Culture	**CUL1**	0.902	
	CUL2	0.819	
	CUL3	0.887	
	CUL4	0.697	Removed
Data Demand	**DAD1**	0.892	
	DAD2	0.895	
	DAD3	0.511	Removed
	DAD4	0.778	
Incentive	**INC1**	0.766	
	INC2	0.754	
	INC3	0.806	
	INC4	0.703	
Infusion	**INF1**	0.741	
	INF2	0.889	
	INF3	0.834	
	INF4	0.840	
IT Competency	**ITC1**	0.871	
	ITC2	0.851	
	ITC3	0.861	
	ITC4	0.742	
OGD Principles	**OGD1**	0.772	
	OGD2	0.746	
	OGD3	0.724	
	OGD4	0.674	
	OGD5	0.841	
	OGD6	0.752	
	OGD7	0.778	
	OGD8	0.614	Removed
Relative Advantage	**RAD1**	0.819	
	RAD2	0.879	
	RAD3	0.879	
	RAD4	0.733	
Routinization	**ROU1**	0.779	
	ROU2	0.889	
	ROU3	0.846	
	ROU4	0.780	
Top Management Support	**TMS1**	0.794	
	TMS2	0.872	
	TMS3	0.822	
	TMS4	0.790	

As part of the measurement model evaluation, three items (CUL4, DAD3, OGD8) were removed on the first iteration of the PLS algorithm analysis due to low factor loadings (< 0.7). However, one item from OGD Principles constructs that score below 0.7 (OGD4) but was still retained in the model after the first iteration of the PLS algorithm function. The rationale behind the retained items is to ensure that the Average Variance Extracted (AVE) value exceeds the threshold value of 0.5. According to Hair Jr, Hult, et al. (2017), although the rule of thumb suggests removing an item lower than the threshold value, nonetheless, if removing an item will cause the AVE value to drop below 0.5, then the item can be retained. Removing too many items should be followed by some consideration as it could also trigger some effects on the content validity of the constructs (Hair Jr, Hult, et al., 2017). Table 5.24 presents the final iteration results of the PLS algorithm analysis.

Table 5.24: Results for Indicator Reliability and Convergent Validity

Constructs	**Items**	**Loadings > 0.7**	**AVE > 0.50**
Acceptance	**ACC1**	0.703	0.662
	ACC2	0.866	
	ACC3	0.869	
	ACC4	0.806	
Compatibility	**CPB1**	0.850	0.688
	CPB2	0.889	
	CPB3	0.772	
	CPB4	0.803	
Complexity	**CPX1**	0.829	0.647
	CPX2	0.812	
	CPX3	0.857	
	CPX4	0.713	
Data Demand	**DAD1**	0.901	0.738
	DAD2	0.904	
	DAD4	0.764	
Incentive	**INC1**	0.766	0.575
	INC2	0.754	
	INC3	0.806	
	INC4	0.703	

Table 5.24: Results for indicator reliability and convergent validity (continue).

Constructs	Items	Loadings > 0.7	AVE > 0.50
Infusion	**INF1**	0.741	0.685
	INF2	0.889	
	INF3	0.834	
	INF4	0.840	
Culture	**CUL1**	0.869	0.788
	CUL2	0.857	
	CUL3	0.867	
IT Competency	**ITC1**	0.853	0.694
	ITC2	0.720	
	ITC3	0.830	
	ITC4	0.729	
OGD Principles	**OGD1**	0.800	0.553
	OGD2	0.802	
	OGD3	0.753	
	OGD4	0.760	
	OGD5	0.656	
	OGD6	0.767	
	OGD7	0.654	
Relative Advantage	**RAD1**	0.819	0.688
	RAD2	0.879	
	RAD3	0.879	
	RAD4	0.733	
Routinization	**ROU1**	0.779	0.680
	ROU2	0.889	
	ROU3	0.846	
	ROU4	0.780	
Top Management Support	**TMS1**	0.794	0.673
	TMS2	0.872	
	TMS3	0.822	
	TMS4	0.790	

5.3.7.5 Convergent Validity

Convergent validity is a correlation between one measure and others that are used for a construct (Urbach & Ahlemann, 2010). In updated works by Hair et al. (2014), the convergent validity is known as AVE, which refers to the mean of all squared loadings from all indicators or items from a construct. In other words, AVE refers to whether indicators that are supposed to measure the same thing are highly correlated. Convergent validity is a critical part of establishing a valid construct. It is useful in establishing or finding the strength of the relationship between two different measures. A general rule of thumb suggested that a latent variable should explain a considerable part of each indicator's variance, usually at least 50%. The rule means that the outer loading of an item from each construct should be above 0.708 as the squared number (0.7082) is equal to 0.50. The results for convergent validity and the factor loadings for each construct are presented in Table 5.24. All constructs achieved convergent validity with AVE above 0.5 after the low factor loading has been removed in the previous subsection of indicator reliability assessment.

5.3.7.6 Discriminant Validity

Discriminant validity refers to the degree to which indicators differentiate across constructs or measure distinct concepts by examining the correlations between potentially overlapping measures (Ramayah et al., 2018). Discriminant validity is an essential assessment as it examines whether the constructs under investigation are truly distinct from one another (Ramayah et al., 2018). In SmartPLS 3.0 software, there are three types of criteria available to assess the discriminant validity, namely i) cross-loading criterion, ii) Fornell and Larcker's (1981) criterion, and iii) Heterotrait-Monotrait ratio of correlations (HTMT).

(a) ***Cross Loadings***

The loadings for indicators for allocated latent variables should be greater than the loadings for all other latent variables under the cross-loading criteria. According to Chin (1998), there must be no less than 0.1 variation in loading between latent variables. If each loading indicator is higher than the other constructs for its assigned construct, it can be claimed that the indicators are not replaceable with other constructs (Ramayah et al., 2018). As can be seen in Table F.1 in Appendix F, all the diagonal values of cross-loading for each block of the indicator are higher than other indicators. Hence, the data comply with the first discriminant validity assessment.

(b) ***Fornell-Larcker's Criterion***

The second discriminant validity assessment is called Fornell-Larcker's criterion (Fornell & Larcker, 1981). In this assessment, a latent variable should explain better the variance on its own indicators than the variance of other latent variables. In SmartPLS software, Fornell-Larcker's criterion can be analysed by looking at each latent variable's diagonal value. The result for Fornell-Larcker's criterion is shown in Table F.2 in Appendix F. The result shows that the square root of AVE for each construct is greater than the inter-construct correlation. Thence the result adds to the discriminant validity evidence of this study.

(c) ***Heterotrait-Monotrait Ratio of Correlations (HTMT)***

Although the cross-loading and Fornell-Larcker's criteria have been widely used to establish discriminant validity in empirical research, both criterion, however, faces major drawbacks (Hair Jr, Hult, et al., 2017). In the latest update by Henseler et al. (2015), the cross-loading criterion cannot establish discriminant validity if two constructs are perfectly correlated. Whereas Fornell-Larcker's criterion functions incompetently to establish discriminant validity for marginally differences between the indicator loadings, unlike when there is a substantial difference (Hair Jr, Hult, et al., 2017). Following the issues, Henseler et al. (2015) suggest a new approach called the Heterotrait-Monotrait (HTMT) ratio criterion, which refers to the ratio of correlation within the constructs to correlations between the constructs. Using the Monte Carlo simulation study, HTMT is able to achieve higher specificity and sensitivity rates (97% to 99%) compared to cross-loading and criterion (Henseler et al., 2015). Scholars justify this reason to the need to add HTMT assessment in the discriminant validity assessment. Table F.3 in Appendix F presents the result from the HTMT assessment. Based on Henseler et al. (2015) HTMT ratio measure, it shows that all the HTMT values are significantly lower than the stringent criterion of HTMT.85 (Kline, 2011) and HTMT.90 (Gold et al., 2001). With the cut-off values are met, it indicates that the discriminant validity of the constructs in the research model is established.

To further evaluate the discriminant validity using the HTMT criterion, a bootstrapping technique was performed. Bootstrapping is a resampling technique of original data in which the data is selected randomly to perform a calculation (Henseler et al., 2015). The result will produce a slightly different value as the procedure is repeated to create a substantial number of samples. The typical bootstrapping iteration creates about 5000 subsamples to estimates standard error. The purpose of conducting the HTMT bootstrapping technique is to check whether the confidence interval's lower and upper bound contains the value of 1 (Ramayah et al., 2018). If the confidence interval’s range is found to stand between 1, it indicates that the data lacks discriminant validity. Similarly, if the confidence interval’s range stands out of value 1, the two constructs are regarded as empirically distinct (Hair Jr, Hult, et al., 2017). The result of the HTMT bootstrapping technique is presented in Table F.4 in Appendix F. The result shows both the lower and upper bound of the confidence interval’s range includes a value of 1. As such, the discriminant validity of the data is established based on the liberal criterion of HTMT inference.

5.3.7.7 Summary for Measurement Model Assessment

When evaluating a measurement model, the aim is to specify how measured variables reflect constructs in a theoretical model that are logically and consistently related to one another (Hair Jr, Hult, et al., 2017; Ramayah et al., 2018). Overall, all results satisfied the evaluation criteria and thereby, the measurement's reliability and validity are established. Table 5.25 summarises all the results for measurement model assessment.

Table 5.25: Results Summary for Measurement Models

Latent Variable	Indicators	Internal Consistency		Indicator Reliability	Convergent Reliability	Discriminant Validity		
		Cronbach's Alpha	Composite Reliability	Loadings	AVE	Cross Loadings	Fornell-Larcker's Criterion	HTMT
		0.60 – 0.90	0.60 – 0.90	> 0.70	> 0.50	(Each indicator is the highest for their designated constructs)	(The square root of AVE of a construct larger than the correlations between the construct and other constructs in the model)	(Confidence interval value does not include 1)
Acceptance	ACC1	0.828	0.886	0.703	0.662	Yes	Yes	Yes
	ACC2			0.866		Yes	Yes	Yes
	ACC3			0.869		Yes	Yes	Yes
	ACC4			0.806		Yes	Yes	Yes
Culture	CUL1	0.866	0.918	0.869	0.788	Yes	Yes	Yes
	CUL2			0.857		Yes	Yes	Yes
	CUL3			0.867		Yes	Yes	Yes
Complexity	CPX1	0.820	0.880	0.829	0.647	Yes	Yes	Yes
	CPX2			0.812		Yes	Yes	Yes
	CPX3			0.857		Yes	Yes	Yes
	CPX4			0.713		Yes	Yes	Yes

Table 5.25: Results Summary for Measurement Models (Continue).

Latent Variable	Indicators	Internal Consistency: Cronbach's Alpha 0.60 – 0.90	Internal Consistency: Composite Reliability 0.60 – 0.90	Indicator Reliability: Loadings > 0.70	Convergent Reliability: AVE > 0.50	Discriminant Validity: Cross Loadings (Each indicator is the highest for their designated constructs)	Discriminant Validity: Fornell-Larcker's Criterion (The square root of AVE of a construct larger than the correlations between the construct and other constructs in the model)	Discriminant Validity: HTMT (Confidence interval value does not include 1)
Compatibility	CPB1	0.848	0.898	0.850	0.688	Yes	Yes	Yes
	CPB2			0.889		Yes	Yes	Yes
	CPB3			0.772		Yes	Yes	Yes
	CPB4			0.803		Yes	Yes	Yes
IT Competency	ITC1	0.855	0.900	0.853	0.694	Yes	Yes	Yes
	ITC2			0.720		Yes	Yes	Yes
	ITC3			0.830		Yes	Yes	Yes
	ITC4			0.729		Yes	Yes	Yes
Incentive	INC1	0.760	0.844	0.766	0.575	Yes	Yes	Yes
	INC2			0.754		Yes	Yes	Yes
	INC3			0.806		Yes	Yes	Yes
	INC4			0.703		Yes	Yes	Yes

Table 5.25: Results Summary for Measurement Models (Continue).

Latent Variable	Indicators	Internal Consistency		Indicator Reliability	Convergent Reliability	Discriminant Validity		
		Cronbach's Alpha	Composite Reliability	Loadings	AVE	Cross Loadings	Fornell-Larcker's Criterion	HTMT
		0.60 – 0.90	0.60 – 0.90	> 0.70	> 0.50	(Each indicator is the highest for their designated constructs)	(The square root of AVE of a construct larger than the correlations between the construct and other constructs in the model)	(Confidence interval value does not include 1)
Infusion	INF1	0.845	0.896	0.741	0.685	Yes	Yes	Yes
	INF2			0.889		Yes	Yes	Yes
	INF3			0.834		Yes	Yes	Yes
	INF4			0.840		Yes	Yes	Yes
Data Demand	DAD1	0.820	0.894	0.901	0.738	Yes	Yes	Yes
	DAD2			0.904		Yes	Yes	Yes
	DAD4			0.764		Yes	Yes	Yes
Top Management Support	TMS1	0.837	0.891	0.794	0.673	Yes	Yes	Yes
	TMS2			0.872		Yes	Yes	Yes
	TMS3			0.822		Yes	Yes	Yes
	TMS4			0.790		Yes	Yes	Yes

Table 5.25: Results Summary for Measurement Models (Continue).

Latent Variable	Indicators	Internal Consistency		Indicator Reliability	Convergent Reliability	Discriminant Validity		
		Cronbach's Alpha	Composite Reliability	Loadings	AVE	Cross Loadings	Fornell-Larcker's Criterion	HTMT
		0.60 – 0.90	0.60 – 0.90	> 0.70	> 0.50	(Each indicator is the highest for their designated constructs)	(The square root of AVE of a construct larger than the correlations between the construct and other constructs in the model)	(Confidence interval value does not include 1)
Relative Advantage	RAD1	0.851	0.898	0.819	0.688	Yes	Yes	Yes
	RAD2			0.879		Yes	Yes	Yes
	RAD3			0.879		Yes	Yes	Yes
	RAD4			0.733		Yes	Yes	Yes
Routinization	ROU1	0.842	0.895	0.779	0.680	Yes	Yes	Yes
	ROU2			0.889		Yes	Yes	Yes
	ROU3			0.846		Yes	Yes	Yes
	ROU4			0.780		Yes	Yes	Yes

Table 5.25: Results Summary for Measurement Models (Continue).

Latent Variable	Indicators	Internal Consistency		Indicator Reliability	Convergent Reliability	Discriminant Validity		
		Cronbach's Alpha	Composite Reliability	Loadings	AVE	Cross Loadings (Each indicator is the highest for their designated constructs)	Fornell-Larcker's Criterion (The square root of AVE of a construct larger than the correlations between the construct and other constructs in the model)	HTMT (Confidence interval value does not include 1)
		0.60 – 0.90	0.60 – 0.90	> 0.70	> 0.50			
OGD Principles	OGD1	0.904	0.911	0.800	0.553	Yes	Yes	Yes
	OGD2			0.802		Yes	Yes	Yes
	OGD3			0.753		Yes	Yes	Yes
	OGD4			0.760		Yes	Yes	Yes
	OGD5			0.656		Yes	Yes	Yes
	OGD6			0.767		Yes	Yes	Yes
	OGD7			0.654		Yes	Yes	Yes

5.3.8 Structural Model Assessment

Prior to evaluating the structural model, it is crucial to ensure that there is no lateral collinearity issue in the structural model. This is due to the lateral collinearity issues (predictor-criterion collinearity) may sometimes mislead the findings in a stealthy way, although the discriminant validity (vertical collinearity) are met (Kock & Lynn, 2012). Furthermore, the lateral collinearity issues can mask the strong causal effect in the model. This condition normally happens when two variables that are believed to be casually connected evaluate the same construct. The following assessment is the collinearity (vertical) and lateral collinearity assessment.

5.3.8.1 Collinearity Assessment

According to Hair Jr, Sarstedt, et al. (2017), collinearity take place when two indicators are strongly correlated. It is called multicollinearity because it includes more than two indicators. Multicollinearity is defined as the extent to which a variable can be explained through another variable in the analysis. Multicollinearity is a serious threat to validity in multivariate analysis (Tabachnick & Fidell, 2012).

In PLS-SEM analysis, a variance inflation factor (VIF) is used to demonstrate the existence of multicollinearity issues. A tolerance value of 0.20 or lower and a VIF value of 5 and higher, respectively, indicate a potential collinearity problem (Hair et al., 2011; Tabachnick & Fidell, 2012). More precisely, the VIF level of an indicator of 5 suggests that the remaining formative indicators associated with the same construct account for 80 per cent of its variance (Hair Jr, Hult, et al., 2017). If the level of collinearity is very high, as indicated by a VIF value of 5 or higher, one should consider removing one of the corresponding indicators. This needs, though, that the rest of the indicators also accurately capture the substance of the construct from a theoretical viewpoint. Table 5.26 provides data on the collinearity statistics after the first assessments. The first VIF assessment found no remaining indicator has violated the tolerance value, as Hair Jr et al. (2016) suggested, which is any score more than value 5.

Table 5.26: VIF Values for Collinearity Assessment

Indicators	VIF	Indicators	VIF	Indicators	VIF
ACC1	1.547	**DAD4**	1.433	**OGD4**	3.179
ACC2	2.181	**INC1**	1.326	**OGD5**	3.386
ACC3	2.231	**INC2**	1.589	**OGD6**	2.222
ACC4	1.947	**INC3**	1.669	**OGD7**	3.186
CPB1	2.095	**INC4**	1.579	**RAD1**	1.865
CPB2	2.440	**INF1**	1.616	**RAD2**	2.387
CPB3	1.713	**INF2**	2.510	**RAD3**	2.464
CPB4	1.753	**INF3**	2.108	**RAD4**	1.695
CPX1	1.760	**INF4**	2.376	**ROU1**	1.664
CPX2	1.704	**ITC1**	1.917	**ROU2**	2.992
CPX3	2.119	**ITC2**	2.261	**ROU3**	2.629
CPX4	1.686	**ITC3**	2.311	**ROU4**	1.657
CUL1	2.884	**ITC4**	1.650	**TMS1**	1.699
CUL2	2.007	**OGD1**	2.549	**TMS2**	2.421
CUL3	2.330	**OGD2**	1.516	**TMS3**	1.980
DAD1	2.577	**OGD3**	4.044	**TMS4**	1.604
DAD2	2.713				

Table 5.27 presents the outcome of the lateral collinearity assessment. All the Inner VIF values for the other independent variables (Compatibility, Complexity, Culture, Data Demand, IT Competency, Incentive, OGD Principles, Relative Advantage, Top Management Support) that need to be examined for lateral multicollinearity are less than 5, indicating lateral multicollinearity is not a concern in the study (Hair Jr, Hult, et al., 2017).

Table 5.27: Lateral Collinearity Assessment

Construct	Acceptance (VIF)	Routinization (VIF)	Infusion (VIF)
Acceptance		1.000	
Compatibility	2.450		
Complexity	1.239		
Culture	1.941		
Data Demand	1.561		
IT Competency	1.382		
Incentives	1.252		
OGD Principles	1.146		
Relative Advantage	2.000		
Top Management Support	1.739		
Routinization			1.000
Infusion			

5.3.8.2 Path Coefficient

The path coefficient for the relationship among latent variables is obtained through the SmartPLS (Ringle et al., 2015) software bootstrapping technique. Inferential statistics (*t*-values) are obtained with bootstrap standard error. The *t*-value use for the significance is 1.645 for a one-tailed test and 1.96 for two-tailed tests (Hair Jr, Hult, et al., 2017). The latest development on statistical analysis requires confidence interval reporting with no 0-value straddle in between the bias-corrected Confidence Interval (CI). The confidence interval represents the approximate range of values that are expected to contain an undefined population parameter; the estimated range is determined from a defined collection of sample data (Hair Jr, Hult, et al., 2017; Ramayah et al., 2018).

This study developed eleven direct hypotheses defined as H1 to H11. Results from Table 5.28 indicates that all relationships are significant with *t*-values above 1.645 at the 5% level ($\alpha = 0.05$; one-tailed test) except for relationships between Compatibility → Acceptance, Incentives → Acceptance, and Data Demand → Acceptance are found not significant. The results also shows that Complexity (β = -0.185, $p < 0.05$), Relative advantage (β = 0.182, $p < 0.05$), Culture (β = 0.121, $p < 0.05$), Top management support (β = 0.291, $p < 0.05$), IT Competency (β = 0.099, $p < 0.05$), and OGD Principles (β = -0.183, $p < 0.05$) are positively related to Acceptance which explains 48.6% of variances. Thus, H2, H3, H4, H5, H6, and H9 are supported.

The structural model is frequently associated with the coefficient of determination (R^2 value). This is in line with PLS-SEM's goal to maximise the R^2 values of the path model's endogenous latent variables. The coefficient, which is calculated as the squared correlation between the actual and predicted values of a specific endogenous construct, is the measurement of the model's predictive power. The coefficient denotes the combined effect or the amount of variance of exogenous constructs that have a link to the endogenous constructs.

Increased levels of predictive accuracy are indicated by higher levels of R^2, which can be found in the range 0 to 1. Acceptable R^2 values are difficult to define because they are dependent on the model's complexity and the research discipline. Because of the mentioned reason, R^2 values of 0.75, 0.50, or 0.25 for the endogenous construct can be described as substantial, moderate, and weak, respectively (Hair Jr, Hult, et al., 2017). However, Cohen (1988) advocates less stringent rules for R^2 threshold values of 0.26, 0.13 or 0.02 as substantial, moderate, and weak models.

Following Hair Jr, Hult, et al. (2017) rules, the R^2 value of Acceptance (0.486) and Routinization (0.43) is rather weak. At the same time, the R^2 value of Infusion (0.505) is considered moderate. In much detailed information, the effect of Acceptance on Routinization indicates that Acceptance (β = 0.656, $p < 0.05$) is positively related to Routinization, explaining 50.5% of the variance of the Routinization. Simultaneously, the effect of Routinization on Infusion indicates that Routinization (β = 0.711, $p < 0.05$) is also positively related to Infusion, explaining 43% of the variance of the Infusion. These results support the H10 and H11 of this study's hypotheses. Figure 5.16 illustrates the bootstrapping function results with 5000 iterations and using a one-tailed *t*-test with a significant level of 0.05.

Table 5.28: Results for The Path Coefficient Analysis.

Hypothesis	**Relationship**	**Std Beta**	**Std Error**	***t*-value**	R^2	**Decision**
H1	Compatibility -> Acceptance	-0.029	0.074	0.385		Not supported
H2	Complexity -> Acceptance	-0.185	0.071	2.593*		Supported
H3	Relative advantage -> Acceptance	0.182	0.069	2.632*		Supported
H4	Culture -> Acceptance	0.121	0.069	1.769*		Supported
H5	Top management support -> Acceptance	0.291	0.064	4.573*		Supported
H6	IT Competency -> Acceptance	0.099	0.056	1.780*		Supported
H7	Incentives -> Acceptance	0.048	0.047	1.010		Not supported
H8	Data Demand -> Acceptance	0.079	0.070	1.122		Not Supported
H9	OGD Principles -> Acceptance	-0.183	0.073	2.493*	0.486	Supported
H10	Acceptance -> Routinization	0.656	0.038	17.133*	0.430	Supported
H11	Routinization -> Infusion	0.711	0.027	23.955*	0.505	Supported

Note: *p<.05; **p<.01; ***p<.001

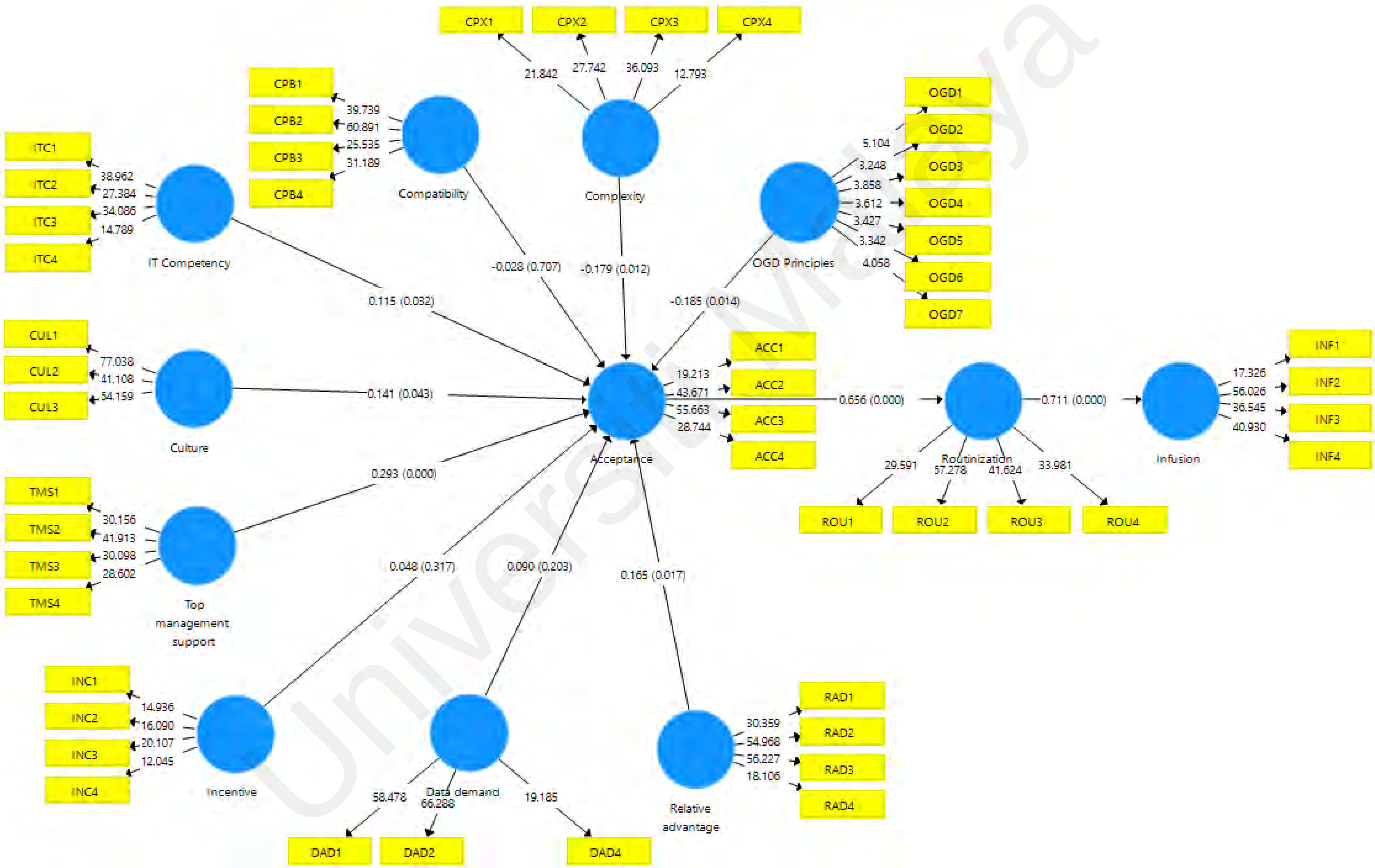

Figure 5.16: Results for The Structural Model Assessment.

5.3.8.3 Assessment of Predictive Relevance: Q^2

As a complement to measuring the R^2 values as the predictive accuracy criterion, researchers are also encouraged to evaluate Stone-Geisser's Q^2 value (Chin, 2010; Hair Jr, Hult, et al., 2017). The Stone-Geisser's Q^2 (Geisser, 1974; Stone, 1974) predictive relevance assessment is to show the out-of-sample predictive strength or predictive significance of the model. A procedure called blindfolding is performed by omitting a specified distance *D* point in the endogenous data matrix. The procedure will then try to use the predicted parameters to estimate the rest of the excluded data points (Hair Jr, Hult, et al., 2017). The omittance distance *D* normally is a prime integer between 5 to 10 (Chin, 2010) and is repeated until the data matrix reaches the end. This study uses the omission distance, D of 7. In a given model, a value Q^2 greater than 0 indicates that the model has predictive relevance for the specified endogenous variables, where Q^2 equal to or less than 0 indicates a lack of predictive relevance value (Chin, 2010; Garson, 2016; Hair Jr, Hult, et al., 2017). Table 5.29 presents the blindfolding results for predictive relevance Q^2. All three Q^2 values for Acceptance (Q^2 = 0.302), Routinization (Q^2 = 0.284), and Infusion (Q^2 = 0.337) are more than 0, suggesting that the model has predictive relevance for the endogenous constructs.

Table 5.29: Assessment of The Predictive Relevance Q^2.

Construct	Predictive Relevance Q^2
Acceptance	0.302
Routinization	0.284
Infusion	0.337

5.3.8.4 Assessment Effect size f^2

The following assessments are additional for the study; as suggested by Ramayah et al. (2018), data analysis should not just be ended with the calculation of *p*-value. Researchers are encouraged to extend the data analysis to assess the predictor constructs' effect size using Cohen's f^2. The value shows how strong one exogenous construct in terms of R^2 with a threshold value of more than 0.35 for large effect sizes, more than 0.15 for medium effect sizes, and more than 0.02 is considered small effect sizes. The stronger the exogenous construct contributes to explaining the endogenous construct, the higher the difference between R^2 included and R^2 excluded, thus leading to a high f^2 (Ramayah et al., 2018). Results in Table 5.30 shows that Complexity (0.050), Relative Advantage (0.027), OGD principles (0.058), and Top management support (0.096) have a small effect in producing the R^2 for Acceptance. Simultaneously, the rest of the constructs have the lowest contribution to R^2 of the endogenous constructs.

Table 5.30: Assessment of The Effect Size f^2.

Construct	f^2	**Effect size**
Compatibility → Acceptance	0.001	-
Complexity → Acceptance	0.050	Small
Culture → Acceptance	0.021	-
Data Demand → Acceptance	0.010	-
IT Competency → Acceptance	0.018	-
Incentive → Acceptance	0.004	-
OGD Principles → Acceptance	0.058	Small
Relative Advantage → Acceptance	0.027	Small
Top management support → Acceptance	0.096	Small
Acceptance → Routinization	0.754	Large
Routinization → Infusion	1.020	Large

5.3.8.5 Assessment of Effect Size q^2

The effect size q^2 assessment focuses on determining the contribution of an exogenous construct to the Q^2 value of an endogenous latent variable. Evaluating the q^2 effect size is determined manually, as the SmartPLS software does not yet have the feature. The previous value of Q^2 was used to calculate the selected endogenous q^2 effect size. The Q^2 value is divided into two parts, $Q^2_{included}$ and $Q^2_{excluded}$. The previous Q^2 estimation is referred to as $Q^2_{included}$, and the $Q^2_{excluded}$ value is derived from a sample re-evaluation after removing a particular predecessor of the latent variable (Hair Jr, Hult, et al., 2017). The q^2 effect size is calculated as the next formula:

$$q^2 = \frac{Q^2_{included} - Q^2_{excluded}}{1 - Q^2_{included}}$$

Table 5.31 presents the results of the assessment of the q^2 effect size. The cut-off value to interpret the q^2 value is based on the same threshold by Cohen (1988): the small effect for q^2 larger than 0.02, the medium effect for larger than 0.15, and the large effect for q^2 value larger than 0.35. Values that are below the threshold are labelled as 'No Effect'. As a result, the Complexity, Culture, OGD Principles, and Top management support has a small predictive relevance for Acceptance, as shown in the 'Effect size' column.

Table 5.31: Assessment of The Predictive Effect Size q^2.

Construct	Q^2 *included*	Q^2 *excluded*	q^2	Effect size
Compatibility → Acceptance	0.302	0.303	-0.001	No effect
Complexity → Acceptance	0.302	0.285	0.024	Small
Culture → Acceptance	0.302	0.296	0.009	Small
Data Demand → Acceptance	0.302	0.300	0.003	No effect
IT Competency → Acceptance	0.302	0.298	0.006	No effect
Incentive → Acceptance	0.302	0.301	0.001	No effect
OGD Principles → Acceptance	0.302	0.285	0.024	Small
Relative Advantage → Acceptance	0.302	0.294	0.011	No effect
Top management support → Acceptance	0.302	0.271	0.044	Small
Acceptance → Routinization	0.302	N/A	0.433	Large
Routinization → Infusion	0.302	N/A	0.433	Large
Compatibility → Acceptance	0.302	N/A	0.433	Large

5.3.8.6 Summary for Structural Model Assessment

The structural model assessment is based on the results from the standard model estimation, the bootstrapping and the blindfolding procedure. The summary of the results is presented in Table 5.32. The first assessment is to check the collinearity issues by examining the VIF value of all indicators of latent variables. The VIF values for all indicators are found to satisfy the threshold value of less than 5.0, indicating that collinearity is not an issue in the structural model. The assessment continues with examining the R^2 value for endogenous latent variables. Adhering to Cohen (1988) rule of thumb, the R^2 values of Acceptance (0.486), Routinization (0.430), and Infusion (0.505) has a substantial effect. Therefore, the model's exogenous constructs possess substantial predictive power over the endogenous constructs.

Along with evaluating the R^2 values of all endogenous constructs, the effect size f^2 of the model was also evaluated. The effect size f^2 refers to the variation in the R^2 value when a specified exogenous construct is excluded from the model can be used to determine whether the excluded exogenous construct has a significant effect on the endogenous constructs (Hair Jr, Hult, et al., 2017). Values of 0.02, 0.15, and 0.35, respectively, represent small, medium, and large effects of the exogenous latent variable, according to Cohen (1988)'s rule. As presented in Table 5.32, it can be noted that the Complexity, Relative Advantage, OGD Principles and Top Management Support have a small effect in producing R^2 value for Acceptance. In contrast, Acceptance has a large effect in contributing the R^2 value for Routinization, and Routinization has a large impact on begetting R^2 value for Infusion.

As suggested by Hair Jr, Hult, et al. (2017), researchers should examine Stone-Q^2 Geisser's value in addition to the magnitude of the R^2 values as a criterion of predictive accuracy. This study extends the structural model assessment to evaluate the Stone-Geisser's Q^2 value using the blindfolding procedure. As shown in Table 5.32, each of the endogenous constructs has a Q^2 value greater than 0, indicating that the model has predictive relevance for the endogenous constructs. Furthermore, this study evaluates the effect size q^2 that qualify an exogenous construct's contribution to an endogenous latent variable's Q^2. Consequently, the predictors for Acceptance such as Complexity, Culture, OGD Principles, and Top management support have only a small predictive significance. Based on the aforementioned explanations, it can be concluded that the study succeeds in evaluating every assessment in the PLS-SEM technique.

Table 5.32: Results Summary for Structural Model Assessment

Latent Variables	Indicators	Lateral Collinearity	Relationship	Path Coefficient		R^2	f^2	Q^2	q^2
		VIF ≤ 5.0		*t*-value	*p*-value				
Compatibility	CPB1	2.095	Compatibility -> Acceptance	0.385	0.346		-		-
	CPB2	2.440							
	CPB3	1.713							
	CPB4	1.753							
Complexity	CPX1	1.760	Complexity -> Acceptance	2.593**	0.004		Small		Small
	CPX2	1.704							
	CPX3	2.119							
	CPX4	1.686							
Relative Advantage	RAD1	1.865	Relative advantage -> Acceptance	2.632**	0.004		Small		-
	RAD2	2.387							
	RAD3	2.464							
	RAD4	1.695							
Data Demand	DAD1	2.577	Data Demand -> Acceptance	1.122	0.135		-		-
	DAD2	2.713							
	DAD4	1.433							
Incentives	INC1	1.326	Incentives -> Acceptance	1.010	0.1611		-		-
	INC2	1.589							
	INC3	1.669							
	INC4	1.579							

Table 5.32: Results Summary for Structural Model Assessment (Continue)

Latent Variables	Indicators	Lateral Collinearity	Relationship	Path Coefficient		R^2	f^2	Q^2	q^2
		VIF ≤ 5.0		*t*-value	*p*-value				
IT Competency	ITC1	1.917	IT Competency -> Acceptance	1.780*	0.039		-		-
	ITC2	2.261							
	ITC3	2.311							
	ITC4	1.650							
Culture	CUL1	2.884	Culture -> Acceptance	1.769*	0.039		-		Small
	CUL2	2.007							
	CUL3	2.330							
OGD Principles	OGD1	2.549	OGD Principles -> Acceptance	2.493**	0.004		Small		Small
	OGD2	1.516							
	OGD3	4.044							
	OGD4	3.179							
	OGD5	3.386							
	OGD6	2.222							
	OGD7	3.186							
Top Management Support	TMS1	1.699	Top management support -> Acceptance	4.573***	0.000	-	Small		Small
	TMS2	2.421							
	TMS3	1.980							
	TMS4	1.604							

Table 5.32: Results Summary for Structural Model Assessment (Continue)

Latent Variables	Indicators	Lateral Collinearity	Relationship	Path Coefficient		R^2	f^2	Q^2	q^2
		VIF ≤ 5.0		***t*-value**	***p*-value**				
Acceptance	ACC1	1.547	Acceptance -> Routinization	17.133***	0.000	0.486	Large	0.302	Small
	ACC2	2.181							
	ACC3	2.231							
	ACC4	1.947							
Routinization	ROU1	1.664	Routinization -> Infusion	23.955***	0.000	0.430	Large	0.284	Large
	ROU2	2.992							
	ROU3	2.629							
	ROU4	1.657							
Infusion	INF1	1.616		-	-	0.505	-	0.337	Large
	INF2	2.510							
	INF3	2.108							
	INF4	2.376							

*Note: *p<0.05, **p<0.01, ***p<0.001*

5.3.9 Assessment of PLSpredict

The assessment of the model's out-of-sample predictive power is rather a new procedure introduced by Shmueli et al. (2016). PLSpredict operates by executing *k*-fold cross-validation. A fold is a subgroup of the total sample, and *k* is the number of subgroups. That is, the whole data set is randomly split into *k* equally sized subsets of data (Hair Jr, Sarstedt, et al., 2017). The recommended naïve benchmark (produced by the PLSpredict method) uses a linear regression model (LM) to generate predictions for the manifest variables by running a linear regression of each of the dependent construct's indicators on the indicators of the exogenous latent variables in the PLS path model (Danks & Ray, 2018). The PLSpredict shown in Table 5.33 indicates that Acceptance indicators in the PLS model have a lower root mean square error (RMSE) and mean absolute error (MAE) compared to the LM model. Whereas the Infusion and Routinization indicators have a higher root mean square error (RMSE) and mean absolute error (MAE) compared to the LM model. Overall, the comparison between the PLS-LM column indicates that only a minority of the PLS model indicators have a lower value of RMSE compared to the LM model. The result concludes that the PLS model of this study has low predictive power.

Table 5.33: PLSpredict Results

	PLS			LM			PLS - LM		
Item	**RMSE**	**MAE**	**Q²_predict**	**RMSE**	**MAE**	**Q²_predict**	**RMSE**	**MAE**	**Q²_predict**
ACC2	0.561	0.414	0.329	0.600	0.452	0.231	-0.039	-0.038	0.098
ACC1	0.762	0.577	0.153	0.760	0.570	0.157	0.002	0.007	-0.004
ACC3	0.664	0.492	0.289	0.709	0.534	0.189	-0.045	-0.042	0.100
ACC4	0.670	0.52	0.314	0.692	0.539	0.268	-0.022	-0.019	0.046
ROU1	0.706	0.569	0.267	0.728	0.574	0.220	-0.022	-1.143	0.047

Table 5.33: PLSpredict Results (Continue)

	PLS			LM			PLS - LM		
Item	**RMSE**	**MAE**	**Q²_predict**	**RMSE**	**MAE**	**Q²_predict**	**RMSE**	**MAE**	**Q²_predict**
ROU2	0.725	0.581	0.328	0.709	0.561	0.359	0.016	-1.142	-0.031
ROU3	0.779	0.647	0.247	0.710	0.578	0.373	0.069	-1.225	-0.126
ROU4	0.663	0.535	0.300	0.672	0.529	0.282	-0.009	-1.064	0.018
INF3	0.697	0.571	0.241	0.683	0.539	0.272	0.014	0.032	-0.031
INF1	0.658	0.548	0.219	0.613	0.484	0.320	0.045	0.064	-0.101
INF4	0.815	0.684	0.256	0.710	0.556	0.436	0.105	0.128	-0.180
INF2	0.747	0.611	0.260	0.730	0.590	0.293	0.017	0.021	-0.033

5.4 Summary

This chapter outlined the preliminary and empirical analysis of the data collected and discussed the results. The preliminary study in Phase 1 of the research design explained the OGD adoption phases in the Malaysian public sector. The researcher then conducts semi-structured interviews with pioneer agencies that have adopted OGD since OGD was introduced in the Malaysian public sector. The output from the semi-structured interviews with the pioneer agencies was extracted and integrate with OGD adoption literature. This information was gathered to develop the research instrument of the study. After a series of instrument validation procedures, the research instrument was distributed for pilot test before the main data collection. The main data collection managed to garner 266 responses from various government agencies that have implemented OGD initiatives.

As this thesis is interested in the relationships between multiple independent variables (measurement items) and three dependent variables (acceptance, routinization, infusion), multivariate analysis is used. Since the dependent variable is categorical and the independent variables are categorical (e.g., IT competency) and continuous (e.g., Complexity), multinomial logistic regression is deemed appropriate. Multinomial logistic regression enables the prediction of a categorical result, such as the adoption stage, using a combination of categorical and continuous predictor variables (Tabachnick & Fidell, 2012). Specifically, using logistic regression, it is possible to assess the government agencies' likelihood of OGD in the post-adoption phase, based on their pattern of replies to the fifty-four measurement items.

This study examines the factors that influence government agencies to implement OGD initiatives in the post-adoption phase. Before the main data analysis, a preliminary analysis was conducted to allow the data to be cleaned and tested for non-response bias and common method variance. Based on the preliminary analysis results, there is no reason for concern for non-response bias. The data distribution is identified as not normal, and the common method bias is not a threat in this study. A detailed study of the respondent's demographic profile was carried out using SPSS software to calculate the demographic features' frequency and percentage.

The reliability and validity tests include internal consistency, indicator reliability, convergent validity, and discriminant validity. Results from the reliability and validity tests indicate that the data fulfilled all the measurement model analysis requirements. All items are found reliable and valid for further analysis. For the measurement model, structural model and hypotheses testing were evaluated and validated using the PLS-SEM method. The assessment involved for the conceptual model consists of measurement model assessment, the structural model assessment, predictive relevance assessment, and assessment of PLSpredict.

A total of 11 hypotheses were proposed in the research model and tested in the structural model assessment. The PLS-SEM results for path coefficient analysis revealed that eight hypotheses out of eleven hypotheses are statistically significant to the OGD in the post-adoption phase. These significant hypotheses will be strong factors to be focused on for OGD post-adoption in the Malaysian public sector.

CHAPTER 6: VALIDATION AND DISCUSSIONS

This chapter presents the validation phase (Phase 3) from the research design of this study. This chapter is subsequent following from the previous chapter in which the discussion about the findings and OGD post-adoption framework analysis are provided. The discussions section elaborates the implications of the findings. The study continues by validating the results through a framework validation procedure. The framework validation is a step taken for this study to ensure that the framework represents the real phenomenon in the Malaysian public sector. The validation procedure employed four field expert reviewers from related fields. Reviews from the experts are deliberated in this chapter. The experts' reviews contributed to the justification of the findings from the empirical study in Chapter 5. Thereafter, the summary of this chapter is provided in the last section.

6.1 Introduction

There are two important concepts that a quantitative study promotes: reliability and validity of the findings. The reliability and validity of the quantitative research findings are normally can be determined using statistical methods. Through the facts and figures of the statistical analysis, quantitative research implies representing the truthfulness of the population under study and that the observations can be replicated (Golafshani, 2003; Kothari, 2015). However, Tashakkori et al. (2020) argue that the validity of the statistical findings is sometimes debatable. This scenario is because the researchers can deliberately cause or manipulate the interaction between structures and evidence, typically by using experiments and other methods to justify their inquiry. In this way, the inclusion of the researcher in the analytical process will substantially decrease the validity of a result (Golafshani, 2003). Therefore, as view by the qualitative researchers, the statistic-based study is insufficient and need a qualitative view to supplement the findings. While there is no universal and firm method for validating the quantitative findings available, the use of the multi-method approach is seen to be able to substantiate and enrich the study findings (Schoonenboom & Johnson, 2017; Venkatesh et al., 2013). For this study, an expert review method is employed to extend the validation of the empirical findings. The expert reviews are then discussed together with the empirical findings from the Phase 2-Development study.

6.2 Framework Validation

The framework validation is the final phase in the research design, as described in section 4.2. In this phase, a qualitative approach called the expert review approach is employed by inviting experts or panels to validate the study's findings and assumptions. The goal of conducting the validation phase with experts is to construct a rational chain of proof and conceptually coherent against the developed OGD post-adoption framework. An expert is an individual who holds special insight and is a specialist in a subject in a profession or has an advantage to an event (Maxwell, 2012). The expert's superior knowledge and experiences are valuable results from an action, responsibilities, and obligations of their specific functional status within an organisation (Cassell et al., 2017). The expert is also a representative of their organisation, representing their organisation or unit's solutions or decision-making structure. These criteria make the expert eligible for an expert review approach. An expert review approach involves asking a number of individuals for a judgement, views, recommendations, input, or remarks on an item, instrument, instructional material, or their views on a certain issue (Angkananon et al., 2013; Cabero-Almenara et al., 2021).

The expert review approach has proven an effective method in establishing rigour and trustworthiness in linking the qualitative inquiry to the positivist quantitative approach (Tobin & Begley, 2004; Zainal Abidin et al., 2016). In general, an expert agreement can be a fundamental tenet of science (Jorm, 2015). Thus, the rationale for using an expert review method for framework validation is to amplify the empirical findings by demonstrating the study's rigour and reliability.

6.2.1 Data Collection Procedure

For the purpose of this framework validation procedure, a structured interview method was employed. Four experts have been selected for the structured interview session based on their expertise in government data management and knowledge in IS research. Furthermore, a study by Turner et al. (2006) recommends that three to twenty participants complement relevant findings. The experts were selected based on the criteria described in Table 6.1. Strong education background and work experiences are among the important criteria to justify the selection of experts. The experts' background is presented in Appendix A in Table A.1.

Table 6.1: Criteria for Expert Review

Criteria
1. Possess a Doctoral Degree in Information Technology or Computer Science or related computing background. 2. Have at least ten years of experience in government data management environments. 3. Position at least managers level in the organisational structure of their agencies.

As the first step, the experts' consent was obtained by sending an email prior to the validation procedure. Once the expert agrees to participate in the validation procedure, the university's letter of appointment is issued for formality. The sample letter of expert reviewer appointment is attached in Appendix I.3. The number of experts appointed was regarded as adequate when the saturation level had been achieved in the findings (Strauss, 1987). The validation procedure is illustrated in Figure 6.1.

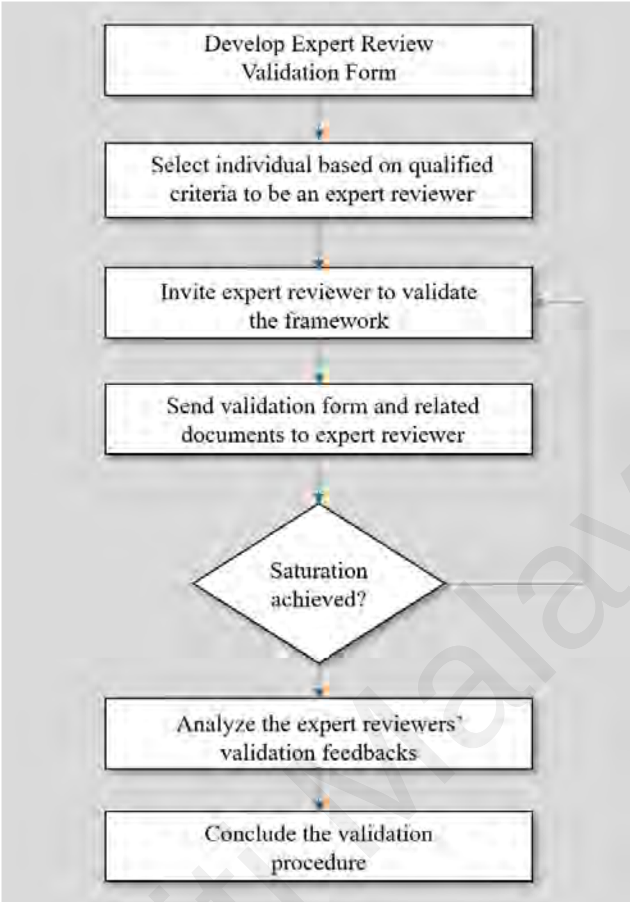

Figure 6.1: Steps for Framework Validation Procedure

The expert review procedure was performed from February 2020 to March 2020 by meeting face to face with the experts according to their convenient time and place. A brief presentation on the study was delivered to the experts in order for them to comprehend the study's aims and the review procedure. The experts were asked to write their reviews in a hard copy of the evaluation form in whichever language was convenient to them. The example of the evaluation form is attached in Appendix H. However, most experts requested a soft copy of the evaluation form and asked to return the form after some time. The hardcopy will allow the experts to have a deep thought about the study's results and findings before giving their reviews. The experts gave their reviews in English except for one expert who chose to give her reviews in Malay. Reviews in the Malay language were translated to English language and resend to the reviewer for verification.

6.2.2 Data Analysis

The reviews obtained from the experts were analysed qualitatively using the content analysis method by Kleinheksel et al. (2020). The analysis seeks to answer the key questions of framework validation:

i) Does the developed framework reflect the current situation of OGD implementation in the public sector?

ii) Do the experts agree on the facts presented by the model?

iii) Is the example described at the desired level of detail of the model?

The expert reviews were examined using the above questions to find the argument supporting the findings. Due to the lengthy answer given by the experts, this thesis is not able to show the whole review. However, the sample reviews from one of the hypotheses, which is the top management support, is shown in Figure 6.2. The experts' agreement statement is given the Boolean value of 1, while disagreement is given the value 0. The mixed opinion or impartial statement was not valued because it is neither agreed nor disagreed but inclined to a neutral statement. The minimum absolute frequency of agreed statements from the experts for each hypothesis statement is set to 3, and the maximum is 4. The minimum value of 3 is considered as the majority vote derived from the concept of 'majority rule' by Eraslan and Merlo (2002). Based on the output from the ATLAS.ti software version 9.1.50, all hypotheses reached the minimum absolute frequency value. In addition, no contradictory opinion was recorded from the expert reviews' feedbacks; however, some suggestions were given for improvement.

	Results from Empirical Analysis	Expert Reviewer 1	Expert Reviewer 2	Expert Reviewer 3	Expert Reviewer 4
Organizational : Top Management Support	**H5**: Organizational culture positively influences OGD acceptance in the public sector. **Results: Supported** •In this study, 'culture' refers to the act of embodying the culture of data openness and sharing with the public. • The findings suggest that understanding data sharing culture encourage government agency to publish more OGD. • Items of culture that is agreed upon by the respondents: i.Our agency is willing to share data with the public. ii.Our agency encourages the practices of information and data sharing with the public. iii.Our agency is open to information and data sharing policy with the public.	Agreed: • Each agency should cultivate OGD by conducting activities that raise awareness (of the importance of OGD) such as technology updates, awareness and change management programs, seminars involves different levels of agency. • The agency's trust and readiness to implement OGD should also be increased	Agreed. This is due there is a policy of data sharing. Based on MAMPU's yearly planning for OGD engagement with government agency, there was a strong need of fostering the data sharing and openness culture.	The culture of data sharing is still low in the agency, even within cross functional in the agency itself. Initiatives to encourage divisions in the agency to be more open and support the implementation of OGD are always implemented from time to time by the Department's Open Data team through meetings conducted. Agency must be ready and very open to sharing data with the public. The agency wishes the benefits of data can be used and benefited others, which data shared from public to public.	Agreed. Need to have open mindset and practice good governance where data sharing policy and guideline are established. Currently open data guideline is available and data sharing policy for public sector will be made available end of the year.

Figure 6.2: Sample field expert reviews for the 'Top management support' hypothesis.

6.2.3 Findings

From the experts' point of view, the arguments in the findings and discussions are well accepted. Although some findings from the analysis seem contradictory, such as results from the environmental context, the experts gave their explicit agreement on the findings. The refined feedbacks from the experts were summarized in Table 6.2.

Table 6.2: Summary of The Expert Reviews' Validation Feedbacks

Constructs & Hypothesis	Results	ER 1	ER 2	ER 3	ER 4	Absolute Frequency
H1: Compatibility → Acceptance	**Not supported**	1	1	1	1	4
H2: Complexity →Acceptance	**Supported**	1	1	-	1	3
H3: Relative advantage → Acceptance	**Supported**	1	1	1	-	3
H4: Culture → Acceptance	**Supported**	1	1	-	1	3
H5: Top management support → Acceptance	**Supported**	1	1	1	1	4
H6: IT Competency → Acceptance	**Supported**	-	1	1	1	3
H7: Incentives → Acceptance	**Not supported**	1	1	-	1	3
H8: Data Demand → Acceptance	**Not supported**	1	1	1	-	4
H9: OGD Principles → Acceptance	**Supported**	1	1	1	-	3
H10: Acceptance → Routinization	**Supported**	1	1	1	1	4
H11: Routinization → Infusion	**Supported**	1	1	1	1	4

Note: ER: Expert Reviewer

6.3 Discussions

Grounded by the innovation adoption in the organisation literature, this study incorporated three theoretical perspectives: the innovation adoption process, post-adoption of innovation, and the Technology-Organisation-Environment framework to build the OGD post-adoption framework in the Malaysian public sector. The outcome of the PLS-SEM analysis is presented in Figure 6.3. The results suggest that the strongest antecedent for OGD post-adoption is 'Top management support' represented by hypothesis H5. The other antecedent that supports the OGD implementation in the post-adoption is 'Complexity' represented by H2, 'Relative advantage' represented by H3, 'Culture' represented by H4, 'IT competency' represented by H6, and 'OGD principles' represented by H9. Three antecedents were found not supported the post-adoption of OGD, represented by H1 is the 'Compatibility', 'Incentives' represented by H7, and 'Data demand' represented by H8. The dependent construct 'Acceptance' is found significant to 'Routinization' through hypothesis H10, and at the same time 'Routinization' is significant to 'Infusion' through hypothesis H11.

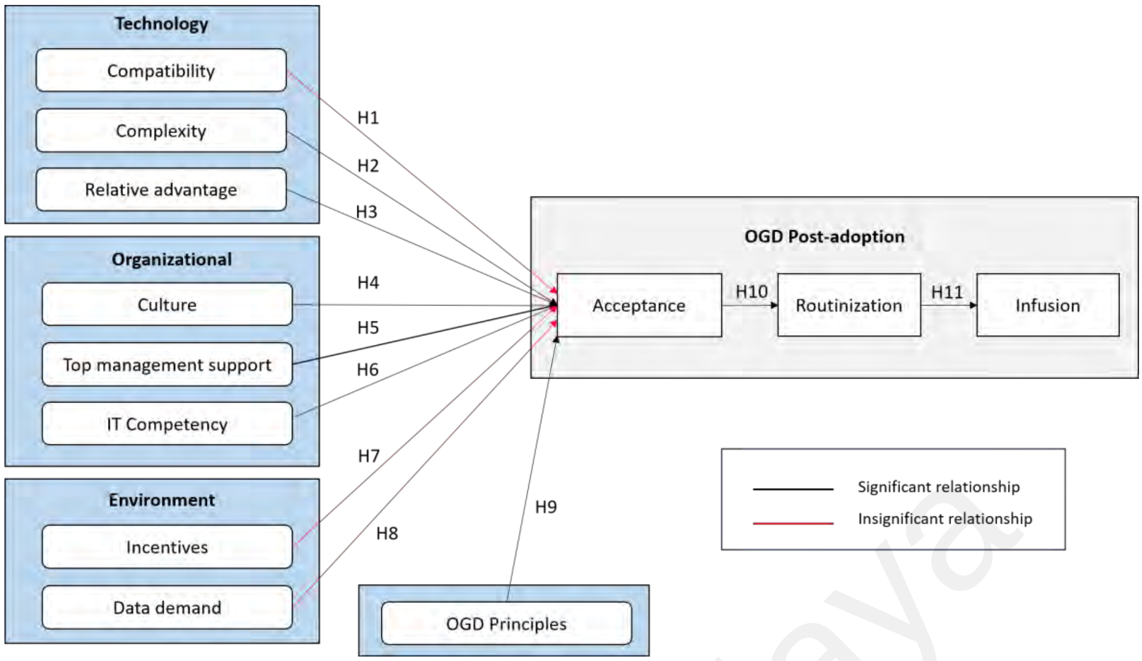

Figure 6.3: The Validated OGD Post-Adoption Framework.

6.3.1 Technology Context

As pointed out in Hypothesis 1, the relationship between Compatibility and Acceptance was shown to be insignificant. The findings suggest that the data's compatibility, operating practices, IT infrastructure, and agencies' values and beliefs do not influence OGD implementation in the post-adoption phase among the government agencies. Centred on the source of authority given, the adoption of OGD in the public sector has been regarded as an obligation rather than a voluntary basis. The nationwide deployment has made the OGD a well-known initiative at various levels of government services. A lot of national ICT strategic planning has delineated OGD as one of the long-term initiatives to be focused on. Based on these reasons, it can be understood why compatibility is not a concern among government agencies because responding to the national agenda is more necessary. Similarly, the study by Amade et al. (2020) and Junior et al. (2019) also find out that the compatibility of innovation is not statistically significant in the evaluation and routinization phase. The study by Amade et al. (2020) seeks to confirm whether compatibility influences Mozambican institutions in an effort to continue using Geographical information technologies (GIT). In contrast, the study by Junior et al. (2019) indicates that compatibility has no positive influence on ERP diffusion among farmers in Brazil.

Compared to the relationship between complexity and acceptance, represented by Hypothesis 2, the results are found to influence OGD acceptance negatively. In other words, the findings suggest that the government agency did not perceive OGD as to be difficult to implement. This finding is consistent with the previous research that has claimed that the greater the perceived complexity of an IT innovation, the higher the adoption cost, thus influence the decision to adopt the innovation negatively (Lin & Lin, 2008). This proves that innovation complexity may serve as an obstacle to adoption and is generally detrimental to adoption (Premkumar et al., 1994). In the case of OGD, the government agency is adapted well to the OGD publication process, making it easier to be accepted as a frequent operation. However, government top management has also been mindful of organising an effective change management program and training to build better expertise among government agencies in operationalizing the OGD initiatives.

As posited by DOI theory, relative advantage has a significant influence on the adoption of innovation. Consistently, the same findings were also reported in previous research that utilises relative advantage or perceived usefulness factor in the post-adoption phase in their study (Kim & Son, 2009; Li et al., 2013; Liu, 2010). Likewise, the findings from Hypothesis 3 are supported in which the relative advantage has a positive influence on the post-adoption of OGD. The findings also suggest that government agency would be more willing to stick to OGD implementation if they perceive that the OGD is beneficial for enhancing effectiveness in service delivery and optimising service quality. Other related studies on innovation adoption in Malaysian organisation shows a strong effect of relative advantage towards the adoption or implementation such as in cloud computing (Sallehudin et al., 2019), and electronic commerce (Shah Alam et al., 2011). In addition, the relative advantage characteristics are in accordance with the Malaysian Public Sector ICT Strategic Plan 2016-2020, which emphasizes accelerating human capital development and strengthening the ICT infrastructure to support economic expansion.

6.3.2 Organisational Context

Organisational context refers to the intra-organisational measure that influences an organisation to innovation adoption (Tornatzky & Fleischer, 1990). In this study, three organisational factors were identified as relevant to the post-adoption of OGD in the Malaysian public sector: culture, top management support, and IT competency. The analysis results show that organisational context is the most significant contributor to the OGD implementation in the post-adoption phase compared to the technology context, environmental context, and OGD principles.

Hypothesis H5 represents the relationship between culture and acceptance. The results indicate a positive influence on the acceptance of OGD in the post-adoption phase. The findings suggest that understanding openness culture encourage government agency to publish OGD in the post-adoption phase. Furthermore, the public sector's data-sharing culture was promoted earlier before the initiation of OGD in Malaysia through electronic data interchange (EDI) initiatives. With the EDI, the government agency is able to build applications that integrate data from various inter-agency seamlessly. What makes OGD a little different is that the data is non-confidential and can be released publicly. According to one of the interviewees during the 'explore' phase, the federal agency has engaged with government agencies throughout the country to explain the OGD initiatives. Clearly, the data openness culture can be fostered with the right approach to change management in the public sector. Furthermore, the lack of acculturation and change management activities have been addressed as one of the challenges in the Public Sector

Digital Strategic Plan 2021-2025. Therefore, a formidable action has to be activated to overcome any lack of acculturation of digital innovation.

Perhaps one of the most consistent and essential factors that affect IT implementation is support from the top management (Thong et al., 1996). Numerous studies have demonstrated this notion in various innovation fields and adoption phases (Hong-kit Yim et al., 2013). Among all the factors, top management support constitutes the strongest significant relationship with acceptance of OGD in the post-adoption phase. Hypothesis H6 represents the relationship between top management support and acceptance of OGD. The findings indicate that top management support or encouragement of senior management plays a crucial role in supporting the OGD implementation post-adoption. The aspects of top management support that the respondents agree upon are articulating the vision and attentiveness towards OGD implementation. Furthermore, given that the government's organisational structure is very hierarchical, lower-level management is highly dependent on top management's efficiency and attention in implementing OGD.

IT competency refers to the organisation's technical competencies, including IT infrastructure and IT human resource capabilities (Zhu & Kraemer, 2005). Hypothesis H7 shows a significant relationship between IT competency and acceptance. The findings suggest that government agencies have sound knowledge and technological resources to manage OGD implementation. The previous study by Zhao and Fan (2018) observed similar findings in which technical competency is a mandatory basis for managing OGD capacity. However, the government agency's IT competency level in operating OGD is still low and needs improvement. It is foreseen that more advanced skills are needed if the government agency intends to increase the OGD potential. Several scholars, such as Ubaldi (2013) and Chu (2016), suggested that the public servants, regardless of their position and job title, should not just have IT-related skills but instead build the ability to cope with the emerging technologies. In addition, Luna-Reyes and Najafabadi (2019) posited that OGD management involving the combination of technology and data analysis expertise is still sparse. In order to strengthen the OGD implementation in public sector entities, high-level technical personnel and training are necessary (Zhao & Fan, 2018).

6.3.3 Environmental Context

Environmental aspects have outlined two measurements of factors that can influence the implementation of OGD, namely the data demand and incentives. The relationship between data demand and OGD acceptance was tested through Hypothesis 8. The data demand is a newly introduced factor in the OGD post-adoption framework to seek government agency feedback in responding to the external environment. The findings suggest that OGD implementation in the Malaysian public sector is not positively influenced by the demand for data, whether the demand comes from the data provider's internal or external environs. A possible explanation for this might be that many government agencies do not seem to prioritise the interests of data consumers and promote their contribution to OGD value creation. In addition, the efforts the government agency take to entertain certain data request would interfere with their daily task. The same argument has been highlighted in Ubaldi (2013) when she observed that the public sector spends more time on strategies rather than knowing the value creation of OGD by fulfilling the need first. It is afraid that ignoring the data demand will hinder more innovations creation in the future.

The incentives factor is classified as an environmental context as the incentives may be provided by the government agency's internal or external party. The relationship between incentives and OGD implementation in the Malaysian public sector is tested through Hypothesis 9. The findings indicate that incentive is not positively motivating OGD implementation among the government agencies. The incentives have the potential to be a positive factor in the future, but they need to be re-model. This is because the lack of motivation from the environment makes the OGD implementation very supply-driven.

In contrast, a study by Kulkarni (2006) finds that incentives have a significant positive effect on Knowledge Management (KM) use. Furthermore, Kulkarni (2006) indicates that the success of KM efforts does influence by secure buy-in from the users apart from top management's commitment. Projecting the same view by Ubaldi (2013), the researcher stated that providing incentives will foster full commitment among the government agency to sustain OGD implementation. The same tone was mentioned in Lu et al. (2020), in which reward (e.g., salary raise, bonus, or acknowledgement by supervisor) has significantly motivated the physicians' acceptance of healthcare information technology (HIT) in the post-adoption phase. However, in the case of the Malaysian public sector, the incentive does not actively influence the OGD implementation. Looking on a different view, it is a positive indication that, without demanding something back in exchange, the government agency is dedicated to the OGD implementation and views OGD publishing as part of its scope of operation.

The insignificant influence from the environmental aspects for this study (data demand and incentives) is analogous to those reported by Zhu et al. (2010), who finds out that external support does not positively affect the successful post-implementation of Enterprise Resource Planning (ERP) in China retail industry. However, compared to the findings from Zhenbin et al. (2020), the external environment in terms of external resources is positively motivated OGD implementation among Singapore's public agencies. Clearly, the environmental context has many interpretations that need to be suited based on the adopter's innovation and other factors. Concerning the environmental context, the government should be aware of other surrounding factors that may encourage the data providers for better support to OGD initiatives.

6.3.4 OGD Principles

The results show that Hypothesis 9, which represents the relationship between the principles of OGD and Acceptance, is supported. This indicates that although the government agencies had to follow the OGD principles before publication, the principles themselves do not hinder OGD implementation in the post-adoption phase. There are eight standard practices for data to be published as OGD. Seven out of eight of the principles were agreed upon by the respondents:

i. Primary – Agency publishes data from the primary data source.
ii. Non-discriminatory – Agency allows anonymous access to its OGD.
iii. Non-proprietary – Agency prepares data into generic format before publishes as OGD.
iv. Timely – Agency publishes OGD as soon as the data is available.
v. License-free – Agency imposed license-free access for its OGD.
vi. Machine-readable – Agency publishes OGD in a machine-readable format (xml, csv, json, etc.)
vii. Accessible – Agency publishes OGD through an online platform.

However, one principle, the 'Complete' has been found as the least followed by the government agencies. The complete principle does not significant to OGD acceptance due to not all datasets are in a complete form. Observations through the government data portal (https://data.gov.my) have identified some of the datasets that have missing value or merely summary data with no breakdown of the details. An example of the case mentioned above is illustrated in Figure 6.4, in which the data from the Ministry of Plantation Industries and Commodities is only shown a yearly number, no breakdown of details for each year.

TABLE 7-2

MALAYSIA : PRODUCTION OF SAW LOG, SAWN TIMBER, PLYWOOD, VENEER, AND MOULDING

('000 Cubic Metre)

Year	Saw Log	Sawn Timber	Plywood	Veneer	Moulding
2010	17,797	4,274	4,280	797	343
2011	15,985	3,995	3,938	1,086	368
2012	15,893	4,178	3,870	808	351
2013	13,926	3,614	3,382	775	159
2014	14,575	3,520	3,284	827	178
2015	13,621	3,245	3,221	718	140

Source : FDPM, FD-Sabah, FD-Sarawak & STIDC

Figure 6.4: Sample of Incomplete Data, Retrieved from The Open Government Data Portal (*source: https://data.gov.my*).

6.3.5 Post-adoption Constructs

Acceptance is the first stage in the innovation post-adoption phase, as Cooper and Zmud (1990) advocate. In this stage, the government agencies are encouraged to publish data that fits the OGD principles criteria. The acceptance stage is relatively agreed by most of the government agencies as the federal government has issued a directive for OGD implementation in General Circular No. 1, 2015. Subsequently, the second stage in the post-adoption phase is the routinization stage. The analysis results have indicated that Hypothesis 10 between Acceptance and Routinization has a strong degree of relationship. This study argues that the strong relationship between acceptance and routinization is because the implementation of the OGD initiative is a mandated decision made at the highest levels of management in the federal government structure; as a result, government agencies are obligated to carry out the OGD initiative as a matter of course.

Hypothesis 11 represents the relationship between routinization and infusion. The OGD routinization in the government was measured by how regular the agency is publishing OGD in the government data portal. The results indicate that OGD routinization is highly significant to OGD infusion. The government agency perceived that once OGD has been a routine task in the agency, it will be easier to infuse in the work norm. Furthermore, studies show that successful IT/IS innovation implementation is associated with in-depth use of the IS/IT in the infusion stage (Hassandoust et al., 2016).

Nonetheless, the post-adoption stage (acceptance, routinization, infusion) can be explored further as a single dependent construct. In this way, researchers can compare the maturity stage that the organisation has reached and the factors that contributed to it. This study combines all three post-adoption stages that occurred in sequence. The reason being is because the organisation must achieve the acceptance stage first before the routinization, and eventually, the infusion stage could happen. All these stages have never been studied in the Malaysian public sector scenario before. Thus, the decision to combine all three post-adoption stages was mostly driven by the findings in Phase 1 (Exploration) of the research design.

6.4 Summary

This chapter has been organized to explain the data analysis findings and the validation phase for the developed OGD post-adoption framework. The validation procedure involves four field experts in government data management from selected government agencies. The validation phase aims are achieved by reflecting the developed OGD post-adoption framework with the expert reviewers. As per discussion, the OGD post-adoption framework is built on the context of technology, organisational and OGD principles. While the environmental context as represented by incentives and data demand factors does not support the framework, additional external factors can be investigated in future research. The OGD post-adoption framework is thus regarded as validated and suitable to be deployed in the Malaysian public sector.

This study has shown its own uniqueness by extending the post-adoption phase in three stages; acceptance, routinization, and infusion. In contrast, previous studies only focus on a single adoption stage that limits to only measure the organisation's intention to adopt OGD as presented, for example, in Wang and Lo (2016) and Yang and Wu (2016a). Additionally, OGD principles emerge as distinct characteristics, which have never been studied previously. These idiosyncratic features strengthen this study's contributions to the body of knowledge which will be discussed in the next chapter.

CHAPTER 7: CONCLUSIONS

This chapter lays the concluding remarks of the study. In this chapter, the research questions and research objectives outlined earlier in Chapter 1 will be revisited to remark whether the research questions have been answered and the research objectives have been achieved. The contributions and limitations of the study are also discussed. Prior to the summary of this chapter, the suggestions for future study are delineated.

7.1 Introduction

The importance of OGD innovation in providing more effective government services is evolving over time. Recognizing the benefits of OGD to the digital community, it is alarming if the acceptance of OGD among data providers is not taken into account. Following these circumstances, this study undertook an OGD post-adoption framework in the public sector. Along the road to achieving the study's main purpose, four objectives and three research questions were defined to drive the researcher's works. The accomplishment of the research questions and research objectives of this study are summarized in the next subsection. Then the contributions of the study are discussed. As much as other studies, the limitation of the study is debated. Thereafter, the suggestions for future study are outlined. This chapter ends with a summary.

7.2 Accomplishment

The section will unpack all the research questions and research objectives that have been answered and achieved in this study.

i) **Research question 1**: What is the current OGD adoption phase in the Malaysian public sector?

Research objective 1: To investigate OGD adoption phases in the Malaysian public sector.

The first research question is answered by achieving the first objective of determining OGD adoption phases in the Malaysian public sector. Based on the innovation adoption process theory, the adoption phases of the Malaysian public sector OGD are anatomized. It was dissected into three phases called the pre-adoption, adoption (decisions) and post-adoption phases. The elicitation of each phase was drawn out by employing semi-structured interviews with top-level officers in the central agency and literature review methods. Eventually, the current phases of OGD in the Malaysian public sector based on the innovation adoption process is concluded as the post-adoption phase and thus answer the first research questions. The rationale behind determining the phases of OGD adoption in the Malaysian public sector can be explained by three reasons. First, it is orchestrated to assure that OGD has reached the post-adoption phase. Secondly, determining the OGD adoption phases help to understand the OGD transition from the pre-adoption to the post-adoption phase. Thirdly, it is also to circumvent the bias of assuming OGD has reached the post-adoption phase without any evidence.

ii) **Research question 2**: What are the factors that influence OGD implementation in the post-adoption in Malaysia's public sector?

Research objective 2: To investigate the factors influencing the OGD implementation in the post-adoption phase in Malaysia's public sector.

This second research question is answered through the second research objective. In achieving the second research objective, a field study was conducted with pioneer agencies that have been implementing OGD since the early phase of OGD implementation in the Malaysian government. The initial factors discovered were compatibility, complexity, relative advantage for technological context. For organisational context, there were culture, skills, training, and top management support. The data demand and incentives were the factors discovered for the environmental context. Finally, OGD principles were identified as unique factors for OGD implementation in the post-adoption phase.

iii) **Research question 3**: How can the OGD implementation be extended in the post-adoption phase in Malaysia's public sector?

Research objective 3: To develop an OGD post-adoption framework in the Malaysian public sector.

Research objective 4: To validate the OGD post-adoption framework in the Malaysian public sector.

The fourth research question is answered through the accomplishment of the third and fourth research objectives. The third research objective was formulated to develop the OGD post-adoption framework in Malaysian public sectors based on the identified factors in the second research objective. With the developed framework, the OGD implementation in the post-adoption can be extended into three sequence stages, namely the acceptance, routinization, and infusion. The final factors from the technological, organisational, environmental, and OGD principles context were analysed by applying PLS-SEM statistical analysis. Two factors from the technology context (complexity, relative advantage), three factors from organisational context (top management support, culture, IT competency) and OGD principles were found to significantly influence OGD implementation in the post-adoption phase in the Malaysian public sector. At the same time, one factor from the technology context (compatibility) and the environment context (data demand, incentives) were found insignificant to OGD implementation in the post-adoption phase in the Malaysian public sector. The OGD post-adoption framework is thus successfully built, which bring this study to accomplish the third objective. The fourth research objective is achieved by validating the developed OGD post-adoption framework. The validation procedure was performed by employing four experts as a reviewer of the developed framework. The experts' reviews confirmed the findings, resulting in the achievement of the fourth research objective.

This study offered an understanding of the OGD adoption process by delineating the activities in each pre-adoption, adoption, and post-adoption phase. Following the findings of the empirical study, technology and organisational factors are the most important determinants of OGD post-adoption in the government sector. The findings also fit the positivism approach in which explain the rules that govern organisational behaviour can be uncovered and measure. As this study answered all research questions and achieved all research objectives, thereby the research aims were accomplished.

7.3 Contributions

This study's contributions are presented in three different perspectives, namely theoretical, conceptual, and practical. From a theoretical standpoint, this study contributes to the IT innovation adoption theory, particularly in the post-adoption phase, by experimenting with OGD initiatives. While most IT innovation adoption studies focused on one single stage of adoption, this study promoted the sequence beyond the adoption decision phase. The potential of most IT innovations to be incorporated in the organisation's daily operation lies in the phase after adoption. Furthermore, the inability to secure profound use of IT innovation beyond the adoption phase could cause its abandonment (Park & Choi, 2019; Zhu, Dong, et al., 2006). Hence, this study presents a post-adoption framework for Malaysia open government data as presented in Figure 7.1.

The framework symbolised the empirical and practical evidence of OGD implementation in the post-adoption phase through ongoing experience and efforts in the Malaysian public sector. An important implication that this study tries to portray is that the lack of a post-adoption framework may hinder the government from planning the next OGD implementation actions.

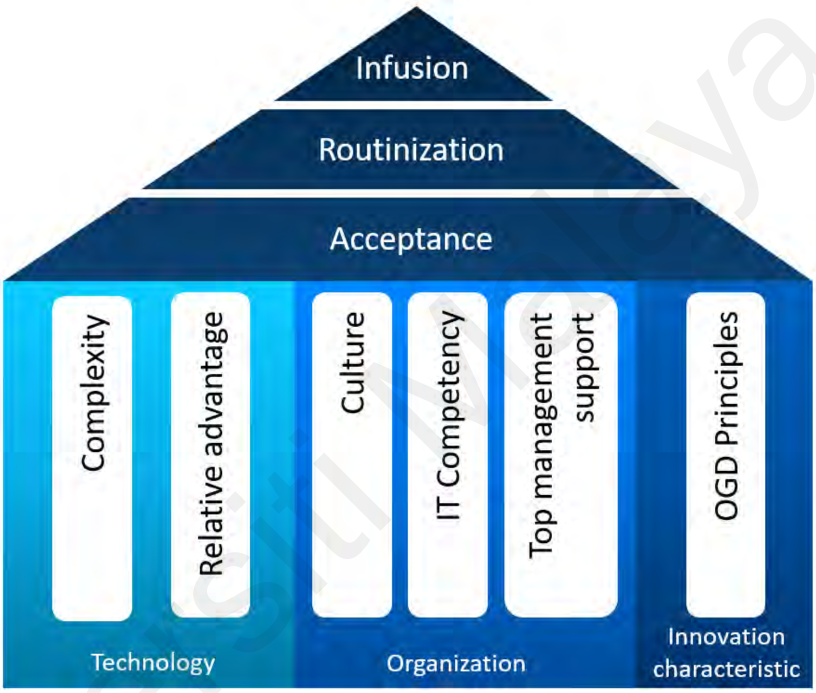

Figure 7.1: A Post Adoption Framework for Malaysia Open Government Data

From the conceptual perspective, this study introduces new factors into the research model: the incentives and data demand in the environmental context and OGD principles in the innovation characteristics context. The incentives factor could be explored deeper to understand what form of incentives might trigger the data providers to publish more quality data. As portrayed in Zhang et al. (2021), the government official's behaviour towards incentives can be studied as an individual factor that contributes to the OGD implementation. The data demand factor is among the crucial factor in the OGD ecosystem. Without the demand factor, the OGD implementation in the government sector could be very supply-driven. Thereby, this study paves the way for a more thorough exploration of the data demand factor. As a final point to consider, the OGD principles are frequently overlooked as a factor that may influence OGD adoption, despite the fact that the OGD principles govern how data should be published. In this study, the OGD principles were appointed as innovation characteristics factors that positively influence the OGD post-adoption. From this, it can be understood that a guided innovation feature will improve the innovation post-adoption performance.

Finally, from the practicality perspective, this study's outcome will guide policymakers from other organisations to use the same step to sustain OGD implementation in the post-adoption phase from the data provider's perspective. The three post-adoption phases (acceptance, routinization, infusion) imply the ideal end state that OGD should reach in an organisation. Thus, policymakers should design an approach that will make OGD part of the integral features in open data management. From the academic point of view, the OGD post-adoption framework could practically be the foundation of much more innovations post-adoption study. The findings of this study can drive the extended works. Last but not least, the OGD post-adoption framework allows the industry player such as the private business, start-up, and technology investor to understand the government agencies' motivation when publishing the OGD. Both the industry players and the government must be aware of the government's challenges in providing the OGD. At the same time, the government must be aware of the industry's desire for higher-quality OGD to cooperate

7.4 Limitations

Like any other research, this study suffers some limitations, which indirectly offer some room for future research opportunities. First, the nine post-adoption factors within the TOE context covered all factors for innovation adoption in an organisation. There is another context that is not covered in TOE, such as the human context. Therefore, there is a window of opportunities to explore other contributing factors for the post-adoption of IT innovation in an organisation. Additionally, replicating the study in different socio-economic or geopolitical statuses would further enrich the findings. Secondly, the number of respondents for the empirical study is rather low, with 40% of the government agencies implementing OGD. Perhaps, soon, more government agencies will join the data providers population to collect more responses. Thirdly, a cross-sectional study was employed in this study in which the data was collected in a specific timeframe. Hence, having a longitudinal study would extend the direction of OGD in the post-adoption phase.

Furthermore, the post-adoption of OGD in an organisation may reflect differently to the surroundings over time. Finally, this study centred only on the organisational context of the Malaysian public sector and its surrounding nature. The existence of the private sector or non-government organisations as OGD providers is yet to be seen. The individual factor is ignored intentionally due to the objective of this study is to explore OGD as an organisational level of analysis. All individual actors in the Malaysian OGD ecosystem, primarily the data provider, are not permanent and may change their position from time to time. However, the job scope of managing OGD implementation will remain in the respective government agency, and new personnel will take over. These actors may not create concrete evidence of impacts on their experience in OGD implementation.

7.5 Future Study

The potential of OGD keeps evolving. The fact that simple data sharing between government agencies in the early years of public service grows to have a dedicated platform to give the public free access to government data proves that OGD is worth the attention. Globally, the impact of OGD in sustainable development is becoming apparent.

Many international bodies, especially the United Nations, are pushing for more transparent data from governments worldwide to aid sustainable development goals.

Future studies are expected to identify more factors that have significant contributions to OGD in the post-adoption phase. Perhaps, the environmental factors have an influence on OGD in the post-adoption phase as time moves. In order to strengthen such a study, subsequent research must draw on the essential outcomes of this research. It is anticipated that this OGD post-adoption framework can be extended to another IS/IT innovation research thus diversified the innovation post-adoption study.

Apart from that, there is a vast area of research that can be done with OGD itself. At one point, the impact of OGD implementation in the Malaysian public sectors needs to be measured. Research on OGD implementation impact will determine whether the government's investment yields any tangible results. Thus far, little has been done to evaluate OGD implementation's impact on the citizen or the government itself.

As mentioned in the OGD ecosystem literature, OGD users and OGD beneficiaries have no less important roles in making OGD sustain. It is conceivable that research from the view of these stakeholders can be performed to understand how OGD is being used and the effect of OGD in citizen's life. In this way, government agencies can improve the OGD publication. Eventually, the OGD publication paradigm can be shifted from supply-driven to demand-driven.

7.6 Summary

Learning from the passivity status of some government's investment in technology, the OGD initiative must take alternative and practical actions to uphold its implementation in the government. This study intended to help project a sustainable OGD implementation in the Malaysian public sector. Following the established quantitatively-driven sequential mixed methods design, the study portrays a combination of qualitative and quantitative approaches through three phases of study in realizing the research objectives. In the first phase of the study, the innovation adoption process was established as the underpinning theories that ground the foundation of the study. Through the qualitative approach of a semi-structured interview, it was determined that OGD implementation in the Malaysian public sector are now in the post-adoption phase. The post-adoption phase was represented by three stages, namely the acceptance, routinization, and infusion. These stages signify the OGD implementation maturity among its adopters.

The study's dominating phase is described in the second phase, which used a quantitative approach. The second phase was dedicated to the creation of a framework for OGD post-adoption in the Malaysian public sector. Guided by the innovation adoption process theory, Diffusion of Innovation and Technology-Organisation-Environment framework, a conceptual framework of OGD post-adoption in the Malaysian public sector was crafted. Followingly, the study's hypotheses were formulated on top of the conceptual framework that comprises three general contexts (technology, organisation, environment) and OGD specific characteristics (OGD principles). To confirmed the conceptual framework, a survey was conducted to gather the responses among OGD data providers in the Malaysian public sector. This data was then analysed using Partial Least Square-Structured Equation Modelling (PLS-SEM) as the factor analysis technique. As a result, the output of the investigation has concluded that environmental context has no significant influence on OGD post-adoption.

The OGD post-adoption framework was further refined by the use of a validation technique, which allowed the study to determine whether the findings corresponded to the true phenomenon under investigation. The validation technique encapsulates the research design to the last phase of the study using a qualitative approach. The qualitative method brought together experts in government data management to reach the consensus that the developed OGD post-adoption framework closely reflects the implementation of OGD in the Malaysian public sector.

In terms of bias in data collection, it was mitigated by using a distinct group of people in each of the three primary data collection methods. In Phase 1 ('Exploration'), a group of higher rank officers from the central agency that led the OGD initiatives was selected as the respondents. Whilst in Phase 2 ('Development'), all government agencies that have registered as the data providers in the government data portal were selected as the population of the study. For the final Phase 3 ('Validation') study, a group of senior government officers that are not involved in OGD initiatives but have the knowledge and experience of government data management practices were selected as the respondents.

In conclusion, this study argues that if this thesis were to state a single overarching theme that served as the essence of the entire research, then the central idea would be the importance of OGD post-adoption in the Malaysian public sector. Beyond ensuring the success of government investments, post-adoption offers a level of sustainability that is often overlooked in the Malaysian public sector's IT investments.

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