AIMC 2017
Asia International Multidisciplinary Conference

IT GOVERNANCE IN INSTITUTE OF HIGHER LEARNING MALAYSIA: A SYSTEMATIC MAPPING STUDY

Amalia Mukhlas (a)*, Delina Beh Mei Yin (b), Husna Sarirah Husin (c)
Bazilah A. Talip (d), Aishah Ahmad (e)
*Corresponding author

(a) Malaysian Institute of Information Technology, Universiti Kuala Lumpur, Malaysia, amalia@unikl.edu.my
(b) Malaysian Institute of Information Technology, Universiti Kuala Lumpur, Malaysia, delina@unikl.edu.my
(c) Malaysian Institute of Information Technology, Universiti Kuala Lumpur, Malaysia, sarirah @unikl.edu.my
(d) Malaysian Institute of Information Technology, Universiti Kuala Lumpur, Malaysia, bazilah@unikl.edu.my
(e) UiTM Kampus Jasin,77300 Merlimau Bandaraya Bersejarah Melaka, Malaysia, aishah582@melaka.edu.my

Abstract

Background: The strategies, goals and objectives of higher learning institution are driven by IT. The mature governance of IT in higher learning institution is essential for institution to address the key issues successfully. *Objectives:* This study initiates to investigate existing research of Information Technology Governance (ITG) focusing Institute of Higher Learning (IHL) in Malaysia. The research aims to discover tabulation of domain covered by ITG, distribution study of ITG from the scope of IHL in Malaysia, classification of research covered by ITG in IHL and to identify the impact and contribution of ITG for IHL in Malaysia. *Method:* We have conducted a systematic mapping study to response the research questions. *Results:* The outcomes indicate that the IT Resource Management achieved the most research performed compared to other domains of ITG. The distribution study of ITG is led by public university and null for private university. The evaluation research (ER) and solution proposal (SP) dominate type of research conducted which resulted there are more space for research approach to be performed in future. The extraction of impact and contribution of previous research shows the implementation conducted. *Conclusion:* Our contribution in this paper is to produce the mapping of studies in order to identify areas to be improved and explored in future. The significance of our findings is essential for the kick-start research of ITG focusing the IHL in Malaysia.

Keywords: Systematic mapping; Information Technology Governance (ITG); Institute of Higher Learning (IHL), University.

1. Introduction

In the recent years, information technology (IT) has become one of the crucial factors in sustainability and growth of an organisation. This includes higher education institutions. The dependency on IT has impressively impacted all business processes as well as the academic implementations. Therefore, clear guidelines and structure to manage and govern the IT infrastructure is important. The IT governance (ITG) is paving the way to ensure all stakeholders understand their roles and responsibilities (Mohamad, Hendrick, O'Leary, & Best, 2014) in managing IT to achieve organisation's missions and goals. In addition, the adoption of IT governance can be a key factor to enable continuous organisational performance (Ajayi & Hussin, 2014).

According to Weill and Ross (2004) IT governance is defined as adjuring rights decision and culpability of framework to reassure preferred behaviour in practicing IT. Another definition coined by Gartner (2017) describes IT governance as the practice to assure appropriate utilisation of IT for organisation to accomplish its goals. On the other hand, Weill and Ross (2004) emphasised that the roles of stakeholder have to be defined clearly in IT governance by describing the person in-charge that relates to decision, provider, handling dispute and analysing issues. Moreover, in the growth of practical information system, IT governance can be used as a mechanism to narrow the slit of responsibility between business and IT people (Hamid & Sulaiman, 2016) thus act as the leading light of IT functions to facilitate institution accomplishing intended goals (Lin, Arshad, Haron, Wah, Yusoff, & Mohamed, 2010).

There are plenty of studies carried out in IT governance. Yet it is seemingly lack of review from the area of IHL in Malaysia. The motivation to conduct this study came in part from two sources. Firstly, the motivation originates to know the scope of ITG in IHL Malaysia through systematic mapping study due to the absence from this method. Secondly, the impact and contribution of ITG towards IHL in Malaysia should be distinguished to date. The motivation of mapping study becomes its base to understand the area through tabulation of domain, research approach, analysis of opportunities as well as impact and contribution.

This paper intends to explore the area of study performed from previous research until current findings. The mapping has been done based on proposed research questions and relate the questions to the mapping study results. Subsequently, we provide evidence from available publications. The result that we presented would help to explore the area which has not been discovered by other research.

2. Problem Statement

The scientific research of ITG focusing the IHL in Malaysia has increased due to demand of institution to achieve strategic objectives. The existing research have expanded the scope of research, discussed, proposed improvised framework, theory, process and practices and optimisation of ITG. This section discusses some of these works related to IHL in Malaysia. The concerns of IT investment failures is higher than before owing to legislation (Ajayi & Hussin, 2014). Noticeable to that is the Sarbanes-Oxley Act (De Haes & Van Grembergen, 2006) that borne out of the need to hold leadership or organisation to be responsible to its corporate governance duties. The strength of this and the likely rules which have been replicated the world over positions organisations to be concerned when it comes to how governance paradigm to be adapted to leverage business and IT alignment (Ajayi & Hussin, 2014). Undeniably, the

universities and other organisations has many similarities. University is declared as organisations in its uniqueness and the way IT is governed in the organisation is vital to be concerned (Mudaliar, Garde, & Sharma, 2009).

IT governance is imperative in academic institutions. This is supported by Grama (2015) that an institution can achieve its goal by applying IT resources optimally through implementation of effective IT governance. IT governance is the way an institution structures decision making about IT to achieve strategic objectives. From the side of higher academic institution perspective, the value includes supporting the academic and research missions, improving institution's competitive advantages and supporting revenue-generating activities. Achieving these values require alignment between academic, business units and IT. An effective IT governance process can bring these parts of the university together and facilitate the development of shared goals and vision for IT services (Carraway, 2016). As a result, IT governance involves decision making procedures to guarantee competent use of IT in institution to accomplish deliberate objectives. A competent IT governance programs will confirm the technology strategies, applicable rules and procedures to support the objectives. Nevertheless, the organisations of IT governance programs in higher learning institution differ prominently. It is based on factors like size, culture, organisation and control (Grama, 2015).

3. Research Questions

This study was performed based on the orientations in Petersen, Feldt, Mujtaba, and Mattsson (2008) to formulate the research questions as outlined in Table 01.

Table 01. Research Questions

No	Question	Motivation
1.	Which ITG domains that mostly research from IHL Malaysia perspectives?	To explore IT governance domain area that has successfully been investigated in IHL Malaysia perspective.
2.	Which type of IHL (private or public university) has mostly been investigated?	To identify type of IHL that mostly been investigated and to explore which type of IHL that has possibility to be investigated in future research.
3.	Which research classification being used for ITG research?	To identify the research classification used in ITG research and to explore the possible research approach for ITG in future research.
4.	What are the impact and contribution of ITG from IHL Malaysia perception?	To investigate the impact and contribution of ITG from IHL Malaysia perception.

4. Purpose of the Study

Numerous studies have carried out in IT governance, but seemingly lack of review from the area of IHL in Malaysia. Thus the overall intentions of this study is to carry out a comprehensive review and synthesis of available research of ITG focusing Institute of Higher Learning (IHL) in Malaysia. The research aims to discover tabulation of domain covered by ITG, distribution study of ITG from the scope of IHL in Malaysia, classification of research covered by ITG in IHL and to identify the impact and contribution of ITG for IHL in Malaysia.

4.1. Tabulation of domain covered by ITG

The study aims to identify tabulation of research that falls under ITG domains through mapping. The result will highlight the tabulation research conducted in ITG domains area and direct future research to focus on improvement of current knowledge or investigation in other direction.

4.2. Distribution study of ITG from the scope of IHL in Malaysia

Identifying the distribution study of ITG among the public and private university or both is the main aim of this research. The idea is to identify which area has been mostly covered and poorly covered by ITG. The findings will help other researchers to direct future research especially in poorly covered area to expand the knowledge in particular IHL in Malaysia.

4.3. Classification of research covered by ITG in IHL

Our study aims to determine the type of research evaluated in each article collected for this study. The findings will highlight the area of research approach which has yet being covered to date hence direct the future research to investigate the area to expand the knowledge area.

4.4. Identify the impact and contribution of ITG for IHL in Malaysia

By identifying the findings from the research performed on impact and contribution of IT Governance in IHL, it helps to scrutinise the depth of ITG contribution in IHL locally.

5. Research Methods

This section discovers the methods and materials involved for collecting and analysing current research conducted. The chosen method used for this study is Systematic Mapping that served methodological advantages and applicability to answer the research questions.

5.1. Search Strategy

To define a search strategy for detection of primary studies, it is essential to determine the keywords to search for key reference. The keyword search strategy has become an important step to determine the main objective of this current study. The work in Petersen et al. (2008) emphasised the necessity for researcher to create search strategy by identifying the keywords. The use of search strings on scientific database has significantly helped the researcher to identify their primary studies within their research interest. In addition, Kitchenham and Charters (2007) claimed the research question is a key in creation of search, as keywords can be created based on population, intervention, comparison and outcome of research. For example, the population of a study (e.g., the number of participant or socio demographic) could lead to keywords like "survey" or "case study" which are research methods to identify the target audiences.

The primary sources in this study are obtained through Scopus indexing to find relevant articles by limiting the years from 2010 to December 2016. The reason is for having the latest research conducted in the area of study. This is due to its bibliographic database which contain abstracts and citations for academic journal article where it comprises a various number of publishers, multidiscipline and subscribed by the

library. The search string was created using *AND* and *OR* operators to limit the search outcomes. The search string used in the mapping study as follows:

- "IT Governance" *AND* "University" *AND* "Malaysia"
- "IT Governance" *AND* "Public University" *AND* "Malaysia"

The first search string displays result of 6 papers whereas the second search string offers result of 4 papers. The papers were compared for similarities and differences that yields 7 papers which relevant for the study. Next, a qualitative assessment was conducted to outline the content for quality of work purposes. The layers of filtration were conducted to extract the content and to answer the research question. Consequently, the outcomes categorise the papers into several domains and classify it into distribution study of either public university, private university or both. Next, the research classification approach is presented followed by discussion of impact and contribution. The papers were assigned with identical number (ID) for easy referencing. Table 2 reveals the publications retrieved for this study.

Table 02. Publications retrieved for this study

Author	ID	Title	Objective
Aliyu (2010)	#1	Measuring IT Governance effectiveness using ITG diagnostic diamond: A case study of Information Technology Division, IIUM	To study how IT aligned to university operation and to know whether IT contribute to enhance operational efficiency and effectiveness in university
Arshad (2014)	#2	Intelligent IT governance decision-making support framework for a developing country's public university	To discover issues on ITG and provide recommendation for ITG Intelligent Decision Making Support System (IDMSS) in public university in Malaysia
Ajayi and Hussin (2014)	#3	Exploring information technology governance in a Malaysian public university: Providers' perspectives	To express how public university governs IT and learn from the practised to improve IT disposition
Ahlan, Arshad, and Ajayi (2014)	#4	IT Governance in a Malaysian Public Institute of Higher Learning and Intelligent Decision Making Support System Solution	To discover disputes of IT governance and the use of IDMSS in a public university in Malaysia
Musa, Abang Ibrahim, Bolhassan, Abdullah, Kulathuramaiyer, and Khairuddin (2014)	#5	An IT governance framework for achieving the development of academic programme in higher institutions: A case of Universiti Malaysia Sarawak (UNIMAS)	To identify impact and model conceptual framework by identifying elements of governance in achieving development of academic program through web based system
Anthony Jnr, Che Pa, Mohd Aris, Haizan Nor, and Jusoh (2015)	#6	Autonomic computing systems utilizing agents for risk mitigation of IT Governance	To propose an autonomic computing model developed to mitigate risk; mainly operational and technical in IT Governance by measuring the risk and providing risk report to the management and staffs in organisations
Ajayi and Hussin (2016)	#7	IT governance from practitioners' perspective: Sharing the experience of a Malaysian university	To discover how higher education institution in Malaysia administer IT to achieve performance according to experimental investigation of practitioners of a public university

5.2. Study Procedure

This study uses research questions, search string and criteria for inclusion and exclusion of articles. The aims are to identify the domain area that focus by research, distribution study, research classification, impact and contribution apart from exploring the direction of future research of IT governance in the area

of IHL in Malaysia. We define the inclusion and exclusion criteria for this study that helps to define relevant study to respond the research questions.

Table 03. Inclusion and Exclusion Criteria

Criteria	
Inclusion	Publications which comprise of IT governance with details and specific domain area where the area of research covered in IHL of Malaysia.
Exclusion	Publication that do not cover IT governance research area in IHL of Malaysia.
	Publication that produced earlier than 2010.
	Studies that do not cover empirical findings or literatures that are not discussed thoroughly.

6. Findings

Once the criterion completed, the data is critically analysed. This section discusses on results which obtained from the systematic mapping study of publications collected, hence the aims are to answer the research questions as below.

6.1. Answer for Research Question 1 (RQ1)

Table 04. reveals a mapping of research identified from 2010-2016 in related to ITG domain. The mapping helps to identify tabulation of research that falls under these domains. The study has chosen IT governance as domain of the study due to its applicable framework for constructing IT governance program. The domains signify five management-related issues that linked to IT governance accountabilities (ITGI, 2003).

Table 04. Mapping of ITG domains

Paper ID	Domains
#5	IT Strategic Alignment
#2,#3,#4,#7	IT Resource Management
#6	Risk Management
#1	Performance Management
-	IT Value Delivery

The findings from Table 04. indicate the IT Resource Management domain has popular studies performed by researchers. The domains like IT Strategic Alignment, Risk Management and Performance Management each indicate a single study. The result indicate there is no studies performed for IT Value Delivery domain. This show that more interest projected toward IT resource management domain compared to other domains specifically IT Value Delivery. This is surprising yet frustrating findings since IT Value Delivery objectives is to accomplish the value proposition during the course of delivery cycle and to ensure successful delivery of benefits by meeting proven value of IT and cost optimisation (ITGI,

2003). However, from the results collected, there is no research performed to investigate on the value delivery of IT.

The findings indicate there are vast opportunity to conduct investigation in IT Value Delivery domain. Hence the future study of IT Value Delivery domain for IHL in Malaysia is acclaimed to be conducted for detail investigation on the value and benefits return to institution. The recommendation for future research should emphasise to deliberate the benefits of strategy applied on how optimisation of cost in IHL is successfully govern. The study could investigate on the effectiveness of technology, innovation of process, procedure, framework or model that could aid cost optimisation in IHL. Such exposure would help the academic institution to acquire necessary process, procedures and strategy to govern IT and sustain survivability of institution.

6.2.   Answer for Research Question 2 (RQ2)

Table 05 reveals tabulation study of ITG from public university, private university or both. The findings disclose that most research are focusing on public university in Malaysia. It reveals only one research performed for the mix area of public and private IHL in Malaysia. We have contacted the author of #6 to verify the sample of study collected. The study by #6 confirmed the research has covered both; public and private university practitioners. The findings reveal the area of private university is still absence from research. From the rising numbers of private university in Malaysia, there are huge potential for new discoveries aiming private university. In similar to public university, the private university competitively performed as an imperative academic institution. In order for academic institution to be competitive internationally, the determination begins from collaboration with international universities and industries through research, projects, exchange of ideas and technology. In addition, the exchange of students and academic through partnership project also conducted among universities (Yaakob, Tarmizi, Yunus, Ghani, & Mokhtar, 2009).

The private university formed through subsidiaries of Government Link Companies (GLC).The institution is privately funded. Despite that, the institution needs to abide goals and objectives of government in providing high quality of education in Malaysia. This is to ensure the education is at the center of excellence (Grapragasem, Krishnan & Mansor, 2014). Therefore, it is compulsory for private IHL to follow the structure provided by the government. The government takes proactive role in controlling and monitoring private institution and the programmes offered. The Malaysian Qualification Agency (MQA) was introduced to govern private education en route for efficient education system. Likewise, the Malaysian Qualification Framework (MQF) has been implemented to control and supervise the quality assurance applies and accreditation of private education (Yaakob et al., 2009). This effort is to assure on precaution and the privileges of Malaysian students in attaining good quality of education. The role of ITG fits in to deal with how IT is being transformed to meet present and future demand of business. Based on these information, it is highly emphasised for the area of private university should be focussed and put into concentration to be explored in the future study of ITG.

Table 05. Distribution study of ITG in university

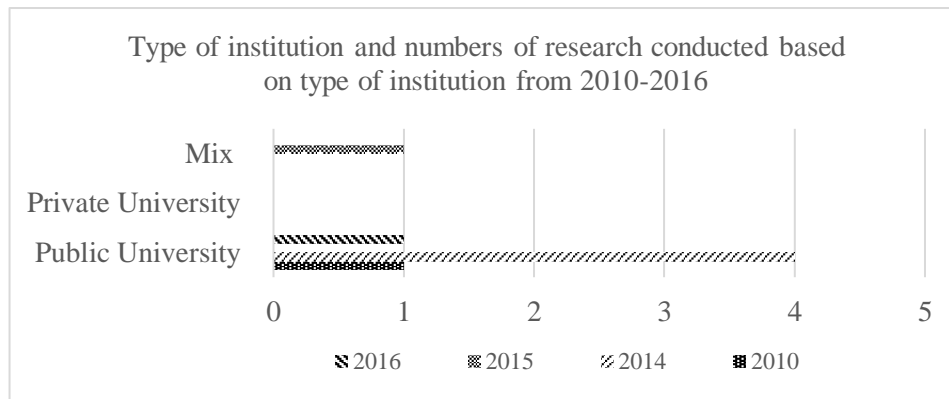| Year	Public University	Private University	Mix (Public and Private University)
2010	#1	-	-
2014	#2,#3,#4,#5	-	-
2015	-	-	#6
2016	#7	-	-

Figure 01. Graph tabulation of type of institution of higher learning (IHL) and numbers of research conducted from 2010-2016

Figure 01. shows the graph tabulation of years and type of university. The graph's result shows the nonexistence of study performed in private university whereas there is only one study perform focusing the mix area of both public and private university.

6.3. Answer for Research Question 3 (RQ3)

In answering RQ3, the classification proposed by Wieringa, Maiden, Mead, and Rolland (2006) was used to determine the type of research evaluated in each article collected for this study. The articles were subdivided into categories which proposes criteria for evaluation and classification for the articles. As claimed by Fernandes, Cardoso, and Marcelino (2015) the classification proposed may be considered a general classification which may be applied to any kind of research. Table 6 tabulates the abbreviation used for this study to indicate the area of classification approach used to support tabulation of Table 7 and the graph of Figure 2.

Table 06. Abbreviation for research approach

Abbreviation	Research classification approach
ER	Evaluation Research
SP	Solution Proposal
VR	Validation Research
EP	Experience Papers
OP	Opinion Papers
PP	Philosophical Paper

Table 07. Research classification approach by Wieringa et al. (2006)

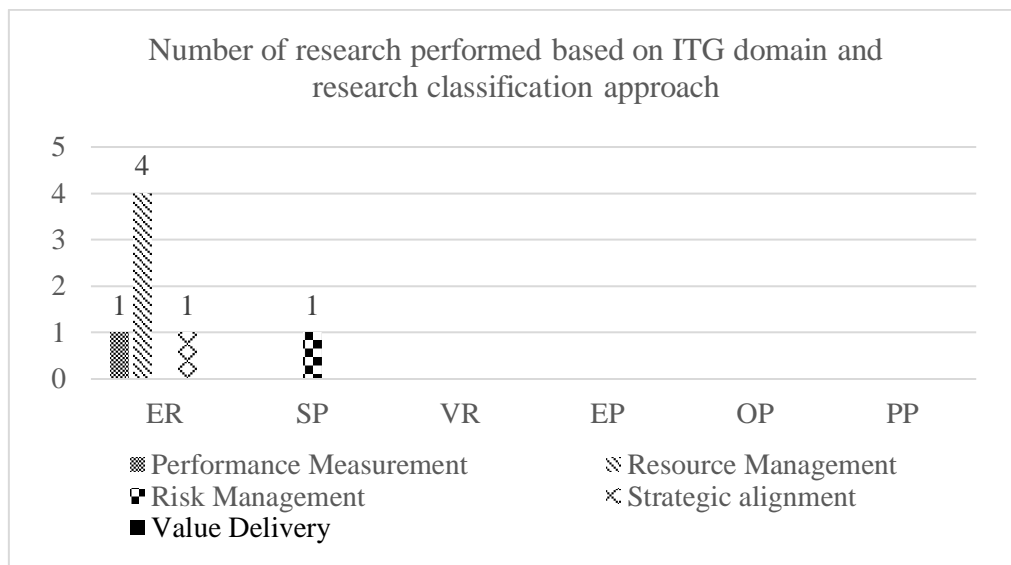| Years	ER	SP	VR	EP	OP	PP
2010	#1	-	-	-	-	-
2011	-	-	-	-	-	-
2012	-	-	-	-	-	-
2013	-	-	-	-	-	-
2014	#2,#3,#4,#5	-	-	-	-	-
2015	-	#6	-	-	-	-
2016	#7	-	-	-	-	-

Figure 02. Graph of ITG domain and research classification approach

Table 07. shows the area of research approach which has yet being covered to date. The areas like validation research, experience papers, opinion papers and philosophical paper are the areas that has potential to be explored in future. The result indicates there are big introductory study of ITG in IHL Malaysia reflecting these areas. The future study could cover the area that absence from classification approach resembling Validation Research (VR), Experience Paper (EP), Opinion Paper (OP) and Philosophical Paper (PP).

The VR is determined to examine the possessions of solution proposal that has not been applied. Nonetheless, the solution may have been anticipated in other area by others. However, a study of ITG in IHL that fits these criteria is yet to be performed. Thus, there are big opportunity of research to be conducted in VR approach. The recommendation of research in proposal solution may emphasised to propose the solutions of IT governance domain specifically in poorly covered areas like value delivery, strategic alignment, performance measurement and risk management. This requires an in-depth of systematic and empirical investigation which yields a valid proof.

The opportunities of future study for EP could discover experience concerning author personal experience. This could be performed based on personal experience in governing IT in institution. The recommendation of future research could focus to discuss ITG domain area which emphasised on impact

and lessons learned of ITG practices in IHL from author's experiences. This is beneficial for other researchers to understand on real experiences and direction of future research to escalate the knowledge further.

Nevertheless, the OP encompasses the viewpoint of a researcher on particular topic of research. The recommendation of future research could discuss the opinion of ITG implementation covering all domains. In addition, it should cover the overcoming and solution for arising issues. Additionally, the recommendation of future study could emphasised on strategy, managing risk, improvement of performance management and share the opinion on IT value delivery.

The PP comprises a new conceptual framework or outline a new way of looking at things. The evaluation criteria for PP intent to investigate originality and insightful of conceptual framework. The opportunities of new research from this approach is to perform a study to investigate private IHL from existing ITG framework. The study yields to contribute detail understanding and implementation of ITG in private IHL Malaysia. In addition, a study may suggest a new framework of ITG focusing private IHL in Malaysia or a study of framework comparison towards suitable implementation of ITG to the university.

6.4. Answer for Research Question 4 (RQ4)

The findings from systematic mapping demonstrate summary and discussions on impact and contribution of IT Governance in IHL of Malaysia as follows:

Table 08. Impact and contribution summary

Impact and contribution	Paper ID
Alignment between IT and business goals	#1,#3,#5
Management involvement for proper governance	#3
Proper structure for IT to achieving ITG level and faster decision making	#1,#3, #7
The use of framework as performance measurement/performance assessment	#1,#3, #7
Optimisation	#1,#2,#6,#7
Consultation, Training, Evaluation	#3,#5
Diagnosing IT governance effectiveness	#1

6.4.1. Alignment between IT and business goal

Aligning IT and business goal is not peculiar in this era. However, the case studies are all-encompassing with organisations that struggled to use IT to achieve business objectives. This is resulted from difference type of goals to be achieved by department, culture, common understanding on process and methods hence result in incompetent products and systems that fail to provide good return on investment (Qualtrough, 2016). Hence, the role of Chief Information Officer (CIO) is important to align IT and business goals and make it successfully aligned throughout organisation structure. As emphasised by Aliyu (2010), the roles and function in organisation is assigned in every bodies to execute responsibilities from all direction, leadership, assisting operation and collaboration. Through proper structure, the IT policy practiced for decision making is allowed to be decided by IT team to resolve the issue (Ajayi & Hussin, 2014). As practice shown by Universiti Malaysia Sarawak (UNIMAS), a close alignment occurred between

IS/IT and business goals to achieve development of academic programme in university. This is done through adopted web based system as tools & strategy to align with business goals. The practice is supported from the management like Senate approval, Board of Director and top management (Musa et al., 2014).

6.4.2. Management involvement for proper governance

Developing a solid IT governance process entails the university to identify criteria involving decision makers who make the decision and input into the decision (Carraway, 2016). As claimed by Ajayi and Hussin (2014) that management involvement is important for proper governance of IT. This helps to leverage business goals and objectives. The involvement derived from the side of management in IT committee and IT policy decision making. It is important that senior management has a working knowledge of the concepts and issues related to IT governance. Senior management needs to be better assured the organisation's IT deliverables are met. With effective governance, the return of IT investment will be high and this business investment in IT can be optimised to extend business strategies and goals (Lin et al., 2010).

6.4.3. Proper structure for IT to achieve ITG level and decision making

There are variations of institutional structure, culture and demand used of information technology and information system of institutions. The purpose of companies from setting up IT governance practices is to make sure the organisation's information systems fulfil its needs. Hence, the role of IT committee is important in institutional structure to fulfil these needs. Due to the aforementioned issues, a proper structure of IT committee with unique responsibilities is emphasised to support this (Ajayi & Hussin, 2014). The position of IT personnel in organisation structure matters and effect the flow and execution of task perform. As highlighted in #7, the arrangement of structure to execute roles of functional unit for making IT decision is important (Ajayi & Hussin, 2016). The position of IT at executive or board will reflect the governance. The involvement of CIO to govern IT echoes the achievement of desired goals. In respond to the obstacles in IHL, it is essential for organisations to mend their capability to react towards business challenges in a fast pace based on limited resources. The companies should be responsive with flexible structure to accomplish competitive benefit. The benefits like faster decision making process and speedy information processing system is expected from a well-developed IT architecture (Sabegh & Motlagh, 2012). Nevertheless, it is agreed that the details of the structure differ from institution to another depending on organisational culture (Grama, 2015).

The research in #7 mentioned the higher level authority like manager performed direct responsibility on how university locate the roles, responsibilities and position. Hence, organising IT from decentralising to centralising could help to restructure the IT and address issues in monitoring yet making the resource meaningful. Moreover, the manager should encourage practising job rotation at IT function level. The rotation helps to obtain knowledge from technical to business knowledge (Ajayi & Hussin, 2016). In addition, the boards have to play their role. The upcoming study could get the boards and the management to perform self-evaluation and evaluate each competency. This can results competence breaches which helps the boards to have well understanding on the governance of IT. Nonetheless allow the boards to

deliberate the influence of IT structure on board IT governance processes (Mohamad et al., 2014). A study performed by #1 suggested a new structure to be proposed to replace the current one. A proper structure assists faster decision making to be made by the expertise. This is supported by Carraway (2016) that in refining decision making, it is typical to split decision making between those who are best positioned in diverse domains. A proper structure is important for decision makers to speed up decision making process. These people are known to make many decisions and vigilant analysis in their hectic activity (Weill, 2004). Consequently the assurance of senior management in IT governance practices and persistent improvement within organisation is important to ensure its success.

6.4.4. The use of framework as performance measurement / performance assessment

The study of Ajayi and Hussin (2014) and Ajayi and Hussin (2016) mentioned tools like COBIT 5.0 and Balance Score Card (BSC) used as performance tools. These tools are used to inspect and control IS resources and value to business. To increase university attainment in ITG, it is recommended for the university to include the elements of COBIT and ITIL in performance measurement (Aliyu, 2010). By possessing suitable administration of IT resources and methods to control delivery of process and strategy, the capability of organisation to controlled business-IT alignment will expand (Sabegh & Motlagh, 2012). The framework of performance measurement comprise budgeting method and metrics. The performance metrics is used to assist in administering measurement and necessary to be paralleled with the goals of organisation. The planning and control of the metrics will be delayed if they are not implemented properly (Haanappel, Drost, & Harmsen, 2011). It is claimed by Fernández and Llorens (2009) that the absence of framework in university environment are the origins of IT governance systems being implemented yet in a maturing rate. Despite the immature practices of IT performance management benefits (Haanappel et al., 2011) it is significant for university to own and implement a framework as assessment and performance measurement. This is to ensure the competent use of IT to achieve the goals of organisation hence received the most value for investment made.

6.4.5. Optimisation

From this study, the optimisation elements originates from data sharing, applying security, risk assessment and mitigation using autonomic computing system and Intelligent Decision Making Support System (IDMSS). The researchers in #7 emphasised on the need to increase data sharing capabilities to generate meaningful data for business intelligence hence enhance management decision making process. The rapid growth of data in IHL environment leads to accelerate the information and knowledge produced. Thus, knowledge sharing help improvised the communication of business, IT managers and executive. This is due to understanding of each other's environment hence act as an influence factor on strategic alignment. Moreover, it is recommended for knowledge to be shared among executives therefore support the chances for firms to have alignment in IT-business strategies (Sabegh & Motlagh, 2012).

Additionally, the security issues have been startling its presence in IHL environment. The IHL deals with varieties of data, information and knowledge that applicable towards all categories of processes, structures and stakeholders. In regards to this, the university applied security in every aspect of ICT (Aliyu, 2010). The information security issues have emerged to be a hot topic in discussion. Due to this, higher

education institutions must constantly improve the maturity of information security programs to protect IT systems and data (Grama & Vogel, 2017).

In supporting optimisation of ITG, the use of autonomous computing system (ACS) aids to alleviate risk for risk assessment and mitigation purposes (Anthony Jnr et al., 2015). The autonomic computing system are system that manage by themselves. The main category of the system is the agent with advanced capacities for reasoning. The agents responsible to measure the probability and the impact of risk. The reasoning is conducted based on existing data in knowledge base or previous experiences. Risk mitigation in ITG intents at early identification of risks and actively alter the course of actions to alleviate the risk (Moradi, Aghaie, & Hosseini, 2013). Anthony Jnr et al. (2015) in #6 discovered the organisation performance can be improved through risk mitigation by assist the management settled its duties facilitating competent and productive management. The module of risk mitigation discussed in ACS model consists of module like Risk Identification, Risk Decision, Risk Treatment, Risk Monitoring, Risk Mitigation Report, Knowledgebase, Operational/Technical Data and Decision Makers. In addition, the study discussed the criteria and communication of agents. The agent-based technology owns characteristic of Autonomy, Sociability, Reactivity, Pro-activeness, Persistence, Intelligence, Mobility and Interactivity. These characteristics make it suitable for constructing risk mitigation system hence accredited agent-based technology as a promising technologies for mitigating risk effectively in high level of uncertainty (Bajo, Borrajo, De Paz, Corchado, & Pellicer, 2012). Anthony Jnr et al. (2015) proposed a multi-agent based model that was enhanced by the agents' ability to measure the risk based on the risk probability, risk impact and degree of data sharing. The proposed model yields advantages by providing availability of risk report to be reused for decision making processes within ITG. Furthermore, the aforesaid risk report has contributed in augmenting critical dependencies between operational and technical risks. In other words, the risk report becomes a continuous effort to assist in risk monitoring and supervising the entire process of risk mitigation.

The study performed by #2 highlighted the need to perform effective ITG in university for optimum usage of IT resources (that gives impact to university performance). The optimisation of ITG in university can be attained by IDMSS which is capable to resolve the ITG themes or areas in intelligent manner using predictive capability. The main component of IDMSS is the information extraction and predictive capability that capable to analyse the information into pattern which represents trend of the event. It will summarise the important information for decision making for ITG. This specification exhibit intelligent behaviour of IDMSS and useful to assist decision maker in making decision.

6.4.6. Consultation, training and evaluation

The consultation and training approach should be made whenever necessary exclusively in improvement or expansion of institution. This will assist to distribute and spread the knowledge consistently among people in the institution. A study performed by Musa et al. (2014) claimed the necessity for committee at university level especially the course outline committee to be established and conducted training for using web based system to realise profitable goals of the web based system. The soft skills are essential to be trained and improved. As claimed by Sukhoo, Barnard, and Eloff (2005) soft skills are seen as competencies that need to be discovered. Through soft skills, software project management teams will

have chances at overpowering existing issues (Hamid & Sulaiman, 2016). In addition, evaluation is an approach to be deliberated to evaluate the actions taken for institutions. The evaluation practices should be emphasised through its participation in every phases involved. This is supported by Ajayi and Hussin (2014) that evaluation need to be encompassed prior to decision making process.

6.4.7. Diagnosing IT governance effectiveness

The study carried out by #1 mentioned the diamond diagnostic model has advantages to identify the value driver of IT and business. The study lead to the division with chances to diagnose the suitability of existing ITG architecture. In addition, it helps to identify strategic inconsistencies and improve ITG architecture.

7. Conclusion

This paper presents a study of ITG in IHL Malaysia based on the systematic mapping methodology. In response to RQ1, there are large openings of research to be performed to acquaint the knowledge according to ITG domain areas. In react to RQ2, it can be concluded that there is a huge opening in the study of ITG from the scope of private university. The study will unwrap a new perspective of practices applied in private university which will contributes the idea of ITG in IHL Malaysia. To respond to RQ3, there are large openings of research approach that can be perform to understand ITG focusing IHL in Malaysia. The variety of research approach will contribute to more knowledge to be filled in this area of study. In answering to RQ4, there are positives number of impact and contribution of ITG in IHL, which matures and grow towards practices. This shows the academic institution has conceded the study which is important and relevant to achieve the objective of IHL. For future direction a detailed focus of research covering each ITG domain is needed. This would assist IHL to foreknow the practice of IHL in each ITG domains.

Acknowledgments

References

Ahlan, A. R., Arshad, Y., & Ajayi, B. A. (2014). IT Governance in a Malaysian Public Institute of Higher Learning and Intelligent Decision Making Support System Solution. *55*, 19-33. doi:10.1007/978-3-642-39928-2_2

Ajayi, B. A., & Hussin, H. (2014). Exploring information technology governance in a Malaysian public university: Providers' perspectives. *In Information and Communication Technology for The Muslim World (ICT4M), 2014 The 5th International Conference on (pp. 1-6). IEEE.*

Ajayi, B. A., & Hussin, H. (2016). IT governance from practitioners' perspective:Sharing the experience of a Malaysian university. *Journal of Theoretical and Applied Information Technology, 88*(2).

Aliyu, M. (2010). Measuring IT Governance effectiveness using ITG diagnostic diamond: A case study of Information Technology Division, IIUM. *In Proceeding of the 3rd International Conference on Information and Communication Technology for the Moslem World: ICT Connecting Cultures, ICT4M 2010.*

Anthony Jnr, B., Che Pa, N., Mohd Aris, T. N., Haizan Nor, R. N., & Jusoh, Y. Y. (2015). Autonomic computing systems utilizing agents for risk mitigation of IT Governance. *Jurnal Teknologi, 77*(18). doi:http://doi.org/10.11113/jt.v77.6490

Arshad, Y., Ahlan, A. R., & Ajayi, B. A. (2014). Intelligent IT governance decision-making support framework for a developing country's public university. *Intelligent Decision Technologies, 8*(2). doi:http://doi.org/10.3233/IDT-130183

Bajo, J., Borrajo, M. L., De Paz, J. F., Corchado, J. M., & Pellicer, M. A. (2012). A multi-agent system for web-based risk management in small and medium business. *Expert Systems with Applications, 39*(8), 6921–6931. doi:http://doi.org/10.1016/j.eswa.2012.01.001

Carraway, D. (2016). Supporting Innovation through IT Governance in Higher Education. *ECAR Research Bulletin.*

De Haes, S., & Van Grembergen, W. (2006). Information technology governance best practices in Belgian organisations. In: System Sciences. *HICSS'06, Proceedings of the 39th Annual Hawaii International Conference on, Kauai(C).*

Fernandes, A. F., Cardoso, J., & Marcelino, M. J. (2015). A Systematic Mapping Applied to MOOC's Study. *7th International Conference on Computer Supported Education (CSEDU)*, 444-449, 423-425.

Fernández, A., & Llorens, F. (2009). An IT Governance Framework for Universities in Spain. *EUNIS 2009 Conference*, 1–13.

Gartner. (2017). Retrieved on March, 5th 2017 from http://www.gartner.com/it-glossary/it-governance

Grama, J. L. (2015, 20th March, 2017). Understanding IT GRC in higher education: IT Governance. *EDUCAUSE Review.* Retrieved on March, 20th 2017 from http://er.educause.edu/articles/2015/2/understanding-it-grc-in-higher-education-it-risk

Grama, J. L., & Vogel, V. (2017). Information Security: Risky Business. Retrieved on April 4th, 2017 from http://er.educause.edu/articles/2017/1/information-security-risky-business

Grapragasem, S., Krishnan, A., & Mansor, A. N. (2014). Current Trends in Malaysian Higher Education and the Effect on Education Policy and Practice: An Overview. *International Journal of Higher Education, 3*(1). doi:10.5430/ijhe.v3n1p85

Haanappel, S., Drost, R., & Harmsen, F. (2011). A framework for IT performance management., 1–83.

Hamid, Z. A., & Sulaiman, H. (2016). COBIT benchmarking of system development governance for a government agency in Malaysia. *Journal of Theoretical and Applied Information Technology, 89*(1).

ITGI. (2003). *Board Briefing on IT Governance* (pp. 1-66). Retrieved from http://www.isaca.org/knowledge-center/research/researchdeliverables/pages/board-briefing-on-it-governance-2nd-edition.aspx?utm_referrer=

Kitchenham, B., & Charters, S. (2007). Guidelines for performing Systematic Literature reviews in Software Engineering Version 2.3. Engineering,. *Engineering, 45*(4ve), 1051. doi:http://doi.org/10.1145/1134285.1134500

Lin, Y. M., Arshad, N. H., Haron, H., Wah, Y. B., Yusoff, M., & Mohamed, A. (2010). IT governance awareness and practices: An insight from Malaysian senior management perspective. *Journal of Business Systems, Governance and Ethics, 5*(1), 43-57.

Mohamad, S., Hendrick, M., O'Leary, C., & Best, P. (2014). Developing a Model to Evaluate the Information Technology Competence of Boards of Directors. *Corporate Ownership and Control, 12*(1). doi:10.22495/cocv12i1p4

Moradi, M., Aghaie, A., & Hosseini, M. (2013). Knowledge-collector agents: Applying intelligent agents in marketing decisions with knowledge management approach. *Knowledge-Based Systems, 52*, 181-193.

Mudaliar, A., Garde, V. D., & Sharma, D. P. (2009). Educational resource planning-A framework for educational institutions. *Second International Conference on Emerging Trends in Engineering and Technology, ICETET-09*, 488-493.

Musa, N., Abang Ibrahim, D. H., Bolhassan, N. A., Abdullah, J., Kulathuramaiyer, N., & Khairuddin, M. N. (2014). An IT governance framework for achieving the development of academic programme in

higher institutions: A case of Universiti Malaysia Sarawak (UNIMAS). *International Conference on Information and Communication Technology for the Muslim World*. doi:http://doi.org/10.1109/ICT4M.2014.7020673

Petersen, K., Feldt, R., Mujtaba, S., & Mattsson, M. (2008). Systematic Mapping Studies in Software Engineering. *12th International Conference on Evaluation and Assessment in Software Engineering (EASE), 8*, 68-77. doi:http://doi.org/10.1142/S0218194007003112

Qualtrough, E. (2016). How are organisations and Chief Information Officers bringing about IT and business alignment?

Sabegh, M. A. J., & Motlagh, S. M. (2012). The role and relevance ot ITG and IT capability *Business and Management Review, 2*(6), 16–23.

Sukhoo, A., Barnard, A., & Eloff, M. (2005). Accommodating soft skills in software project management. *Issues in Informing Science and Information Technology,*(2), 691–703.

Weill, P. (2004). Don't just lead, govern: How top-performing firms govern IT. *MIS Quarterly Executive, 3(1)*, 1-17.

Weill, P., & Ross, J. W. (2004). IT governance: How top performers manage IT decision rights for superior results.

Wieringa, R., Maiden, N., Mead, N., & Rolland, C. (2006). Requirements engineering paper classification and evaluation criteria: a proposal and a discussion. . *Requirements Engineering, 11*(1), 102-107.

Yaakob, M., Tarmizi, M. A. A., Yunus, B., Ghani, Z. A., & Mokhtar, M. Z. (2009). Directions and challenges of private institutions of higher learning in Malaysia : A holistic approach from the perspective of Universiti Tenaga Nasional (UNITEN). *Asaihl*, 126–131.