THE EFFECT OF ICT INVESTMENT, ICT GOVERNANCE MECHANISMS, BOARDS WITH DIVERSE ICT EXPERTISE AND OWNERSHIP STRUCTURES ON FIRM PERFORMANCE

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ABSTRACT

This thesis examined the effects of ICT investment, ICT governance mechanisms, boards with diverse ICT expertise, and ownership structures on firm performance of Malaysian technology sector in the Malaysian Public Listed Companies from 2010 until 2014. This study employed the balanced panel data for a sample of 33 listed companies, with 165 observations. A dynamic model was built and estimation was carried out by using the System Generalized Method of Moments (SGMM). As predicted, ICT investment incurred in the current year displayed a significantly negative impact upon ROE. Even though ICT investment failed to exhibit a significantly positive effect upon firm performance during the initial period of spending, the findings portrayed that ICT spending in current year had the ability to positively influence Tobin's Q. In fact, ICT investment incurred in the lag of a year showed significantly positive impact on Tobin's Q. In terms of ICT governance mechanisms, the presence of ICT governance committee had been found to have a significantly negative effect on ROA, ROE, and Tobin's Q, whereas the presence of ICT senior management showed significantly positive effect upon Tobin's Q. The boards with ICT industrial experiences displayed a positive effect upon ROA, ROE, and Tobin's Q, but a significantly negative effect was discovered for boards with ICT professional qualifications on Tobin's Q. As for ownership structures, managerial ownership exhibited significantly positive effect on Tobin's Q, but negatively on ROA. Furthermore, the government and foreign ownerships were found to have significantly positive effect on ROA. Hence, the findings from this study are indeed beneficial not only for all stakeholders, including policymakers, regulators, and academics; but also for board of company and management level in ascertaining that their ICT implementation is properly governed under appropriate ICT standards.

Keywords: ICT investment, ICT governance, board diversity, ownership structures, firm performance

ABSTRAK

Tesis ini mengkaji kesan pelaburan ICT, mekanisme tadbir urus ICT, lembaga dengan pelbagai kepakaran ICT dan struktur pemilikan terhadap prestasi firma sektor teknologi Malaysia di Syarikat Awam Tersenarai Malaysia dari tahun 2010 hingga 2014. Kajian ini menggunakan data keseimbangan panel bagi sampel daripada 33 buah syarikat tersenarai, dengan 165 pemerhatian. Model dinamik dibina dan anggaran dilakukan menggunakan Sistem Kaedah Umum Momen (SGMM). Seperti yang diramalkan, pelaburan ICT yang berlaku pada tahun semasa menunjukkan kesan negatif terhadap ROE. Walaupun pelaburan ICT gagal menunjukkan kesan positif yang signifikan terhadap prestasi firma semasa tempoh awal perbelanjaan, hasil kajian menunjukkan bahawa perbelanjaan ICT pada tahun semasa mempunyai keupayaan untuk mempengaruhi *Tobin's Q* secara positif. Bahkan, pelaburan ICT yang berlaku pada lag setahun menunjukkan kesan positif yang signifikan terhadap *Tobin's Q*. Dari segi mekanisme tadbir urus ICT, kehadiran jawatankuasa tadbir urus ICT didapati mempunyai kesan negatif yang signifikan terhadap ROA, ROE, dan *Tobin's Q*, sedangkan kehadiran pengurusan senior ICT menunjukkan kesan positif pada *Tobin's Q*. Lembaga dengan pengalaman industri ICT menunjukkan kesan positif terhadap ROA, ROE, dan *Tobin's Q*, tetapi kesan negatif yang signifikan ditemui bagi lembaga dengan kelayakan profesional ICT pada *Tobin's Q*. Bagi struktur pemilikan pula, kepemilikan pengurusan mempamerkan kesan positif yang signifikan terhadap *Tobin's Q*, tetapi negatif terhadap ROA. Selain itu, kerajaan dan kepemilikan asing didapati mempunyai kesan positif yang signifikan terhadap ROA. Oleh itu, penemuan kajian ini memang bermanfaat bukan sahaja untuk semua pihak yang berkepentingan, termasuk penggubal dasar, pengawal selia, dan ahli akademik, tetapi juga untuk lembaga syarikat dan peringkat pengurusan dalam memastikan bahawa pelaksanaan ICT mereka disusun dengan baik di bawah piawaian ICT yang bersesuaian.

Kata kunci: pelaburan ICT, tadbir urus ICT, kepelbagaian lembaga, struktur pemilikan, prestasi firma

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LIST OF ABBREVIATIONS

4G	Fourth generation
ACA	Accelerated Capital Allowance
ADICTG	The adoption of ICT governance standards and frameworks
ASC	Architecture Steering Committee
BOC	Boards of commissioner
BSIZE	Board size
CAGR	Compound Annual Growth Rate
CEO	Chief of Executive
CGEIT	Certification of Governance of Enterprise IT
CGICT	Corporate governance of ICT
CIFI	Computer Information Forensics Investigator
CIO	Chief Information Officer
CISA	Certification of Information Systems Auditor
CISM	Certification of Information Security Manager
CISSP	Certified Information Systems Security Professional
CNIIs	Critical national information infrastructures
COBIT	Control Objectives for Information and Related Technologies
COGS	Cost of goods sold
CRISC	Certification of Risk and Information Systems Control
CSO	Chief Security Officer
CTO	Chief Technology Officer
DGMM	Difference GMM
DOS	Malaysian Department of Statistics
DPM	Dynamic panel model
EAITs	Earnings after interest expenses and taxes
EBITs	Earnings before interest expenses and taxes
EGIT	Enterprise Governance of IT
EPF	Employee Provident Funds
ERP	Enterprise Resource Planning
FDI	Foreign direct investment
G7	Group of Seven
GCFs	Government-controlled funds
GDP	Gross domestic product
GLCs	Government Linked Companies
GLICs	Government Linked Investment Companies
GMM	Generalized Method of Moments
GOCs	Government-Owned-Corporations
HDI	Human Development Index
IAS	International Accounting Standards
IASB	International Accounting Standards Board
IC	Intellectual capital
ICT DR	ICT Disaster Recovery Services
ICT	Information and communication technology
ICTC	Information and Communications Technology Council
ICTSC	ICT Security Committee
IEC	IEC the International Electrotechnical Commission

IFRS	International Financial Reporting Standard
IP	Intellectual Property
IPSC	ICT Project Steering Committee
IRRC	Investor Responsibility Research Center
IS	Information security
ISACA	Information Systems Audit and Control Association
ISC	International Information Systems Security Certification Consortium
ISMS	Information Security Management System
ISO	International Organization for Standardization
IT	Information technology
ITAA	Information Technology Association of America
ITGI	IT Governance Institute
ITIL	Information Technology Infrastructure Library
ITIM	ICT investment management
ITSM	IT Service Management
KWAP	Kumpulan Wang Amanah Pencen
LII	Legal Information Institute
MAMPU	Malaysia Administrative Modernization and Management Planning Unit
MASB	Malaysian Accounting Standard Board
MCCG	Malaysian Code on Corporate Governance
MIP	Intellectual Property Management and Digital
MKD	Menteri Kewangan (Diperbadankankan)
MOSTI	Malaysian Ministry of Science, Technology and Innovation
MPLCs	Malaysian Public Listed Companies
MPSD	Malaysian Public Service Department
MSC	Malaysian status companies
MSIC	Malaysia Standard Industrial Classification
MTB	Market-to-book value ratio
MyBOL	My Benefits Online
NACD	National Association of Corporate Directors
NEP	New Economic Policy
OECD	Organization for Economic Co-Operation and Development
OLS	Ordinary Least Square
PIKOM	National ICT Association of Malaysia
PNB	Permodalan Nasional Berhad
R&D	Research and development
SALGA	South African Local Government Association
SC	Securities Commission Malaysia
SEC	Securities and Exchange Commission
SFA	Stochastic frontier analysis
SGMM	System Generalized Method of Moments
SOEs	State-Owned Enterprises
T&D	Training and development
TRBC	Thomson Reuters Business Classification
U.S. GAO	United States General Accounting Office
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nation Development Programme
VAGO	Victorian Auditor-General's Office

APPENDICES

CHAPTER ONE

INTRODUCTION

1.1 Overview of the Chapter

This chapter begins with background of the information technology infrastructure development in Malaysia. Then, it is followed by the problem statement and justification, the purpose of the research and the main objectives and the significance of the study. The main questions which are investigated within scope of research are introduced. Finally, the contribution and overview of entire thesis are presented.

1.2 Background of the Study

The rapid growth of the information technology (IT) industry in Malaysia occurring in business environment has been prominent in South East Asia over the last few years due to the vast advancement of IT evolution. Convergence and reinforcement of information, cloud, mobile and other social elements (Carlton, 2012) are supported by a wide range of latest multi facet technological capabilities including seamless communication, speed, wireless, the development of technological innovations and sophisticated of various software and hardware. This technological advancement has been seen as a good opportunity and competitive advantage for the industry to further develop the information and communication technology (ICT) usage. In general, the advancement in Information Technology (IT) has brought about countless positive effects upon the progress of many sectors in Malaysia by shaking up the entire world market structures, landscapes of business, consumer behaviour, and people's lifestyles.

In fact, the great massive progress in the area of IT has become more of a necessity rather than a facility. This is because; the modern technology is indeed hassle-free for everyone worldwide with access to active IT innovations. Hence, it is not surprising if countries, including Malaysia, have contributed a lot of funds to the IT development primarily to intensify the modern lifestyles of people, indirectly leading to a significant increased in demand for ICT products and services to boost economic development. Moreover, the penetration of IT into various types of sophisticated technologies has accelerated the economic growth in Malaysia. Furthermore, the Malaysian government has offered varied incentives to attract more companies, both within and outside the country, to generate greater IT investment, mainly to boost the economic development in Malaysia.

ICT is an important component to numerous business organizations. Besides, survival and the ability to achieve goals can become difficult if the execution is not supported by the extensive use of IT in this present environment. Due to this situation, many organizations have decided to invest in ICT for it may give many benefits to these companies in the long run (Mohd Noor & Apadore, 2014). This statement, nonetheless, is supported by the literature because several reasons have been listed by some organizations for investigating in ICT (Ashrafi & Murtaza, 2008; Brynjolfsson, 1994; Brynjolfsson, 1993). Apart from the need to create wealth for organization, as well as to improve output levels in production and service delivery; ICT investments also open up opportunities to them to produce quality products and services, besides controlling communication activities in order to achieve customer satisfaction.

Additionally, business organizations invest in ICT because it is among the many necessities of doing business driven by changes in the industry level (i.e. rapid changes in information and stiff competition) (Mohd Noor & Apadore, 2014). Besides, some stated that investment in ICT assets is also a particularly marked contribution to the economic growth across the Group of Seven (G7) economies in the late 1990s (Colecchia & Schreyer, 2002; Schreyer, 2000), which enhanced productivity, competitiveness, and citizen engagement (Kodakanchi, Abuelyaman, Kuofie, & Qaddour, 2006).

Nevertheless, the issue of whether the level of ICT investments can bring real benefits to the firms is still questionable. With that, an economist, Nobel Laureate Robert Solow, labelled that the phenomena of ICT productivity paradox occur due to weaknesses in IT resources management control, which contribute to the failure of achieving target from returns on IT investments. This phenomenon takes place when large investments in IT, has apparently failed to enhance the performance exerted by firms' in the 1980s. Meanwhile, in the early 1990s, the second productivity paradox was examined at the firm level and revealed nil correlation between IT investment and firms' profitability (Strassman, 1990).

Recent study has proved that ICT investment, by itself, is not strong enough to enhance the performance of firm, unless if its implementation is in conjunction with other factors that have to be weighed in to influence firm performance. With the emergence of ICT today, along with dynamic business environments, greater ICT investments have been expected to generate better profitability among firms. As such, this particular research, believes that in-depth comprehension can be attained by introducing several significant factors for their exceptional effects, especially within the context of corporate governance factors.

Therefore, the primary aim of this research is to shed more light on the effect of ICT investment and several corporate governance factors on firm performance. Furthermore, in the light of ICT investment, the related evaluation weighs in time-lagged effect before the advantages of ICT investment could bring some positive effects on firm performance (Yaylacicegi & Menon, 2004). A number of corporate governance elements, for instance, ICT governance, boards with diverse of ICT expertise, and ownership structures, are introduced and applied in this study so as to protect investments made by shareholders and overall firm performance (Shleifer & Vishny, 1997). Moreover, the aspects of corporate governance like ICT governance, boards with diverse of ICT expertise and ownership structures have been developed based on several theories, for instance, Theory of Agency and Theory of Resource Dependency.

The Malaysian technology sector had been selected as the sample for this study, mainly because this particular sector has been identified by the National ICT Association of Malaysia (PIKOM) as the sector that is closely related to ICT usage, in comparison to other industries (PIKOM, 2014; 2013; 2012). Besides, since the nature of this sector is highly engaging with ICT equipments, the efficiency of the board within the ICT field is seen as one that is crucial, especially for ICT investment decision-making and its related governance process. Thus, if the board fails in conducting ICT governance in an effective manner, their limitation may potentially decrease firm performance due to issues related to agency that arise in the company.

As the companies try to improve business strategies through their better conduct of ICT governance, the need for ICT expertise among board members is also seen as important driver for the company's growth. Beyond the need to support ICT development at the management level, companies are facing the need to increase the ICT expertise at the board level as well. The role of board members with diverse of ICT expertise including ICT educations, ICT professional qualifications, ICT job experiences and ICT-related trainings is crucial in order to bring about changes in the boardroom culture and to better understand the risks and opportunities the technology provides especially in the boardroom discussion. However, past evidences have shown that many boards simply do not have adequate expertise to assess the issues and make decisions about ICT strategy, investment and how to best allocate ICT resources.

Once business goals have been established, the business strategies are developed. Apart from the important need of the ICT governance implementation and having boards with diverse of ICT expertise, the other corporate governance factor such as ownership structures would also be considered in this study since they play an important role in providing sufficient capital for companies' growth. Past researchers have also argued that the ownership structures have the ability to enhance the firm performance through their important impacts on firm's strategies, including investment decision, compensation schemes, management successions (Hu & Izumida, 2009), financial resources, technology expertise, as well as technical support for ICT development (Choi, Park, & Hong, 2012; Uwuigbe & Olusanmi, 2012).

In this case, the Resource Dependence theory compliments to the Agency theory in mitigating the issues associated to agency by taking in boards with diverse expertise, especially those in the ICT field, in order to offer beneficial resources to the company in terms of advice, legitimacy, as well as external information (Carter, D'Souza, Simkins, & Simpson, 2010; Hillman, Cannella, & Harris, 2002; Preffer & Salancik, 1978) that may enhance firm performance (Rose, Munch-Madsen, & Funch, 2013). Furthermore, from the insights of Agency theory and Resource Dependence theory, this study examined the effect of ICT investment, ICT governance mechanisms, boards with diverse ICT expertise, and ownership structures on firm performance in the Malaysian technology-based sector.

1.3 Problem Statement

Investments in ICT normally reflect high provision (Meliville, Kraemer, & Gurbaxani, 2004) ICT has been widely acknowledged as a source of competitive advantage (Sirirak, Islam, & Khang, 2011). In general, ICT investments are meant to harness ICT potentials, as an essential enabler in guiding organizations to boost their business productivity and financial performance. In precise, the smart use of ICT enhances the performance of firms, besides generating good returns to organizations (Bates, Holton, & Seyler, 1996). Moreover, prior studies have displayed significantly positive effect between ICT investments and firm performance (Arabyat, 2014; Makinde, 2014; Romdhane, 2013; Hung, Yen, & Ou, 2012; Leckson-Leckey, Osei, & Harvey, 2011; Gaith, Khalim, & Ismail, 2008; Chari, Devaraj, & David, 2008; Jun, 2008; Shin, 2006; Yaylacicegi & Menon, 2004; Anderson, Banker, & Hu, 2003; Brynjolfsson & Hitt, 2003; Brynjolfsson & Hitt, 1996; Brynjolfsson & Hitt, 1993). Unfortunately, some empirical evidence has failed to support the logic behind such expectations, in which these gaps have to be filled.

Besides, although numerous empirical studies have proven either significant or positive correlation between ICT investments and firm performance, the phenomenon of ICT paradox still persists. In addition, from many other on-going and evolving researches, Malaysia has proven that although huge ICT investments have been made, numerous ICT projects have yet to prove their success (Meng, Samah, & Omar, 2013). For example, Goh Thean Eu, a journalist from the Digital News Asia (2015) and Bernama (2012), reported recent cases of failure in Malaysian ICT projects, which involved losses of millions of Ringgit. Besides, recent studies have also revealed several cases of ICT failure in other nations with cutting-edge ICT development, such as the U.S. (Standish Group, 2013; Flyvbjerg & Budzier, 2011), European countries (Standish Group, 2013), the U.K. (Solon, 2015; Flyvbjerg & Budzier, 2011), and Australia (Victorian Ombudsman, 2011). For example, the Standish Group ―CHAOS Summary 2012" carried out a survey and discovered more than half of the ICT projects in the ICT sector have failed or challenged. On the other hand, Robert Goatham (2009), who is the Principal of Calleam Consulting Ltd; and a leading expert in the field of Project Management, stressed the fact that high failure rates of ICT projects within the ICT sector had been considerably higher than the other types of engineering projects. In fact, some complexities were identified to have inhibited the effective implementation of ICT, such as low barriers to enter into the profession, lack of governing body, obstacles to develop expertise, as well as the often low levels of investment meant for training.

Furthermore, many empirical studies have highlighted various types of critical factors that contribute to the failure of ICT implementation, including, lack of user involvement, lack of skills and knowledge in project management, incompetent ICT decisions at the top management level, as well as inadequate ICT resources (Standish

Group, 2013; Nawi, Rahman, & Ibrahim, 2012; Al-Ahmad, et al., 2009). Besides, prior researches have classified the contributing factors to cases of ICT failure into several categories, such as project management, top management, technology, organization, complexity, and process (Nawi et al., 2012; Al-Ahmad, et al., 2009), which are closely related to the role of and actions taken by human factor. On top of that, the limitation of human factor in managing ICT leads to failure in implementing ICT, hence causing decrease in firm performance. This is because; effective ICT management aids firms in enhancing their performance (Bates et al., 1996), thus it is vital that its implementation is in line with the best corporate governance practices so as to ensure that investment in ICT can indeed lead to better firm performance (SALGA, 2012). However, one critical issue that has been highlighted in corporate governance dealing at the present time is related to board diversity (Deloitte, 2015; Leblanc, 2015). Moreover, issues that revolve around the capabilities of the board in handling ICT related matters are often claimed as a major contributing factor to failure of ICT implementation (Birmingham, 2015; Cohn & Robson, 2011; Nolan & McFarlan, 2005). Furthermore, as boards play a vital role in all decisions linked to strategic planning of ICT in firms, undue reliance on management capabilities in handling ICT would drag the principal-agent relationship to issues related to agency problems. Thus, boards should realize the significance of having board members with diverse expertise, especially in ICT, to help firms improve their performance.

In fact, the notion of corporate governance has been in the limelight when associated to the present ICT challenges. Besides, despite of the issue of having boards with diverse ICT expertise, the effect of ICT governance on firm performance has yet to be explored (Lazic, Groth, Schillinger, & Heinzl, 2011a; Lazic, Heinzl, & Neff, 2011b; De Haes & Van Grembergen, 2009) as its adoption is rather low, particularly within the Malaysian practices (Kaur, Mohamed, & Ahlan, 2012; Othman, Chan, & Foo, 2011; Teo & Tan, 2010). Moreover, firms would face risk without ICT conduct, which could eventually affect the performance of firms (U.S. GAO, 2015; Kaur et al., 2012; Van Grembergen & De Haes, 2010). Another common issues highlighted in the corporate governance literature is ownership structure, as studies have proven that ownership structure is a serious concern in the field of corporate governance due to its impact on firm performance (Srivastava, 2011). In addition, prior studies showed that the firm performance could be enhanced by effective control via firm ownership structures, especially within the context of investment decisions (Hu & Izumida, 2009). Moreover, Sulong and Nor (2008) indicated that the benefits derived from firm performance could differ across firms as their incentives are varied with respect to their type of ownership structure.

Additionally, prior studies have investigated the impact of some ownership structure variables, such as concentrated ownership (Basyith, Fauzi, & Idris, 2015; Lee & Lee, 2014; Zakaria, Purhanudin, & Palanimally, 2014; Mule, Mukras, & Oginda, 2013; Alimehmeti & Paletta, 2012; Darmadi, 2012; Fauzi & Locke, 2012; Wahla, Shah, & Hussain, 2012; Garcı´a-Meca & Sa´nchez-Ballesta, 2011; Sulong & Mat Nor, 2010; 2008; Ganguli & Agrawal, 2009; Tam & Tan, 2007; Haniffa & Hudaib, 2006; Demsetz & Lehn, 1985), managerial ownership (Basyith et al., 2015; Nath, Islam, & Saha, 2015; Zakaria et al., 2014; Fauzi & Locke, 2012; Uwuigbe & Olusanmi, 2012; Wahla et al., 2012; Din & Javid, 2011; Sulong & Mat Nor, 2010; 2008; Haniffa & Hudaib, 2006), government ownership (Musallam, 2015a; 2015b; Tran, Nonneman, & Jorissen, 2014; Zakaria et al., 2014; Menon & Ng, 2013; Phung & Hoang, 2013; Goh, Khan, & Rasli, 2013; Najid & Rahman, 2011; Mohd Ghazali, 2010; Sulong & Mat Nor, 2010; 2008; Lau & Tong, 2008; Tam & Tan, 2007), and foreign ownership

(Musallam, 2015b; Zakaria et al., 2014; Phung & Hoang, 2013; Darmadi, 2012; Uwuigbe & Olusanmi, 2012; Mohd Ghazali, 2010; Sulong & Mat Nor, 2010; 2008; Lau & Tong, 2008) on firm performance. Nonetheless, this particular research discovered a glaring gap as the effects of ownership structures on firm performance have yet to be looked into from the light of technology sector. This study, thus, is definitely relevant for it contributes to the existing knowledge pertaining to the area of corporate governance.

Even though numerous empirical studies have contributed to the effect of ICT investment on firm performance, the aspects of corporate governance have been scarcely examined (e.g. ICT governance mechanisms, boards with diverse ICT expertise and ownership structures) although its function is rather essential in influencing firm performance, especially for the Malaysian technology sector. With that, this study examined the effect of ICT investment and several corporate governance aspects, such as ICT governance mechanisms, boards with diverse ICT expertise, and ownership structures on firm performance within the context of Malaysian study.

1.4 Research Questions

The research questions developed for this study are listed in the following:

1) What is the extent of ICT investment in the Malaysian technology-based sector?
2) Does ICT investment have a significant effect on firm performance in the Malaysian technology-based sector?
3) Do ICT governance mechanisms (process and structures) have significant effects on firm performance in the Malaysian technology-based sector?

4) Do boards with diverse ICT expertise (ICT education background, ICT professional qualifications, ICT industrial experiences, and ICT-related trainings) have significant effects on firm performance in the Malaysian technology-based sector?
5) Do different types of ownership structures (concentrated ownership, managerial ownership, government ownership, and foreign ownership) have significant effects on firm performance in the Malaysian technology-based sector?

1.5 Research Objectives

The objectives of this study are given in the following:

1) To examine the extent of ICT investment in the Malaysian technology-based sector.
2) To examine the significant effect of ICT investment on firm performance in the Malaysian technology-based sector.
3) To examine the significant effects of ICT governance mechanisms (process and structures) on firm performance in the Malaysian technology-based sector.
4) To examine the significant effects of each board with diverse ICT expertise that is comprised of boards with ICT education background, boards with ICT professional qualification, boards with ICT industrial experiences, and boards with ICT related-trainings on firm performance in the Malaysian technology-based sector.
5) To examine the significant effects of different types of ownership structures that are comprised of concentrated ownership, managerial ownership, government ownership, and foreign ownership on firm performance in the Malaysian technology-based sector.

1.6 Research Motivation and Contribution

Advancement in ICT has been proven to bring many positive changes to firm performance. Significantly, as the global information and knowledge economies have emerged to be crucial, a majority of businesses, industries, and individuals rely on ICT to smoothen business processes towards improvising their business performance. Therefore, in order to determine the effect of ICT investments on firm performance, the importance of such investments has to be determined if they exhibit a positive effect on firm performance. Moreover, the sole purpose of ICT investment is to improve firm performance, and on the other hand, failings to achieve the outlined investment objectives can affect performance to generate more profitably and efficient.

Even though studies concerning ICT have extensively investigated the effect of ICT investment on firm performance in various industries, such as financial institutions, manufacturing, mixed industries and others; only one study had been found by the researcher to have examined the effect of ICT on the performance of Malaysian construction sector (Gaith et al., 2008), while some past studies have looked into the effect of ICT investment on firm performance in ICT and telecommunication sector (Anderson et al., 2003). In precise, the effect of ICT investment on firm performance has yet to be unravelled, especially within the context of Malaysia. Therefore, examining the effect of ICT investment on the performance of firms in the Malaysian technology-based sector is deemed to iron out issues related to failure of ICT projects within the ICT sector (Goatham, 2009), mainly because of its business nature that is more attributable to the nature of ICT sector, which is closely linked to ICT components (TRBC[1], 2015; PIKOM, 2014; 2013; 2012). As a main precursor in the ICT field, companies in the Malaysian technology sector must prove that ICT investment does open door to opportunities of greater improvisation for future firm performance. Besides, huge investments demand adequate ICT management strategy. As such, an investment project could be successful if the execution of complex projects is accompanied by other elements from the corporate governance best practice mechanisms. In fact, one without the other impairs the probability of continuous success. Furthermore, strong mechanisms of corporate governance like ownership structures, and other elements related to ICT, do matter, for instance, ICT governance mechanisms and boards with diverse ICT expertise that have been believed to influence firm performance in a positive manner, especially within the Malaysian context.

In specific, this paper contributes to the ICT and corporate governance literature in certain ways. First, this study adds to the ICT and corporate governance literature as its focus is placed in examining the effect of ICT investment, as well as other corporate governance elements, such as ICT governance mechanisms, boards with diverse ICT expertise, and ownership structures, on firm performance. Furthermore, despite of the legislative reforms on corporate governance structure, studies of ICT investment, ICT governance, and firm performance have remained unexplored, especially among developing nations like Malaysia. Such investigation should offer interesting evidence on the aspect of corporate governance area. Moreover, the study on the effect of ICT investment and corporate governance elements, especially ICT governance best practice in Malaysia is still relatively low and calls for further action

[1] TRBC refers to the Thomson Reuters Business Classification.

by weighing in its significant effect on firm performance, resulting from ICT implementation.

Second, numerous past studies have examined the effect of ICT investment in various industries, the ICT sector has been scarcely looked into. In addition, the usage of ICT has been dominantly utilized by ICT or the technology sector for it is closely linked to ICT equipment (TRBC, 2015; Paytas & Berglund, 2004). Moreover, due to the varied nature of ICT usage among different industries (Van Grembergen & De Haes, 2010; De Haes & Van Grembergen, 2004), acknowledging these factors, especially within the context of Malaysian technology-based sector, which is identifed as one of the main ICT core-based companies in Malaysia, is indeed essential in examining the effect of ICT investment on the performance of firms in the sector. With that, this study highlights a specific sector study, i.e. firms in the Malaysian technology-based sector, to provide better comprehend the effect of ICT investment on technology-based firm performance. With such specific topic within a particular industry, this study offers in-depth understanding towards the examined issues.

Third, the Resource Dependence theory depicts that the acquisition of ICT resources is seen as a mechanism of survival and growth for firms (Pfeffer & Salancik, 1978), while boards of directors play a crucial role to ensure maximum investment returns of ICT for company benefits. Nevertheless, the issue of boards‘ capabilities in managing ICT has often been disputed, maninly because their lagging ICT competency has been ruled out as a contributing factor to failure of ICT implementation. Hence, such notion has induced boards to undue depend on management competencies in making ICT-related decisions. Furthermore, based on the Agency theory, undue reliance of boards upon management competencies can potentially lead to agency issues. Meanwhile, the

Resource Dependence theory suggests a way to overcome the issue of lack of ICT competence among boards by bringing in diverse boards with ICT expertise into being board members themselves. Hence, these two theories depict that by having, board members with diverse ICT expertise; a firm can gain greater insights due to their contribution for better ICT management, which could lead to enhanced performance.

Fourth, this study also addresses the issue related to corporate governance best practices that specifically focus on ICT-related matters within the Malaysian technology-based sector. Furthermore, due to the various types of problems faced by firms in governing ICT (e.g. lack of knowledge, as well as lack of expertise and experiences) on how certain technologies like cloud, analytics, social media, and mobile can be beneficial, the best practice of ICT governance had been examined in this study. Furthermore, this best practice of ICT governance mainly focuses the significance of ICT governance standards adoption, as well as the effect of this adoption upon firm performance. Besides, the issue of board diversity in the present corporate governance practice has also been highlighted by experts, mainly in mitigating problems related to ICT conduct in firm (Deloitte, 2015; Leblanc, 2012). In addition, the revised Malaysian Code of Corporate Governance 2012 asserts on the need among non-executive directors to possess diverse skills and experience so as to bring good and independent judgement during boardroom discussion. Besides, other factors like, skills, knowledge, expertise, and experience of candidates have to be taken into account so that the selected directors could carry out their functions in a more effective manner. Besides, researches concerning the adoption of ICT governance standards and framework are still scarce (Kaur et al., 2012; Othman et al., 2011; Teo & Tan, 2010), as well as the composition (diversity) of board of directors, which has been considered as a vital element of corporate governance codes among all jurisdictions.

As such, this paper adds to the literature of ICT governance standards within the context of Malaysian study, narrowed to firms in the Malaysian technology-based sector. Besides, this study placed its focus on board diversity, which specifically addresses criteria for boards with diverse ICT expertise, such as ICT educational background, ICT professional qualification, ICT industrial experiences, and ICT-related trainings. Nonetheless, these various criteria of boards with diverse ICT expertise have yet to be examined, thus the contribution of this part of the study, hopefully could further elaborate the effect of boards with diverse ICT expertise on firm performance in the Malaysian technology-based sector.

Fifth, despite of the fact that extensive literature has highlighted the role of ownership structure in corporate governance worldwide (La Porta, Lopez-de-Silanes, & Shleifer, 1999; Shleifer & Vishny, 1997), scarcity is noted in past empirical researches in examining the impact of ownership structure on technology-based firm performance, especially within the context of Malaysia. Moreover, as the effects of ownership structures have never been tested; this study intends to extend the existing literature by examining the effects of ownership structures on firm performance, especially within the context of Malaysian technology-based sector. Lastly, this particular study contributes to a dynamic multiple regression model that is comprised the elements of lagged years of ICT investment since ICT investment does not immediately influence firm performance and it takes several years to payoff, several corporate governance variables, and lagged values of dependent variable as an independent variable. Additionally, as ICT alone is inadequate to enhance firm performance, several variables of corporate governance, for instance, ICT governance mechanisms, boards with diverse ICT expertise, and ownership structures, have been introduced in this study.

1.7 Scope of the Study

This study has placed its focus on examining the effect of ICT investment and other corporate governance variables, such as ICT governance mechanisms, boards with diverse ICT expertise, and ownership structures on firm performance in the Malaysian technology-based sector. The particular sector had been selected based on the evidence found in prior studies, in which failure of ICT projects has contributed to the declining performance in the ICT sector (Goatham, 2009). Nevertheless, there is no specific ICT sector is listed in the Bursa Malaysia. To this end, the study, basically, covers firms in the Malaysian technology-based sector listed in the Malaysian Public Listed Companies (MPLC) as this sector is closely related to the ICT sector (TRBC, 2015; PIKOM, 2014; 2013; 2012). As such, the study sample is comprised of 33 firms in the Malaysian technology-based sector with 165 observations in 5 periods from 2010 until 2014. Next, secondary data analysis was performed using published annual reports retrieved from 2010 to 2014 obtained from the MPLC website. Furthermore, a dynamic model had been developed as the element of lagged dependent variable of firm performance is introduced in the right equation of the model built in this study. In specific, the estimation method of System Generalized Method of Moments (SGMM) had been employed as it has been identified as the most appropriate estimation method to examine the dynamic model introduced in this study.

1.8 Organization of the Study

This study is organized into five chapters including the Introduction. Details of the remaining chapters are described as follows: The Literature Review of this study will be discussed under two chapters that have been classified in accordance with specific topics, namely, Chapter Two focuses on a review of Firm Performance and Information and Communication Technology (ICT) Investment literature, Chapter Three focuses on a review of Corporate Governance of ICT literature. Meanwhile, Chapter Four describes the research framework and hypotheses to answer the research questions based on the extensive review of literature and problem statement. Overview of sample and data collection as well as measurement used for variables is also provided. The remainder of this chapter outlines briefly the regression model and it ends with a summary for section.

CHAPTER TWO

LITERATURE REVIEW OF FIRM PERFORMANCE AND INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) INVESTMENT

2.1 The Concept of Firm Performance

The concept of firm performance refers to a very broad concept and many researchers in the field of firm performance have exclaimed various views regarding its definition. Nonetheless, a definite definition that describes the term ―performance” is absent from the literature. For instance, Venkatraman and Ramanujam (1986) provided elaborated interpretation of performance and success by associating this term to the effectiveness of a company. Besides, their definition regarding business performance refers to a subset of organizational effectiveness that includes financial and operational (non-financial) performance indicators, quantified by the introduction of new products, assertion of product quality, as well as exceptional marketing effectiveness. Besides, Stannack (1996) referred the term ‗firm performance' as multi-dimensional measurements, for example, transactional, input, and output efficiency. Meanwhile, Bourguignon (1998) conceptualized performance into performance result (comparison between the result obtained and the objective set), performance action (commitment towards achieving results), and performance success.

In addition, firm performance is also expressed as the ability of firms to deliberately use available resources in pursuit of specific business goals (Wade & Ricardo, 2001), as well as to enhance competitive advantage (Almajali, Alamro, & Al-Soub, 2012; Iswatia & Anshoria, 2007). In fact, the three types of elements emphasized by Cascio

(2006) while defining performance can be characterized via setting and assessing towards goals, facilitating performance by providing adequate resources, staffing effectively, and removing possible blocks that can hinder firms to succeed, whilst an encouraging performance provides employees with extrinsic rewards.

Over time, the notion of firm performance is transformed into a more inclusive concept because it emerges as a part of firm‘s strategy (Neely, 2007) to pursue growth. Furthermore, in most studies, performance is treated as an aggregate firm-level outcome or a dependent variable, which could be operationalized in many ways, ranging from financial and market-based indicators to dimensions of social performance (Orlitzky, Schmidt, & Rynes, 2003)[2].

2.2 Determinants of Firm Performance and Justification of Its Measurements

A large body of past literatures has attempted to investigate various factors that ascertain firm performance. This issue has emerged as a central question in strategic management studies and have gained significant attention among researchers in the area of firm performance. Moreover, the analysis of the determinants of firm performance is indeed vital for all stakeholders, especially among investors because a well-performing firm will definitely bring good returns on their investments. Other than that, several chronological literature studies have revealed completely contradicting effects of influential factors in the firm performance research field, inclusive of the following issues: firm age, firm size (Hatem, 2014; Almajali et al, 2012), capital intensity (Shiamwama, Ombayo, & Mukolwe, 2014; Mirza & Javed,

[2] Firm performance can not only be influenced by the strategies and operations in the market, but also through non-market environments, such as reputation that represents an aspect of corporate social performance (CSP). It is argued that CSP also can be part of companies‘ strategy for attaining their strong corporate financial performance (Orlitzky et al., 2003).

2013), human resources (skills) (Shiamwama et al., 2014; Ahmad & Schroeder, 2003), firm leverage and liquidity(Almajali et al., 2012), ownership structure (Shiamwama et al., 2014; Mirza & Javed, 2013), corporate governance (Shiamwama et al., 2014; Al-Matari, Al-Swidi, & Fadzil, 2014; Mirza & Javed, 2013; Almajali et al., 2012; Ibrahim & Abdul Samad, 2011), and technological factor (Shiamwama et al., 2014), to name a few. Meanwhile, as for the influential factors of firm performance, this extensive literature study suggests two major streams: the first factor highlights the importance of Information and Communication Technology (ICT) that represents technological factor, while the second concentrates on corporate governance as an important driving force that improves firm performance. However, some attention has been given to ICT elements in describing the factors of corporate governance.

Furthermore, varieties of ways are available to measure firm performance. This broader measure of firm performance is continually debated among researchers, thus emerging as the subject with best interest among academics. In fact, both financial and non-financial evaluation measures are used to assess the achievement of firm performance. Measures of financial performance are derived from or directly related to firm's audited financial statement, whereas non-financial measures are subjective and are usually measured based on the quality of products and satisfaction ratings from customers and employees.

Nonetheless, selecting an appropriate measurement approach is a challenge. Its importance is considered to work well as a method of identifying the growth of firms. Although conventional (financial) measurement systems of firm performance, such as net profits, sales growth, earnings growth, return on investment (ROI), return on asset (ROA), and return on equity (ROE) reflect directly the performance of business firms, their function is still a matter of debate to date. This is because; opponents of the traditional financial measures often claim that this measurement is particularly inadequate to gauge firm performance. In fact, the sole application of this evaluation system is inadequate to support firm performance primarily because it cannot cater to industrial operation or capture relevant issues pertaining to performance in the present challenging business environment (Ghalayini, Noble, & Crowe, 1997).

Hence, for the purpose of firm performance measurement, conventional financial measures alone are inadequate, thus non-financial measure should complement the financial indicators (Chow & Van Der Stede, 2006) in order to produce a wholesome picture of the firm performance, as well as for longer-term success and viability of firms (Georgescu, Budugan, & Cretu, 2010; Kaplan & Norton, 1992; Kaplan, 1984). In fact, limited extensive information on the quality aspects within traditional financial measures, such as involvement level of employees, timing of production, delivery, and client satisfaction (Fullerton & McWatters, 2002), are some reasons for the inclusion of non-financial development measures in demonstrating its contribution to firm performance.

Apart from solely financial (short-term) aspects, Goergescu et al., (2010) highlighted that the assessment of long-term firm performance should weigh in the full range of non-financial aspects. Besides, the abilities and expertise possessed by firms may positively influence the short-term performance displayed by a firm, but the extent to which firms continuously rely on these two benefits while other many contributing factors may affect such performance. On top of that, all non-financial indicators are subjective and it is difficult to quantify from the financial point of view. Moreover, researchers discovered that non-financial indicators (e.g. quality of products, management capabilities, employee satisfaction, and innovation) exhibited positive effect on firm value with market share. This measurement embeds not only financial items, such as profits and revenue growth, but also a number of non-financial indicators, pointing out the existence of a wide variety of firm performance measurements.

Although these actual measurements are designed by excluding non-financial indicators, financially-oriented measures could also be valid and acceptable depending on the method of measuring firm performance. Furthermore, it is widely known that financial indicators, generally, could only measure short-term effects, instead of long-term returns based on the decisions made in the present. Besides, in accounting, once a cost is incurred, it must be recorded during the accounting period in which it is incurred, hence reducing profits within the same year. Nonetheless, the outcomes of the research would display good return on investment if market-based measurement is adopted (Georgescu et al., 2010).

In addition, the proponents of financial measures have highlighted that they are indeed necessary and important performance indicators due to the primary objectives of a firm. Many researchers still adopt the financial measures rather than the non-financial measures to the assessment of the firm performance. In fact, some argued that the traditional financial performance measures are able to reflect the past or short term financial performance, as well as future or long term financial performance. However, consensus concerning the relationships between both financial performance measures is unavailable, as depicted in several empirical evidences. Moreover, as cited by Gentry and Shen (2010), Venkatraman and Ramanujam (1986) suggested that accounting-based and market-based measures, over several examples of indicator measures comprised of sales growth, profitability, and earnings per share, are unrelated due to the conflicts that exist between achieving economic goals for both short and long term performances. Besides, unclear correlation was found between accounting- (earnings) and market-based measures (stock prices) in 2003 (Ertimur, Livnat, & Martikainen, 2003).

Besides, according to Ertimur et al., (2003), firms that rely on earnings forecasts for future growth, while missing their revenue forecasts, have significantly negative stock returns during the earnings announcement period. Besides, Gentry and Shen (2010) investigated if any correlation existed between accounting profitability and market measures as interchangeable performance indicators. Nevertheless, no evidence was found to support the relationship between the four accounting measures; return on assets (ROA), return on equity (ROE), return on sales (ROS), return on investment (ROI), while market-to-book value ratio (MTB) was employed to measure market performance. As a result, the study found that both performance measures were not interchangeable. In the contrary, a recent study revealed a relationship between accounting- and market-based performance measures (Aliabadi, Dorestani, & Balsara, 2013). The study asserted that both measures were linked to each other although the basis used for each measure differed. Moreover, the four-stage model was adopted, which had corporate value drivers, financial indicator, intrinsic value, as well as from corporate value to stock price to justify both measurements. As a result, the stock of entity human capital, knowledge, and reputation were positively affected by the accounting measures and justified by the four-stage model.

Furthermore, from the light of ICT and corporate governance, prior studies showed that financial performance measures have still been receiving great attention by researchers mainly to determine the effect of ICT investment and corporate governance upon firm financial performance, as presented in Tables 2.1 and 2.2, respectively. In fact, various types of accounting and market measures have been used as indicators to describe the degree of financial performance in firms. Besides, in assessing the effect of ICT investment on firm financial performance, most studies applied either accounting- or market-based measures, while some embedded both approaches. Although the results were mixed and displayed a negative link between ICT investment and some financial measures, these measures remain necessary to evaluate the past, the present, and the future of firm performance (Hellstron, 2005).

Meanwhile, the financial ratios used in past studies, as shown in Table 2.2, also demonstrated mixed findings for the effect of corporate governance on firm financial performance. Despite of the intuition that good governance leads to good performance by firms, lack of conclusive evidence has been noted on this linkage, along with mixed results, while other studies found negative relationship between corporate governance and firm performance. For instance, Omoregie, Adeparubi, and Iboi (2014) revealed that financial accounting ratios had been comprised of the following: (1) Profit and loss ratio; (2) balance sheet ratio; and (3) combined ratio (information from profit and loss accounts, as well as balance sheet), which is in line with the study carried out by Adeniji (2004) that evaluated firm performance and found that the future trends of ratios had both strengths and weaknesses for firm‘s financial position within a certain period (Omoregie et al., 2014; Adeniji, 2004), whether the business performance was doing well in the then financial performance than it was within the last period (Monea, 2009).

Table 2.1 The Effect of ICT Investment on Firm Financial Performance

Financial Measures		Authors	Results
Accounting-based	**Market-based**		
ROA	N/A	Ugwuanyi & Ugwuanyi (2013)	Negative
		Anderson et al.(2003)	Positive
ROA & ROE	N/A	Arabyat (2014), Makinde (2014) and Jun (2008)	Positive
		Beccalli (2007)	Mixed
ROA, ROE & Profits	N/A	Ekata (2011)	Negative
		Shin (2006)	Positive
ROI & ROS	Sales growth and Market value	Byrd & Marshall (1997)	Negative
	Growth in revenue and sales & Market-to-book value	Mahmood & Mann (1993)	Positive
ROA, ROE, operating income ratio and net income ratio	N/A	Hung et al. (2012)	Positive
ROI, ROA, ROS, Income, Profits, Revenue & operational costs	N/A	Liang, You, & Liu (2010)	Mixed
Profits	N/A	Thouin, Hoffman, & Eric (2008)	Mixed
	Market value	Kim (2004)	Mixed
N/A	Tobin‘s Q	Zhang et al. (2012), Chari et al. (2008)	Positive
ROA, ROE & ROS	Tobin's Q, Market value & short-window abnormal stock returns)	Lim, Richardson, & Roberts (2004)	Mixed
Sales & turnover profitability, profitability per customer, investment profitability, & ROA	Market growth	Zehir, Muceldili, Akyuz, & Celep (2010)	Mixed
ROA & ROS	Sales growth & Market value	Weill (1992)	Mixed
	Sales	Brynjolfsson & Hitt (1996)	Positive
ROI, ROS, Income, Revenue & Productivity	Market value	Mahmood & Mann (2005)	Mixed

Table 2.2 The Effect of Corporate Governance on Firm Financial Performance

Financial Measures		Authors	Findings
Accounting-based	**Market-based**		
ROA	Tobin's Q	Qasim (2014) and Haniffa & Hudaib (2006)	Mixed
		Naushad & Malik (2015)	Mixed
	N/A	Goh et al. (2013)	Negative
		Johl, Kaur, & Cooper (2015) and Zakaria et al. (2014)	Mixed
ROE	Tobin's Q	Wahba (2015)	Negative
ROA & ROE	Tobin's Q	Ibrahim & Abdul Samad (2011) and Sami, Wang, & Zhou (2011)	Positive
ROA, ROE, & EPS	N/A	Haider, Khan, & Iqbal (2015)	Positive
ROE & EPS	N/A	Yusoff, Mohamed, & Lame (2015) and Wan Yusoff & Alhaji (2012)	Mixed
ROA, ROE, Return on Capital Employed (ROCE) and Profit before Tax (PBT)	N/A	Aggarwal (2013a)	Positive
ROA, ROE, ROS, & ROCE	N/A	Aggarwal (2013b)	Positive
N/A	Tobin's Q	Al-Matari et al. (2014)	Mixed

Additionally, the evidences retrieved from various streams of corporate governance and firm performance literatures portray that the most commonly used financial accounting ratios had been based on either accounting data or market data, while several studies adopted both approaches as their key dependent variables. On the other hand, Lubatkin and Shrieves (1986) and Bromiley (1990) introduced market-based measures in the strategic management research and further asserted that accounting-based measures alone are inadequate (Lubatkin & Shrieves, 1986) and hence, market-based measurement is needed to interpret market performance since the assumptions of market efficiency that reflect firm value (Bromiley, 1990) leads to controversial issues (Tobin, 1984; Bettis, 1983). Nonetheless, the trend of performance measurement landscape has evolved over time and many researchers have admitted that both accounting- and market based measures are interpretable in assessing firm financial performance.

Obviously, this trend can be observed from the application of both measures; not only in ICT, but also in other fields like corporate governance, whereby these measurements have been commonly used as proxy for firm financial performance. In this study, however, the financial measures were employed to advance the field of financial performance outcomes, also weighing in some views expressed by several empirical researchers as they claimed that accounting performance identified the past or short term financial performance, whereas Zhang, Huang, and Xu (2012), as well as some others stated that market performance determined the future or long term financial performance (Merchant & Van der Stede, 2007; Ittner, Larcker, & Randall, 2003; Hoskisson, Johnson, & Moesel, 1994; Kaplan, 1984).

2.3 The Concept of ICT Investment

ICT refers to technologies, for instance, desktop and laptop computers, software, peripherals, and connections to the Internet, which fulfil information processing and communication functions (Statistics Canada, 2008). Meanwhile, investment is the essence of the process of creating wealth, in which its definition can be used in a number of contexts. In a good economic sense, an investment strategy in physical capital is important for both growth and development. Besides, several business theories have depicted that the transition of a strategy is viewed as the process of utilizing resources; starting with buying a physical or tangible asset, for example, a building, technological tools or machinery, with the expectation that this investment can help the business to penetrate the production process to reap long term benefits.

Information and communication technology (ICT) has been the most dynamic of investment component in recent years. According to the 1993 System of National Accounts, ICT investment covers the acquisition of equipment (hardware) and computer software that is used in the production process for more than one year. Generally, ICT investments are intended to harness the potential of ICT, as a crucial enabler in helping companies to improve their business productivity as well as financial performance (Mohd Noor & Apadore, 2014). In other words, the smart use of ICT can enhance firm performance.

2.4 Trends of ICT Investment in Developed and Developing Countries

2.4.1 Developed and Developing Countries

Investment in ICT is imminent due to demand of components, especially after the global investment boom in ICT assets that began between late 1990s and early 2000s. Besides, the growth of ICT adoption has resulted in globalization, while the trends of ICT investments have become more important; turning it into a catalyst for the development of many nations. As such, this literature highlights on the nature of trends that reflect ICT investment practices from the view of developed countries, developing countries, and Malaysia in specific. However, before moving further into the explanation on ICT investment trends, this study briefly defines developed and developing countries.

In fact, numerous economic criteria are available in describing developed and developing nations. According to the International Monetary Fund (2001), countries with high gross domestic product (GDP) per capita are referred as developed countries, whereas countries with lower ratings on GDP are described as developing countries. Meanwhile, the Human Development Index (HDI) has been claimed to be the best statistical method to measure the development of a country. HDI refers to the combination of an economic measure, such as national income, with other measurement indices like life expectancy and education. Besides, according to the United Nation Development Programme (UNDP) (2013), countries with very high HDI rating are termed as developed countries, while those with lower HDI rating are known as developing countries.

Back to the purpose of this section, the rapid trends and revolution of ICT have improvised a number of aspects in many people‘s lives. This sustainable use of science and technology in all aspects of life has turned ICT an important investment for many countries. In fact, people make use of technology almost every single minute; thus leading towards immense increase in the demand for technology components with each passing day that also promotes more innovative technologies. Hence, it is not surprising that many nations put their highest priority initiatives in ICT investment due to its ability to not only improve tasks at the individual level, but also in bringing positive changes to companies, industries, and economics.

Moreover, modernization and expansion process of technology can be interpreted as capacity development for ICT, which could lead to sustained increment of productivity growth at various levels of firms, industries, and nations. Thus, ICT investment can enhance productivity growth by offering the essential technology infrastructure required for growth and network modernisation. Meanwhile, in the late 1990s, the ICT has become commercialized and diffused rapidly, thus contributing to extraordinary performance in developed countries, especially for the US economy (Stiroh, 2002; Oliner & Sichel, 2001; Jorgenson & Stiroh, 2000), besides influencing a number of developed nations like Australia, Finland, Ireland, and Sweden (Daveri, 2002).

Nonetheless, technological revolution among developing countries has remained lagging, except for a few countries like Malaysia, Thailand, Taiwan, Philippines, and South Korea, which have benefited from ICT production that has led to significant economic growth (IMF, 2001). Moreover, advancement in ICT equipment has increased the power levels for all equipment in fulfilling the demands of ICT users. The US economy in the late 1990s has experienced this phenomenon where during the rapid evolvement of technology resulted in falling prices of existing products with widespread uses in the rest of the economy.

For instance, steep declines in semiconductor prices in the US have allowed the highest increment in the production of computer hardware and software, as well as telecommunication equipment, leading to price fall in these industries. Such falling price is viewed as a potential opportunity for technology users when they start making extraordinary investment in these goods, resulting in significant capital deepening. Moreover, in the context of ICT, capital deepening occurs when there is an efficiency rise in the ICT usage and stimulating labour productivity growth by means of faster deepening effect without changing any technological production across the economy (O'Sullivan & Sheffrin, 2003).

Furthermore, many past studies found that this capital deepening attempted to accelerate productivity growth via better development and deployment of IT investment in the US (Oliner, Sichel, & Stiroh, 2007; Jorgenson, Ho, & Stiroh, 2005; Jorgenson, 2001) and also in the UK (Oultan, 2002). Other than that, several prior studies discovered that the productivity growth of UK economy lagged due to lacking ICT-producing industries and low levels of ICT investment activities (Daveri, 2002; Colecchia & Schreyer, 2002). In fact, investment in ICT between 1995 and 2000 exhibited an incredible growth on the global business due to the falling price of ICT equipment in the late 1990s, thus causing a further boost in demands for ICT goods. While the world economy benefited significantly from ICT investment spending, spending on ICT has dropped sharply in 2001 due to the recession in March 2001, and recovered in late 2001, then modestly improved in 2003 (U.S. Department of Commerce, 2003).

In addition, over the 2001 to 2003 period, the entire ICT development significantly declined due to economic slowdown. Since the US economy depended on offshore capital for ICT investment, this declining US economic condition had stifled and affected the economic growth in other countries. However, in November 2005, the US economy began improving, which regained the trust of the public, thus coaxing investors to start investing in ICT. Moreover, according to the Information Technology Association of America (ITAA), in early 2005, confidence grew strongly among CIO about their health budgets and future spending prospects (ITAA, 2005), which moved to bolster ICT investment spending where the US invested $1.8 trillion on ICT equipment and infrastructure in 2005 (Lauden & Lauden, 2006; 2005).

Next, over the period of 2007 to 2009, the global economic, which the US gave tremendous effect not only to developed countries, but also among most developing countries. Hence, it had been a crucial period for the ICT sector to redevelop rapidly, with almost all first quarter indicators declining, often very sharply. Despite of having undergone a massive economic deceleration, many nations began improving better practices in order to favour better continuity for ICT development.

Although the 2009 financial crisis had severe and wide-ranging impact upon many nations worldwide, the ICT sector has not stopped revolutionizing and evolving its capacity to benefit all areas. Besides, a 2009 study highlighted that the crisis of the ICT industry within the economic situation that increased ICT investments did improve technology innovation and helped companies to get back on its track to meet their goals concerning their short term return (Contreras & Tormo, 2009). Moreover, companies need to reduce their expenditures, including ICT, in order to reduce the impact of the crisis on their income statement while trying not to curb their revenue, i.e. they need to perform the similar or even more, but with less. Thus, in order to be able to do more with less, ICT investment reduces the impacts caused by economic crisis.

As we are now incorporating new era of a so-called the ‗Digital-Age', moves the implementation of ICT to the digital implementation, widely exposed to cloud or network centric, two way broadcasting interaction, and the booming phenomenon of ICT-enabled web services such as Wikipedia, Facebook, Twitter, Google Map, YouTube, and etc. ICT in the 21^{st} century is expected to be more vibrant with various sophisticated of ICT development infrastructures, with an enhanced legal and regulatory environment, as well as various incentives provided by the government to encourage more investments in high speed broadband Internet access, fourth generation (4G) wireless network, multimedia content development packaged software, and in technological advancements pertaining to Nanotechnology, Micro-Electro-Mechanical Systems, Semantic Technology, Wireless Communication, Grid-Computing, Biometrics, and Biotechnology, which are aimed to spur the global economic development (PIKOM, 2014).

2.4.2 Malaysia

Advancing into the 21st century, ICT has emerged as the backbone of business organizations (Nwabueze & Ozioko, 2011). Virtually, every facet of various industries is touched by ICT and depends heavily upon it to support their complex business processes, as well as for efficient achievement of their goals. As technology growth depends on information management, IT investment is vital. Besides, the Malaysian Department of Statistics reported that the Malaysia‛s total population was about 30.27 million and by year 2040, the total population is projected to reach 38.5 million people. Moreover, based on the economic theory, as the total population grows; the demand for goods and services increases as well because each member of the population has needs to be fulfilled.

In fact, prior studies have revealed a positive link between population number and IT use (Puspitaningdyah, 2012; de No-ronha Vaz, Morgan, & Nijkamp, 2006). Such results portray stronger evidence to support the fact that increment in the number of population may affect IT use. In precise, increment in population density hikes the demand for ICT products and services. Besides, Table 2.3 shows that the productivity level by key services sector in Malaysia, as reported by the National Information and

Communications Technology (ICT) Association of Malaysia (PIKOM, 2013), the ICT sector is a rapidly growing sector and it has been considered as one of the high performing sector to enhance the overall productivity of the nation. This massive ICT progress is seen as an essential resource to foster the competitiveness of the ICT sector in accelerating economic growth by bolstering the domestic demand of ICT.

Table 2.3 Productivity Level by Key Services Sector, 2007 to 2012.

Key Services Sector	**Productivity Level by Key Services Sector: 2007 - 2012 (RM thousands)**						
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**CAGR[3] (1%)**
Logistic	132.5	133.2	123.1	129.6	134.3	140.2	1.14
ICT	302.6	342.2	350.2	376.4	400.5	423.4	6.95
Wholesale & Retail Trade	N/A	439.8	419.6	463.7	496.6	550.9	5.79
Business and Professional	55.25	61.35	69.67	73.79	77.49	84.6	8.89
Tourism	49.4	53.1	53.2	55.1	57.6	59.2	3.69
Private Education	43.8	46.1	47.9	50.3	52.4	54.5	4.47
Health Care	47.86	54.93	61.49	67.04	72.31	79	10.55
Construction	20.74	21.61	22.85	23.9	24.64	25.8	4.46

Source: Productivity Report 2011/ 2012, MPC, and PIKOM Estimates (PIKOM, 2013)

Furthermore, according to the 10th Malaysia Plan, the ICT sector accounted for 9.8% of GDP in 2009 and once again, it was projected to register a significant growth by contributing 10.2% to GDP by 2015[4]. In acknowledging the significance of ICT and its potential to transform the development of the nation, the Malaysian government has provided various ICT strategic plans to build knowledge-based economy and society in the 21st century. In tandem with the strategy, Malaysia is poised to embark

[3] CAGR refers to the Compound Annual Growth Rate.
[4] http://www.pmo.gov.my/dokumenattached/RMK/RMK10_Eds.pdf

upon indigenous inventions and innovations, in which ICT is seen as a key enabler to play a significant role in this endeavour.

Furthermore, the rapid spreading out of ICT services in Malaysia and the need to assess them in order to fulfil global needs has triggered a demand for ICT-based products and services. Besides, Table 2.4 presents that the distribution of ICT services by ICT sector from year 2000 until 2014 was inclusive of ICT value-added services, telecommunication services, and computer services, thus enhanced continuous growth from 2000 until 2014.

Additionally, the table shows that ICT products and services grew at a Compound Annual Growth Rate (CAGR) at 12.4% by increasing its value-added services from RM11.7 billion in 2000 to RM59.8 billion in 2013. Besides, the demand for ICT had been poised to reach the mark of RM67.99 billion in 2014 by registering a repeat annual growth rate of 12.4%. In tandem, the share of ICT service sector in the national GDP increased from 3.3% to 6.4%, almost doubling over the period of 2000-2014 (PIKOM, 2014).

Furthermore, the advent of Malaysia Standard Industrial Classification (MSIC) in 2000 has opened many doors for various innovations in the ICT sector. For instance, imperial expansion in the ICT sector to many more ICT services, such as video and television programmes, programming and broadcasting, as well as information services, began in 2008; whereas other services offered like publishing services and motion pictures intensified the contribution of ICT sector to national income. These additional and new ICT-based products and services contribute to approximately 21.3% of the total ICT sector in terms of value-added services.

Table 2.4 Distribution of ICT Services by ICT Sector, 2000-2014.

Year	ICTs Value Added Services ('000)	Share of ICTs to Overall GDP (%)	Telecom-munication Services ('000)	Computer Services ('000)	Sub-total	Publishing ('000)	Motion Picture video and Television Programme ('000)	Programming and Broadcasting ('000)	Information Services ('000)	Sub-total
2000	11,771,057	3.3	10,335,256	868,758	11,204,014			193,273	373,770	567,043
2001	12,744,792	3.6	10,815,979	1,257,657	12,073,636			269,319	401,837	671,156
2002	14,652,306	2.8	12,261,462	1,412,888	13,674,350			254,765	723,191	977,956
2003	14,922,154	3.6	12,368,517	1,916,304	14,284,821			255,963	451,370	707,333
2004	1,607,422	3.4	12,773,701	2,056,348	14,830,049			356,714	900,659	1,257,373
2005	20,187,921	3.9	16,352,349	2,718,059	19,070,408			387,730	729,783	1,117,513
2006	23,858,012	4.2	19,252,783	3,125,191	22,377,974			419,412	1,060,626	1,480,038
2007	25,036,393	3.9	19,532,436	3,772,887	23,305,323			427,088	1,303,982	1,731,070
2008	30,090,354	3.9	22,655,972	5,168,116	27,824,088			447,618	1,818,648	2,266,266
2009	31,999,469	4.5	22,912,378	6,496,356	29,408,734	271,688		1,483,674	1,839,604	3,594,966
2010	42,095,951	5.3	27,106,855	9,363,020	36,469,875	503,080	1,056,006	1,565,327	2,001,388	5,125,801
2011	45,259,877	5.1	29,778,845	9,945,621	39,724,466	590,079	1,065,823	1,690,288	2,189,221	5,535,411
2012	52,430,520	5.6	33,166,728	11,862,431	45,029,159	719,835	1,405,592	2,150,865	3,125,069	7,401,361
2013	59,835,527	6.1	36,386,010	12,774,925	49,160,935	1,038,179	2,027,211	3,102,079	4,507,122	10,674,591
2014	67,991,747	6.4	39,810,610	13,687,420	53,498,030	1,409,616	2,752,501	4,211,933	6,119,667	14,493,717
Projected Sub-Sector Share (%) in 2014	100.0		58.6	20.1	78.7		4.0	6.2	9.0	21.3
CAGR (%): 2000 - 2014	12.4		9.4	20.2	11.0		21.1	22.8	20.5	24.1

Source: Department of Statistic and Economic Planning Unit, Various Publications; and Projection for 2013 and 2014 by PIKOM (PIKOM, 2014).

2.5 Factors that Influence ICT Investment

2.5.1 General Perspectives

Why do firms invest in ICT? What are the factors that influence firms to make ICT investment? As the business environment keeps on changing to keep up with the real business nature, many companies rely on the power of IT. In fact, many studies have discovered a variety of internal and external factors that drive companies to make ICT investment decisions. In the context of business environment, the internal factors are generally controllable and have direct effects on the business because firms can modify their business mission and objectives, business targets, the style of leadership, strategies, culture, activities, as well as employees‘ working attitude and their motivation, to suit the environment. Furthermore, the management needs to thoroughly and strategically scan the business environment before deciding to adopt and invest in ICT, especially in identifying the major factors that may hinder companies from reaping potential benefits from their ICT investments.

Past studies, for example, have suggested that ICT adoption is influenced by several internal favourable factors, such as employees‘ attitude (Bruque & Moyano; 2007; Caldeira & Ward, 2003), management commitment and support (Irefin, Abdul-Azeez, Tijani, 2012; Caldeira & Ward, 2003; Premkumar, 2003; Thong, 2001; Premkumar & Roberts, 1999), business growth (Bruque & Moyano, 2007), information system planning (Thong, 2001), improving productivity (Premkumar, 2003), anticipated profitability (Hollenstein, 2002), cost reduction (Irefin et al., 2012; Hollenstein, 2002), survival purposes and attainment of competitive advantage (Premkumar, 2003), business size (Irefin et al., 2012; Premkumar, 2003; Hollenstein, 2002; Premkumar &

Roberts, 1999), levels of experience in conducting technology (Alam & Noor, 2009; Caldeira & Ward, 2003; Thong, 2001), availability of ICT infrastructures (Irefin et al., 2012; Chan & Ngai, 2007; Gregor et al., 2004), knowledge capacity (Hollenstein, 2002), ICT capability (Liu, Lu, & Hu, 2008), and technological improvement (Southern & Tilley, 2000).

On top of that, investment actions are also often influenced by external factors. The external factors are indirectly interactive factors that consist of external factors that might affect firm performance. Nevertheless, there could also be a slew of factors, like customers, political, policies, social, and economic conditions that drive the motivation to invest in ICT. If a firm ignores the opportunities from the external factors to improve their business capacity, but competition does not, it would be challenging for the firm to make proactive changes that can bring vastly varied results to its performance. Besides, empirical studies have discovered that investment activity in ICT is influenced by external environmental factors, such as competitive pressure (Iyanda & Ojo, 2008; Bayo-Moriones & Lera-Lopez, 2007), government support (Pan & Jang, 2008; Gregor et al., 2004), cultural issues (Pan & Jang, 2008; Gregor et al., 2004), key suppliers (Quayle, 2002), as well as external ICT consultants and vendors (Pan & Jang, 2008).

In fact, the adoption of ICT is much influenced by ICT products itself, which are characterized by some important factors, including compatibility and security of ICT process (Premkumar, 2003; Premkumar & Roberts, 1999), availability of quality software in the market (Caldeira & Ward, 2003), user friendliness (Premkumar & Roberts, 1999), perceived benefits (Alam & Noor, 2009; Premkumar, 2003; Thong, 2001; Premkumar & Roberts, 1999) and ICT impacts on company, types of ICT used, and age of ICT implementation in company (Caldeira & Ward, 2003). Besides, the rapid change in business dynamics are placing competitive pressure on firms to keep pace with market changes and demand; thus forcing them to improve the efficiency of their business capacities via ICT adoption (Premkumar, 2003). Therefore, firms must fight to remain competitive and innovative by actively devising ways to make their business processes more efficient.

Apart from that, the government also plays an important role in promoting the use of ICT in the wider community, especially for business industries. With government plans of setting up legal and regulatory to foster ICT adoption, business industries could benefit from the opportunities offered by the government (Gregor et al., 2004). The various forms of government support to support ICT expansion, for example, rules and regulations, ICT policies, financial aids, electronic channels, incentives, and grants, may help businesses to become stronger in adapting to the competitive new reality in the present business environment. It is, therefore, very significant for business industries to become more proactive in aligning their business goals and ICT strategies to reap benefits provided by the government. Moreover, previous studies reveal that positive correlations could be found between government support and ICT adoption (Alam & Noor, 2009; Southern & Tilley, 2000).

2.5.2 Malaysian Perspective

In Malaysia, the government has provided various incentives, rights, and privileges to encourage the development of the ICT industry. In line with that, the CEO of PIKOM, Saifubahrim Salleh, as well as Ramachandran Ramasamy (2013), the Head of Policy, Capability & Research at PIKOM; ICT Investment is viewed as a potential new source that can encourage further economic growth in a nation, besides improving firm performance to further thrive.

In fact, the 2014 Budget saw some great opportunities for companies with ICT investment. Those who acquire or buy ICT equipment, including software, are eligible for Accelerated Capital Allowance (ACA) that offers an initial allowance of 20% and an annual allowance of 40%. This exemption is given until the year of accounting (YA) 2016. Based on the budget highlights, the Income Tax is responsible for handling the claims of ACAs only until YA 2013. However, the time frame for claiming ACAs has been extended due to the Malaysian GST implementation, which has been effective since 1st April 2015.

Meanwhile, under the 10th Malaysia Plan, the development of ICT has become more ubiquitous. It is seen as a primary enabler to position Malaysia as a competitive knowledge-based economy (Abdul Wahab & Ramacahandran, 2011), as well as a global hub of ICT and multimedia. The 10th Malaysia Plan also continues to emphasize on the ICT strategic planning by expanding the existing communication networks to bridge the digital gap between urban and rural areas, enhancing human resource development in ICT fostering via ICT education and trainings, as well as encouraging more business and communities to participate actively in their promotion via digital commerce. Besides, focus is also given to strengthen the local capabilities in developing creative content, as well as soft infrastructure development (EPU, 2014).

Furthermore, the present emerging trends of green ICT could transform the industrial sector to be more environmental sensitive. This could reduce all energy, economic, and pollution issues in the most efficient and effective way. Moreover, the term ‗green

ICT‘ has been actively defined by many researchers and industrial players based on their insights. According to the Organization for Economic Co-Operation and Development, green ICT is defined as ―ICT to reduce environmental load and ICT for using as a promoter to relieve social environment influence, for instance, energy use, water use, land use, toxicity, global warming, non-energy depletion, and ozone layer depletion."

Meanwhile, the Malaysian Green Technology Corporation, presented by Ismail (2013) in empowering green markets forum, defined the green ICT as ―an approach to energy saving efficiency, for instance energy saving of IT equipment (―of IT") and entire society‘s energy saving by IT (―by IT") of IT (energy saving of IT equipment) – improving energy efficiency of IT equipment and electronics; IT equipment such as PC, server, storage etc., electronics such as TV, DVD, refrigerator etc., data center and semiconductor. Besides, in tandem with the evolution of technology advancement, many industrial sectors have begun realising the potential benefits of green ICT adoption to facilitate the industrial sectors in their operations. In Malaysia, investing activities in developing ICT has begun as early as in the 1980s for all industrial sectors that generate economy.

However, Malaysia has only started pursuing aggressively ICT investment in the 1990s, particularly with the establishment of Multimedia Super Corridor (MSC), which seeks to nurture Malaysian industrial sectors towards becoming world class businesses, on par with other developed countries. Moreover, many conglomerates have adopted green ICT to save energy and to preserve working environment from pollution (Murugesan, 2010). Increasing demand for green ICT, in addition, has encouraged many industrial sectors to improve their operational processes to operate with environmental efficiency, especially in the Malaysian economic sectors, such as energy, waste water, building, transportation, manufacturing, and ICT (Abd Hamid, Mohamad Kamar, Ghani, Mohd Zain, & Abdul Rahim, 2011).

Moreover, increase in green ICT usage leads to the creation of green ICT jobs in varied sectors. Besides, instead of increasing green ICT investment, as well as research and development (R&D), to improve business efficiency, most companies have been expected to increase job employment in R&D and ICT. In line with the Malaysian ICT policy guidance, as shown in Figure 2.1, introduced by the Malaysian Ministry of Science, Technology, and Innovation (MOSTI), the policy is also viewed as a big factor in influencing and encouraging the use of ICT among communities, besides indirectly strengthening ICT investment activities in the Malaysian corridor. The strategy of the policy is vital and it is not just a slogan to boost the regional ICT development, but also to be able to boost the reputation of Malaysian ICT development, to be on par with other developed countries.

Malaysia ICT Policy Guidance	**Malaysia ICT Policy Guidance**
National ICT Policies (current); • Enhancing Position as a global ICT and Multimedia Hub • Towards Ubiquitous Communication Network • Bridging Digital Divide • Rollout Designated Cyber-cities and MSC Flagship Applications • Fostering New Sources of Growth • Increasing Development of the ICT Workforce • Accelerating e-Learning Acculturation;and • Enhancing Information Security	ICT Strategic Programs (Current); • ICT Funding (DAGS, Techno Fund, Science Fund etc) • Development of local content (e-Content) • MSC Malaysia Development • National Cyber Security Policy Implementation • ICT for All (Awareness and Outreach) • ICT Research and Development • National ICT Roadmap

Figure 2.1: Malaysia ICT Policy Guidance.
Source: Malaysia Ministry of Science, Technology and Innovation website.

2.6 The Effect of ICT Investment on Firm Performance

Demand for firm output increases as the capacity in producing output increases, which results from the productive activities of the firm. This greater demand, in turn, would significantly boost sales to a great extent and increase firm profitability. However, risk in ICT investment lurks around many firms; questioning if such investment could actually contribute in achieving their financial growth targets. Besides, in recent decades, ICT development has led many nations, industries, and business firms to invest heavily in ICT. Despite of the widespread diffusion investment in ICT, many researchers have questioned if such investment adds value to business firms. The use of ICT, hence, has been promoted as having tremendous promise in affecting a firm's structure through its capabilities and in becoming indispensable for firms to improve their business planning process.

For instance, *Appendix 1* presents a sampling of prior studies of the effect of ICT investment on firm performance, including the key results. Besides, the positive contribution of ICT investment on firm performance has been widely viewed and researched in past studies from the light of varied industries, mainly from the financial service industry like banking and insurance companies. For example, ICT plays an important role in enhancing the development of effective bank operations. Moreover, the rapid pace of ICT has transformed the banking sector in a manner that can bring tremendous value to the financial landscape. In fact, ICT reforms have exhibited the effect of inducing banks to invest in ICT by bringing huge changes into the banking system.

Additionally, a study in the Taiwanese domestic banks financial performance, measured using ROA, ROE, operating income ratio, and net income, had improved despite of the investment made by banks in ATM technology (Hung et al., 2012). Meanwhile, Romdhane (2013) found that investment in ICT components (software and hardware investments, as well as ICT services) play a major role in improving the cost efficiency of Tunisian banks. Other than that, Arabyat (2014) tested the effect of two ICT investment proxies on ROA and ROE as proxies for bank financial performance, which displayed significantly positive impact of ICT investment on both financial measures.

The result retrieved from Arabyat is consistent with findings of another study applied to Nigerian banking sector (Makinde, 2014). With similar dependent variables, Makinde (2014) found that ICT investment proxies (investment in ICT, investment in other assets, and operating costs) positively influenced Nigerian banking performance. However, studies in the similar financial area displayed inconsistent results. For example, Francalanci and Galal (1998) found negative effects of IT expense, two of work compositions (clerical and professional intensity) and combined effects of IT, as well as clerical and professional intensity on the productivity among 52 US life insurance companies.

Meanwhile, Beccalli (2007) discovered positive effect of ICT services, such as consulting services, implementation services, training and education, as well as support services, on 737 banks of Europe from 1993 to 2000, but negative link for the effects of ICT hardware and software investments upon firm performance. Moreover, Safari and Zhen Yu (2014) determined the benefits of ICT to technical efficiency levels among privately- and publicly-owned Iranian banks. By comparing the ICT impact on efficiency of both types of banks, the stochastic frontier analysis (SFA) method was applied to bank-level data over 22 years (from 1995 until 2011). All ICT matters, such as software investment and ICT services, functioned as significant indicators that reduced costs, which enhanced the technical efficiency. However, the effect of hardware investment was insignificant.

Furthermore, a review by Ekata (2011) on the relationship between IT expenditures and financial performance in Nigerian commercial banks identified nil correlation between IT spending and financial performance measures (net profits and ROE). Besides, IT budget and IT training costs also had insignificant correlations with net profit. Hence, one can conclude that even if the level of ICT investment continues to grow at respectable rates, the phenomeon of the so-called ‗ICT paradox' still exists in this century. Even if ICT investment positively contributed to the performance at the industry level, the results were not robust for profitability and productivity measures at the firm level. Ugwuanyi and Ugwuanyi (2013) examined the effect of IT investment on bank returns among four Nigerian banks. The ordinary least square regression was applied to cross sectional data gathered for the analysis from annual reports and financial accounts of the sample banks from 2005 until 2011. Three ICT investment proxies, the total number of IT branches and ATMs, as well as IT expenditures, have been chosen to predict the dependent variable of ROA. The result of the tested hypothesis showed that ICT expenditures of the samples did not increase ROA.

Besides, past studies have also shown the positive effect of ICT investment on the performance of manufacturing firms. An empirical study of ICT and firm performance within the context of Malaysia was conducted by several authors to examine the roles of ICT in affecting the performance exerted by Malaysian construction firms. Using a combination of qualitative and quantitative methods, the impact of ICT investment has been believed to influence firm performance. Several ICT measurements, namely communication investment, ICT specific labour investment, R&D investment, and ICT training investment, had been estimated to respond positively to firm performance, however, only a weak relationship was captured (Gaith et al., 2008).

Moreover, in the early 1990s, Weill (1992) looked into the relationship between ICT investments and firm performance among 33 small- and medium-sized valve manufacturing firms. Based on the data gathered and analysed through 6 years of indicators for each firm, the study discovered mixed results for the relationship between ICT investment and firm performance. The result of investment in the transactional IT displayed a significant effect on performance, while the strategic IT investment was associated with lower performance, and insignificant relationship was found between informational IT investment and firm performance - the so-called productivity paradox.

Other than that, Kim (2004) determined the effect of ICT investment on IT manufacturing Korean firm performance for year 1996. Several dependent variables (marginal product of IT capital, profitability, productivity, and market valuation of IT capital) were employed to represent firm performance. The findings, as a result, were mixed, with some results reported positive effect of marginal product of IT capital, productivity, and market valuation of IT capital upon Korean firm performance. Although, the sales growth (profitability ratio) was positive, the ICT investment did not have any significant effect upon firm profits. Besides, the literature depicts that mismeasurement issue of ICT investment may be caused, for instance, due to inappropriate methodology, ignorance of the effects of time-lag for ICT investment and returns, which clearly underestimates ICT potential (Weill & Olson, 1989; Stiroh, 2002).

In addition, from the perspective of ICT investment in the healthcare industry, Devaraj and Kohli (2000) discovered that IT labour and IT capital exemplified positive effects on the financial performance, which was measured by net patient revenue per day and net patient revenue per admission. However, the quality index of mortality rates had been negatively affected by IT labour. Next, Thouin et al., (2008) have also examined the impact between the ICT investment proxies and profitability in the health industry. Using the profit as their only measure of profitability, performance of the sample health industry was estimated using ordinary least square regression model to confirm if the ICT investments incurred and performances are positively correlated. Moreover, the results showed that increased profitability was dissociated from its increase in IT personnel, while positive results were found for IT budget and IT outsourcing linked with performance.

In addition, Spyros and Euripidis (2014) have tested the effects of ICT on product and process innovation based on data gathered from 743 European hospitals. With the advent of a direct measurement technique, the authors discovered that investment in ICT infrastructure (hardware, software, and networks), E-business, and two hospital-specific ICT applications (Picture Archiving, Communication System, and Computerized Physician Order Entry) had been positive to both products and process innovation. Meanwhile, the ICT budget spent on operating expenses reflect positively on process innovation, but insignificant effect was found among the two independent variables used (ICT personnel and website) for both product and process innovation.

Besides, past studies on ICT investment and firm performance have tapped into the context of all industries (mixed). For instance, Brynjolfsson and Hitt (1993) conducted a research that involved 380 US large firms from the period between 1987 and 1991, which revealed that investment of information system was indeed a significant contribution to firm output. Besides, spending on computer capital was identified as the main contributor to firm output compared to spending on other non-capital expenses. In 1996, they pursue with a study and again, the results were consistent with those obtained for their 1993 study, which demonstrated the positive contribution of ICT as an important driver of productivity at the firm level (Brynjolfsson & Hitt, 1996).

The study examined output data over 1,000 US firms from 1987 to 1991 and found that ICT contribution was still higher even if the measurements had weighed in capital depreciation linked to ICT capital. Thus, one can conclude that these two studies have discovered that investment in ICT has made a significant impact on output at the US firm level, thus strongly denying the existence of productivity paradox. Meanwhile, in other study, a cross-sectional analysis was carried out to measure the impact of ICT investment (ICT spending) upon the future performance measure of a firm (ROA was divided into profit margins and asset turnover). Thus, a strong and positive link was found between ICT spending and firms‘ future earnings for information, while a weak and positive link between the variables in automating role.

On top of that, a study that investigated the manufacturing and service sector from 1995 until 1997 conceptualised that financial performance of diversified firms improved upon increasing ICT spending, hence proving that the moderating variable of strategic direction was the most plausible explanation for the link between ICT spending and firm performance (Shin, 2006). Besides, Chari et al., (2008) also revealed that ICT investment had a positive impact on firm performance, especially those with greater levels of diversification, among 117 firms from varied sectors like manufacturing, retail, wholesale, transportation, communication, and others.

Nonetheless, some studies presented contradicting results between ICT investment and firm performance within mixed industries. Mahmood and Mann (1993), for instance, obtained mixed results from their varied Pearson and Canonical analyses. In Pearson analysis, the effect of IT investment was weak and negative on firm performance, while the Canonical analysis displayed a more significant correlation between the variables for various industries from 1991 until 1993. Hence, this study suggested that the effect of time lag may exist because several years may pass before firms could benefit from their investments. The authors employed multiyear and cross-sectional result to measure the performance, thus revealing that those firms that consistently invested more in ICT possessed a state-of-the-art ICT infrastructure than those that did not invest heavily in ICT. However, the analysis, via combined data over several years, failed to prove a link for ICT investment with firm performance and productivity.

Additionally, Zehir et al., (2010) studied the correlations between various ICT variables, including level of ICT investment, ICT usage, ICT perception, ICT at decision making process, future orientation, technology orientation, and firm performance, within a competitive setting. Thus, many hypotheses were tested to determine the correlation between ICT variables with several indicators representing performance (financial measures, technology orientation, and future orientation). This study, nonetheless, displayed mixed findings. The results showed that IT perception, IT at decision making, and technology orientation were insignificant for firm performance. IT usage was negatively related to future orientation, while IT investment, IT perception, and IT usage were not positive to technology orientation. In precise, from the light of ICT investment, ICT variable exhibited a positive correlation with firm performance and future orientation. As a conclusion, if ICT investment is properly managed, ICT can emerge as an important component in enhancing firm performance.

Other than that, Liang et al., (2010) proposed an integrated model to investigate both the direct effect of resources on firm performance and the indirect effect using the mediator of organizational capabilities. Firm performance was evaluated via financial and efficient performance. The results, in the end, had been mixed. Nil association was revealed between technological and organizational resources with firm financial performance, while a weak association was found for internal and external capabilities with financial performance. This weak association was also found between technological and organizational resources and firm efficiency performance, whereas internal capability was positively linked with efficiency performance, but not for external capability. The results concluded that the mediator of organizational capabilities displayed the ability to explain the value of IT, in comparison to the direct-effect model without organizational capabilities.

In addition, Byrd and Marshall (1997) extended the framework developed by Mahmood and Mann (1993) by leveraging the methods. With similar data analyses technique, structural equation was believed to analyse the hypothesized relationship between IT investment and firm performance. Moreover, several variables, which were used to measure the extent to which users had access to IT, were found to have significantly positive links with sales by employee; an organizational measure of labour productivity. Meanwhile, the values of supercomputers, mainframes, and minicomputers, as well as the percentage of IT budget spent on IT staff, had been significantly negative for sales by total assets; a traditional measure of capital productivity. The other IT variable, the percentage of IT budget spent on IT staff training, failed to exhibit any association with any performance variable.

Furthermore, Jun (2008) analysed the effect of ICT investment on the performances exerted by Korean security firms. This study proposed a methodology to analyse longitudinal data (over 12 years) through the relationship between ICT investment proxies (computer and capital budget ratios) with regard to some performance variables (ROA, ROE, and net profit-operating revenue ratio) used to fit continuous response indicators. Overall, the results indicated that the capital budget ratio (among IT proxies) had a positive impact on ROA. Besides, the capital budget ratio responded more strongly to the profitability aspect of security firms, in comparison to computer capital budget, which appeared to exert the largest influence upon the profitability of Korean security firms.

2.6.1 The Issue of Time Lag

Brynjolfsson (1993) has categorised four factors that contribute to IT productivity paradox, namely, measurement error, lags, redistribution, and mismanagement. In fact, time-lag (delay of several years before reaping benefits of IT investment) (Yaylacicegi & Menon, 2004), which has been highlighted as a factor that contributes to the intricacies in measuring the effect of IT investment, produced inconsistent results in earlier studies (Brynjolfsson, 1993; Brynjolfsson & Hitt, 1993). The researchers asserted that there were time-lag of 2 or 3 years before the effects of IT investment can be realized (Brynjolfsson, 1993; Brynjolfsson & Hitt, 1993).

Moreover, Devaraj and Kohli (2002) claimed that time-lag contributes to IT productivity paradox, while the true outcomes observed after an initial period may range anywhere from several days to several months or even years, depending on the size and the complexity of IT implementation. Hence, the aspect of time-lag has to be considered, especially in determining the effect of IT investment upon firm performance. In measuring the effect of ICT investment, Kohli and Devaraj (2003) highlighted several reasons on why the lagged effect is imminent in measuring ICT investment payoff.

First, lagged effects have been emphasised as a reason for the insignificant impact upon ICT productivity due to the use of contemporaneous data (Brynjolfsson, 1993). Second, the impact of ICT productivity is indirectly visible in financial measurements like Tobin's Q (Bharadwaj, Bharadwaj, & Konsynski, 1999). However, improving operations by accumulating IT stock has yet to be validated. Third, neglecting asset accumulation like ICT can have greater impact on return of activities (e.g. product market activities) (Dierickx & Cool, 1989).

The next reason includes the financial theory of capital investments that suggests adjustment costs from capital acquisition are convex (Jorgenson, 2001). This theory further implies the delay of positive impact from technology and the negative impact of adjustment costs on values during the initial acquisition period. Besides lag length, when and for how long ICT investment from a year could sustain a significantly positive impact on future output are highlighted; thus leading to the estimation of ICT economic life, which is relevant in accounting intangible assets like hardware and software capitalization, as well as amortization (Lev, 2003).

Next, Brynjolfsson, Malone, and Kambil (1994) discovered that the decline in firm size was greater after a lag of 1 to 2 years following IT investment. Meanwhile, Francalanci and Galal (1998) predefined sizes of lagged effects in each year, while the weight of a firm‘s IT expenditures incurred in a given year, *t*, was calculated from the amortization quotas of IT investments over a five-year period. The results showed that the effect of IT investment increased by double after two years IT investment was made at year *t*. Moreover, Devaraj and Kohli (2000) incorporated time-lags into their research model and found that the effect of IT on performance was reflected in about 2 to 3 months‘ time-lag, whereas Anderson et al., (2003) claimed that firms took 1 to 4 years to reap benefits from IT investment. Besides, Brynjolfsson and Hitt (2003) used various lengths of time-lag (1 to 7 years) to determine the effects of computerization on productivity and output growth among US firms.

Additionally, Byrd and Marshall (1997) looked into the link between IT investment and firm performance by using IT investment data over a 3-year period, while 4-year period for performance data. As such, the lag of 2 to 4 years was believed to explain the correlation between IT investment and firm performance. Besides, Yaylacicegi and Menon (2004) employed huge samples of 23 years to investigate at what period the positive relationship emerged between IT capitals spending and firm performance. The study suggested that firms would reap good returns from IT capital spending after a lag of 5 years and over a period of 2 years thereafter.

Meanwhile, Beccalli (2007) introduced the model 1-lag effect between realization of IT investment and potential benefit for firm performance. In another study, Zhang et al., (2012) claimed that the time-lagged effects do play an important role in determining the effects of Enterprise Resource Planning (ERP) implementation on firm performance. The researchers found that during the first 3 years after ERP implementation, the Tobin‘s Q for firm performance was insignificant; but significant increment was noted after four years of its implementation. Surprisingly, Hung et al., (2012) proved that the effect of IT investment was positive for firm financial performance based on lag-1 and lag-2 period models.

2.7 Summary of the Chapter

Many researches pertaining to firm performance and ICT investment have been reviewed in this study. From the light of financial measures, prior evidences portray that firm financial performance measurements have gained much attention, especially in determining the effect of ICT investment and corporate governance on firm financial performance. With that, both accounting- and market-based measures have been considered to be dependent variables in evaluating firm performance. As for ICT investment, this chapter extensively reviews ICT investment trends in developed and developing countries, including Malaysia. Besides, this chapter elaborates the influential factors of ICT investment based on the insights of general and Malaysian practices. In fact, the Malaysian government has been proactive in encouraging ICT investment activities to strengthen its development of ICT industry. Next, this chapter reviews past studies that evaluated the effect of ICT investment upon firm performance, as well as issues concerning measurement effect of ICT investment on firm performance. The next chapter taps into the aspect of corporate governance of ICT, which is embedded in this study to ascertain proper ICT investment implementation

CHAPTER THREE

LITERATURE REVIEW OF CORPORATE GOVERNANCE OF ICT

3.1 The Concept of Corporate Governance

In comprehending ICT corporate governance, it is necessary to first understand the concept of corporate governance (Leonida & Mulligan, 2005). Basically, corporate governance is designed to create an effective corporate culture of fairness, transparency, and accountability, so as to ascertain that stakeholders' interests are protected and to hinder any potential agency issues. Such responsibilities refer to the role of board in bringing in value to organization with successful performance (Cadbury, 1992). Besides, many nations have issued their Codes of Best Practices in Corporate Governance that assist corporations in addressing specific aspects of effective governance to promote high standards of corporate discipline, transparency, and accountability regarding corporate governance practices. This is because; implementation of proper corporate governance practices reduces risk for investors, attracts investment capital, and improves corporate performance (Rezaee, 2009).

Besides, corporate governance is a system that balances the best interests of its participants, including board of directors, typically known as the central to corporate governance, and other internal participants like executives and employees, while external participants are comprised of shareholders, debt holders, trade creditors, customers, and suppliers. In fact, it is an essential relationship of group system, which ensures that any decision the board makes would not be detrimental to the rest, but to move effectively in catering to the needs and interest of its wider stakeholders.

Corporate governance, hence, is defined as the manner in which corporations are directed, controlled, and held to account with special concern for effective leadership of the corporations to ensure that they deliver on their promise as a wealth-creating organ of the society in a sustainable manner (Wilson & Howcroft, 2002). In other definition, Jayashree (2006) defined the corporate governance as follows:

Corporate governance when used in the context of business organization is a system of making directors accountable to shareholders for effective management of the companies in the best interest of the company and the shareholders along with concern for ethics and values . It is a management of companies through the board of directors that hinges on complete transparency, integrity and accountability of management.

The above definition of corporate governance clearly emphasizes that the importance role of board of directors is not only in overseeing the management on behalf of shareholders (Adams, Hermalin, & Weisbach, 2010) but also responsible for setting the strategic directions and acts as a best counsellor while confronting crisis situations (Adams et al., 2010) as well as to communicate the true underlying financial information to the shareholders (Ow-Yong & Guan, 2000). The boards are directly accountable to the company shareholders and owe fiduciary duties to control and monitor company management processes and activities so that the interests of shareholders and stakeholders (clients and management) are optimally aligned and well-protected. Thus, the effective role of the boards could potentially increase firm performance (Abdullah & Mohd Nasir, 2004).

3.2 General and Current Issues of Corporate Governance

Most of the contemporary issues discussed in corporate governance are concerned with agency issues that can arise in corporations due to segregation of ownership and control (Berle & Means, 1932). The issue of ownership and control segregation was initiated by Adam Smith (1776) and followed by Berle and Means (1932), who also argued that the segregation of ownership and control in conglomerates could lead to potential conflict of interest among its agents (managers) in exploiting the company's wealth for their own benefits. Hence, the purpose of corporate governance is to determine corporate direction and performance through proper control of management in the best interest of the company. This corporate governance process has evolved from the theory of agency, where the principal owner of a company has to monitor the performance of agents (managers) in serving ownership interest (Hermalin & Weisbach, 2012; Lipartito & Morii, 2010; Fama & Jensen, 1983; Berle & Means, 1932). In the agency theory, there is a possibility that agents may confront moral hazards by exploiting principal to satisfy personal benefits (Miller & Sardais, 2011; Wong, 2011, Jensen & Meckling, 1976). In order to alleviate this agency problem, the principal might work in some difficult situations to monitor or to limit action of agents that can incur costly correctional behaviour (Jensen & Meckling, 1976), besides preventing the controlling owner from exploiting company resources (Abraham, 2010).

Meanwhile, another issue of concern related to corporate governance is the ownership structure, which is relatively varied across nations worldwide (Chen & Yu, 2012). In fact, firm ownership structure is defined based on two varied dimensions. According to Iannotta, Nocera, and Sironi (2007), the first nature of ownership focuses on the degree of ownership concentration among shareholders where firms differ from each other depending on their level of dispersion. Second, the nature of the owners is based on the type of shareholders. Thus, the ownership structure is a vital element in corporate governance for its proven ability in mitigating agency problems between shareholders (the principal) and managers (the agent) (Fauzi & Locke, 2012). However, literature studies depict that the nature of ownership cannot isolate itself from being a cause to agency problem in controlling shareholders and minority shareholders (La Porta et al., 1999), which is in accordance with the theory of agency. Besides Berle and Means (1932) suggested that division of ownership can cause potential conflict of interests between principal and agent.

According to the agency theory, the problem that occurs between these two conflicting parties also tends to increase agency costs (La Porta, Lopez-de-Silanes, Shleifer, & Vishny, 2000; Shleifer & Vishny, 1997; Morck, Shleifer, & Vishny, 1988; Shleifer & Vishny, 1986), which are internal costs incurred from asymmetric information to sustain an effective agency relationship. Normally, the controlling shareholders often spend substantial investment in equity to pursue their private benefits to fund their boards in managing the company on their behalf (Jensen & Meckling, 1976), so as to prevent them from acting for the best benefit of themselves. This situation vividly shows a complete control over firm in excess of real cash flow by controlling shareholders (majority shareholders). Furthermore, the disparities between control and ownership rights tend to cause agency problems because controlling shareholders may have incentives to abuse their power by appropriating firm resources (Abraham, 2010; Shleifer & Vishny, 1997; Morck et al., 1988) to accumulate wealth as private benefits of control. Most importantly, the conflict between these two parties can potentially affect firm performance.

In addition, the collapse of several high profile companies, such as Enron, WorldCom, Goldman Sachs, as well as the issue of the Boeing buyback, illustrates the catastrophic prevalence of agency issues. Moreover, many criticisms have been passed in relation to the malpractice of corporate governance due to serious deficiencies in governance practices. Besides, the corporate governance deficiencies are cantered on several factors, including weaknesses in management internal control, lacks of skills and capabilities, poor management communication with the board, and conflict of interests. With a string of problems found in the management of corporations, the effort to strengthen corporate governance mechanisms has become a key priority of reforms to enhance governance practices among corporations as a means of contributing to higher firm performance. In other words, corporate scandals have emphasised the need for broad and deep governance and management changes to strengthen firm performance via good governance practices.

In fact, many countries have issued their Codes of Best Practices in Corporate Governance that assist corporations in addressing specific aspects of effective governance; the Cadbury Report was produced in the UK, the Sarbanes Oxley in the US, the King‘s Report in South Africa, the Olivencia Report in Spain, the Dey Report in Canada, the Principles and Guidelines on Corporate Governance in New Zealand, and the Cromme Code in Germany, primarily to promote high standards of corporate discipline, transparency, and accountability regarding corporate governance practices (Bhagat & Bolton, 2009). Likewise other countries, the discovery of several cases of corporate misconduct that involved high profile companies in Malaysia, such as Perwaja, Renong Berhad, Sime Darby, Technology Resources Industries Berhad, and Malaysian Airline Systems, has forced the Malaysian government to empower its codes on corporate governance to ensure that good governance practices are served as an integral part of organizations. Although the codes of corporate governance have been revised several times to keep pace with the current market practices and to enhance the effectiveness of governance practices in organizations, challenges for incorporated good governance still do exist.

Moreover, as highlighted by experts, many organizations face vastly different challenges deriving from a wide range of risks. Some confront external challenges of geopolitical influence, terrorist threats, cyber-attack, and health risk, which may potentially affect the implementation of good governance in organizations. However, some of these challenges are seen as an opportunity to better serve the growth and the development of the organization. The advances in technology also aid in bringing effective changes for an organization to fit with the dynamic nature of strategy and competition (Deloitte, 2015). For example, Deloitte (2015) outlined several issues that are likely to affect companies and their board of directors, so that the board-management discussions around the on-going strategy are aligned with the present and future challenges. Besides, the Deloitte report also includes useful insights to help boards in identifying and seizing new opportunities, while simultaneously adopting a risk mitigation strategy to ensure that potential risks can be recognized and mitigated efficiently. As for ICT challenges, the report has emphasized the need for boards to be well-prepared for cyber-breach or social media attacks by embedding cyber security risk in their companies, protecting their reputation through their active role in their governance of best practice by overseeing, advising on, and increase monitoring on company from inherent cyber risks.

Moreover, the digital technology revolution is the biggest challenge faced by every board and company to date. Its revolution dramatically changes the company business model to a more dynamic way; making it even riskier if not handled properly. Based on the Deloitte survey, many traditional companies are still confronted with such problems due to lack of knowledge, as well as lack of expertise and experiences on how technologies like cloud, analytics, social media, and mobile can benefit them, leaving the companies behind to compete with those who are good at managing technology. Furthermore, investing in technology incurs large amounts of money and boards are at risk of failure if not regulated by proper governance. For example, the South African Local Government Association (SALGA) in its comprehensive guide to successful ICT governance emphasized that the growing importance of ICT in supporting company‘s strategy and the need to provide agility require any company to be able to use technology efficiently. As such, many companies have begun adopting ICT and its implementation must be well governed and controlled so as to ensure that ICT supports the objectives of the company (SALGA, 2012).

Given the present fast changing globalized operating environment and digital disruption, the issues of proper ICT governance practice and board diversity (Leblanc, 2012) in the corporate governance do matter (Deloitte, 2015). The issue is stressed on the need for the board members with diverse competencies, knowledge, and experiences to enhance the effectiveness of board discussion. Having a broad range of board capabilities, hence, may improve risk management and strategic planning, besides leading to good corporate governance practices. Moreover, given the implementation of ICT as a controversial issue for corporate governance practices, the next section focuses on ICT corporate governance.

3.3 The Effect of Corporate Governance on Firm Performance

Appendix II provides a number of sample studies in relation to the effect of corporate governance on firm performance. The results of these studies are inconsistent. Although corporate governance is seen as an important system to ensure that the management runs the business with the best interest of other stakeholders, the crisis associated with corporate governance has remained unresolved. Moreover, some recent studies showed mixed (Johl et al., 2015; Naushad, & Malik, 2015; Al-Matari et al., 2014; Qasim, 2014; Zakaria et al., 2014; Goh et al., 2013; Haniffa & Hudaib, 2006), negative (Yusoff et al., 2015; Wahba, 2015; Wan Yusoff & Alhaji, 2012), and nil effect (Wan Yusoff & Alhaji, 2012) of corporate governance on firm performance.

Nonetheless, others have proven that corporate governance is an effective mechanism for companies to breakthrough performance improvements (Haider et al., 2015; Naushad & Malik, 2015; Aggarwal, 2013a; Aggarwal, 2013b; Sami et al., 2011). Putting people to promote best practices and helping the company remain in the forefront of organization of good corporate governance is definitely not an easy task. This is because; effective corporate governance must be associated with diverse people (Deloitte, 2015; Leblanc, 2012), along with a proper mix of skills, experiences, background (OECD, 2009), and knowledgeable (Financial Reporting Council, 2012). The scope of board governance role has to be extended, not only restricted in structuring and attaining the objectives via proper monitoring of firm performance, but also that their area of expertise has to be extended in specific ICT knowledge to constitute an effective corporate governance team with higher order thinking skills in questioning not only about ICT risks and expenses, but also competitive risks (Nolan & McFarlan, 2005).

3.4 Corporate Governance in Relation to Corporate Governance of ICT

While corporate governance refers to the combination of processes and structures to be implemented by board of directors for they are responsible to protect shareholder‘s value through transparency and openness, in which the extremely sophisticated pervasive use of ICT has led to critical dependency on ICT that demands more focus on ICT corporate governance. Hence, ICT corporate governance specifically focuses on board responsibility to ensure better decision-making process for ICT-related investments and for operational efficiencies of the company to remain transparent and are upheld. This accountability process enables a company to enhance its performance through great strategy deployment for return on ICT investment by monitoring and optimising benefits at an affordable cost with a reasonable level of risk (SALGA, 2012).

Besides, the notion of ICT governance can be divided into two, namely corporate governance of ICT and governance of ICT, by weighing in the different roles played by various components or groups in a firm. In fact, the corporate governance of ICT (CGICT) can be denoted as –a system by which the current and future use of ICT is directed and controlled that involves evaluating, directing plans, as well as monitoring the alignment of company ICT strategy and policies in order to achieve plans" (ISO/IEC 38500: 2008). On the other hand, the concept of governance of ICT reflects on the effective and efficient management of ICT resources to facilitate company strategic objectives (King III: 2009). As such, CGICT has become an integral part of the corporate governance system in a company (Van der Walt, Coetsee, & Von Solms, 2013; SALGA, 2012; Mueller, Magee, Marounek, & Phillipson, 2008; Carroll, Ridley

& Young, 2004; ITGI, 2003), but poorly executed governance could affect company performance in a negative manner (Van der Walt et al., 2013).

In general, the adoption of ICT governance is aimed at ensuring that ICT endeavours are in line with company objectives: (1) Alignment of strategic ICT to create business value from ICT; (2) ICT enhances company to exploit opportunities and maximise benefits; (3) responsible use of ICT resources; and (4) appropriate handling of ICT risk management (ITGI, 2003). In attaining ICT governance objectives, a proper planning process is a key point that affects a company. A company cannot effectively achieve its ICT governance objectives without high level management support. In fact, this issue has reached the boards' awareness about the importance of having strong and effective ICT governance framework to cater to the needs of its stakeholder requirements, while achieving its highest business purposes at an acceptable level of risk. Nevertheless, no one single proper CGICT model suits all companies (Zhang & Chulkov, 2011; Hagen, 2008) due to the varied nature of business (De Haes & Van Grembergen, 2004) in terms of business markets, products, channels, and customer needs. The board governance itself, hence, must develop in-depth understanding of what a company really wants to achieve. In doing so, the board should be able to address several critical questions on how the CGICT model should be: What decisions must be made to ensure appropriate management and use of ICT? Who is responsible for making these decisions? How will these decisions be implemented and monitored?

Hence, in executing ICT governance, it is a collective responsibility that is shouldered by the board of directors and the management executives, which consist of leadership strategy, organizational structures, processes, and mechanisms to ascertain that the enterprise ICT does sustain and extend the strategies and objectives outlined (ITGI, 2003). However, its execution should have clear governance structures to monitor the progress of ICT implementation because varied organizations may have different combinations as their structures, processes, and relational mechanisms (De Haes & Van Grembergen, 2004). In line with this, De Haes and Van Grembergen (2004) proposed a comprehensible framework developed by Peterson (2003), which demonstrated the correlations between ICT governance structures, processes, and relational mechanisms, as presented in Table 3.1. ICT governance structures describe the functions of IT executives and other IT committees.

Table 3.1 ICT Governance Structures, Processes, and Relational Mechanisms

Structures, Processes and Relational Mechanisms for IT Governance				
	Structures	**Processes**	**Relational Mechanisms**	
Tactics	IT executives and accounts Committees and councils	Strategic IT decision-making Strategic IT monitoring	Stakeholder participation Business/ IT partnerships	Strategic dialog Shared learning
Mechanisms	- Roles and responsibilities - IT organization structure - CIO on board - IT strategy committee - IT steering committee(s)	- Strategic information systems planning - Balanced (IT) scorecards - Information economics - Service level agreements - COBIT and ITIL - IT alignment/ governance maturity models	- Active participation by principal stakeholders - Collaboration between principal stakeholders - Partnership rewards and incentives - Business/ IT colocation	- Shared understandings of business/ IT objectives - Active conflict resolution (non avoidance) - Cross functional business/IT training - Cross functional business/IT job rotation

Source: Adopted from Peterson (2003), Information Strategies and Tactics for Information Technology Governance, in Strategies for Information Technology Governance, Idea Group Publishing, Pennsylvania, USA.

Meanwhile, ICT processes refer to strategic decision-making and monitoring, whereas relational mechanisms are comprised of business/ IT participation, strategic dialogue, shared learning, and proper communication (De Haes & Van Grembergen, 2004; Van Grembergen, De Haes, & Guldentops, 2004; Peterson, 2003). The study also emphasized the roles of individuals involved in the ICT governance framework. Thus, the roles of the boards and ICT management are crucial in assuring ICT governance

(De Haes & Van Grembergen, 2004). For example, the Chief of Executive (CEO) is responsible for carrying out and implementing strategic direction, goals, and policies that have been decided at the board level. The CEO also should ensure that everyone within the company (the Chief of Information and other senior management) is aware of the objectives of the board so that all can walk in the same direction. In fact, ICT expertise at the management level is the main pillar of any company to ensure that ICT strategy is implemented in the best interest of company needs. However, depending solely on ICT management expertise can potentially put the board of directors at risk. As such, boards need to expand their ICT know-how to maximize values derived from ICT. Thus, the importance of ICT expertise among boards should be seriously considered, or else, they would fall into a difficult situation to regularly capture vital knowledge concerning current business models, management techniques, technologies, as well as potential benefits and risks, that are closely related to ICT management executives.

The effectiveness of CGICT is highly dependent on the effectiveness of management practices via proper governance and management systems in a company. According to Hagen (2008), the CGICT, at its best, reaches a balance as an adequate support function to approach all company business units with specific emphasis on the unique needs of each. Besides, its effectiveness is a crucial success factor that contributes to better harmonization and coherence with respect to ICT security levels, ICT project management methodologies, and in general, ICT systems, as well as an enabler to enhance both effectiveness and efficiency of a company in facilitating change management (Zhang & Chulkov, 2011). To this end, the mechanism of CGICT should ensure that the decision-making processes, including strategic direction, planning, and investment decisions of ICT, are driven by proper conduct so as to enable close alignment of ICT in meeting company needs, as well as those of stakeholders.

3.5 ICT Issues in Relation to Corporate Governance

3.5.1 ICT Governance Standards and Best Practices

3.5.1.1 General Standards of ICT Governance

A strong focus on building and sustaining transparent ICT governance framework is essential in assuring good governance conduct that covers all company support mechanisms. The best practices to deal with complex processes, however, with a good approach, can help realize the goals outlined. In formulating the ICT governance framework, the best practice of continuous integration should embed prevailing standards of CGICT best practices. Moreover, as the present development of ICT process has become more complex and risky, the CGICT would underscore the need for applying elements from a wide variety of local and international best standards of ICT governance.

ICT GOVERNANCE STANDARDS AND BEST PRACTICES

- ISO/IEC JTC 1/SC 40 IT Service Management and IT Governance
- COBIT (Control Objectives for Information and Related Technologies)
- King III Code of Governance
- Information Security Techniques (ISO/IEC JTC 1/SC 27)
  - ISO 27001 Information Security Management System (ISMS)
  - ISO 27002 Information Security Standard
  - ISO/IEC 24762 ICT Disaster Recovery Services

Figure 3.1: ICT Governance Standards and Best Practices
Sources: The International Electrotechnical Commission (2016); SALGA (2012); The International Organization for Standardization (2013; 2008).

Such emergence of the latest ICT governance, in relation to standards and best practices illustrated in Figure 3.1, consists of ISO/IEC JTC 1/SC 40, COBIT (Control Objectives for Information and Related Technologies), King III Code of Governance, and Information Security Technique, which can help the board of directors to foster good ICT governance culture in the company. The ISO/ IEC JTC 1/SC 40 IT Service Management and IT Governance refers to a standardization subcommittee of the Joint Technical Committee ISO/ IEC JTC 1 of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC)[5]. Besides, John Sheridan, who is the Chairman of ISO / IEC JTC 1/SC 40 IT Service Management and IT Governance, has suggested that the development of ISO/ IEC TC 1/SC 40 offers good standard of practice to companies, including the areas of ICT activities like audit, digital forensics, governance, risk management, outsourcing, service operations, and service maintenance.

In addition, Table 3.2 presents the list of ISO/ IEC JTC 1/SC 40 program standards, which are believed to assist companies in achieving ICT benefits through the best practice frameworks and standards offered. Furthermore, the implementation of IT Service Management (ITSM) is often associated with Information Technology Infrastructure Library (ITIL), which exposes a company to strategic approaches with the right people, processes, and technology in place so that the company can attain its business needs. Nonetheless, ITIL differs from ITSM. ITSM refers to the actions taken to manage the services delivered to customers. In fact, ITIL is the best practice framework of ITSM, where ITIL helps one to work more efficiently (Rance, 2015).

[5] The IEC is the world‘s leading organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

Table 3.2 List of ISO/ IEC TC 1/SC 40 Standards

ISO/IEC Standard	**Title of Programs**
ISO/IEC 20000	IT Service Management
ISO/IEC 30105	IT Enabled Services-Business Process Outsourcing
ISO/IEC 30121	IT Governance of Digital Forensic Risk Framework
ISO/IEC 38500	IT Governance for Organization
ISO/IEC TS 38501	IT Governance Implementation Guide
ISO/IEC TR 38502	IT Governance Framework and Model
ISO/IEC TR 38503	IT Governance [Guidance on the Audit of the Government of IT]
ISO/IEC TR 38504	The Structure of Principles-Based Standards in the Government of IT
ISO/IEC 38505	IT Governance: Part 1: The Application of ISO/IEC 38500 to the Governance of Data

Source: https://en.wikipedia.org/wiki/ISO/IEC_JTC_1/SC_40

ITSM involves activities like planning and managing changes, fixing things that may go wrong, as well as properly managing budget to ensure that companies are running their ICT systems efficiently. In order for companies to be more effective, efficient and agile at their ICT services, Rance (2015) argued that ITIL provides a best practice framework in empowering the ITSM by ensuring the benefits of technology-centric and customer-centric design philosophies are realized by the companies. The ISO/IEC 30121 emerges as the best guide framework for corporate boards to conduct digital investigations related to cyber-crime. Moreover, the emergence of the latest revision of ISO/IEC 38500:2015 offers guiding principles for corporate boards to deploy good ICT governance practices within a firm that emphasizes on the top level management responsibility. Meanwhile, the latest version of ISO/IEC TS 38501 provides guidance on how organizations manage their implementation arrangements for effective IT governance.

Besides, the ISO/IEC TR 38502 is seen as the best standard because it offers guidance on the nature and mechanisms between governance and management level for the present and future use of IT. However, ISO/IEC TR 38503, ISO/IEC TR 38504, ISO/IEC 38505, and ISO/IEC 30105 standards are still under development[6]. The Control Objectives for Information and Related Technology (COBIT) is a framework developed by the Information Systems Audit and Control Association (ISACA) in 1996, while the present version of COBIT 5 was published in 2012. COBIT 5 is a consolidation of COBIT4.1, Val IT, and Risk IT that helps companies in managing their IT risk in a manageable and logical structure to enhance their governance and management of ICT. The five principles held by COBIT 5, as portrayed in Figure 3.2, is a comprehensible framework that benefits all companies, regardless of their size, geography, or industry (ISACA, 2012).

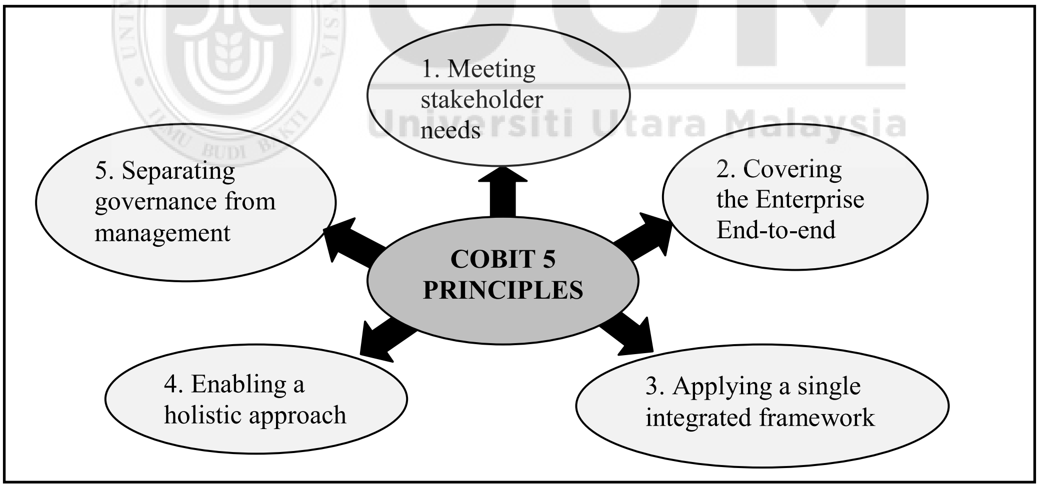

Figure 3.2: COBIT 5 Principles
Source: COBIT® 5© 2012 ISACA® All rights reserved

The first core principle of COBIT emphasizes on meeting the needs of stakeholders, which are important to embed ideas generated by stakeholders to ensure that their input can optimize the utilization of resources and minimize complexities in their attempt to maximize benefits. The second principle stresses that COBIT 5 is not only

[6] https://en.wikipedia.org/wiki/ISO/IEC_JTC_1/SC_40

applicable to the ICT department, but it also covers the use of information and ICT for all parts of business processes, ICT development, and its implementation activities. In the application of a single integrated framework, COBIT offers a complete framework that includes all aspects of information storage, flow, and processing; hence providing a foundation for a more efficient control implementation that could aid companies to optimize resources efficiently, maximise benefits, and minimise complexities. The fourth principle enables a holistic approach as it is comprised of the following seven enablers to support ICT governance and management practices: (1) Principles, policies, and framework; (2) Processes; (3) Organizational structure; (4) Culture, ethics, and behaviour; (5) Information; (6) Service infrastructure applications; as well as (7) People, skills, and competencies. At the governance level, the COBIT 5 emphasizes on the boards' responsibility to ensure that stakeholders' needs, setting direction, decision-making, and monitoring performance are achieved successfully; while at the management level, the executive management ensures that planning, building, and monitoring activities are in line with those determined at the governance level.

Next, the King III Code on Governance was released by the Institute of Directors on 1st September 2009, which came into effect and replaced the then existing King II Code on Governance established on 1st March 2010 (SALGA, 2012). The King III Code strengthens past requirements of King I and King II by improving the guidelines and introducing new recommendations to iron out issues of practices. Hence, this Code promotes the best standards of corporate governance practices in companies. Nine important key requirements with some new changes that have been addressed in the new code are given in the following: (1) Ethical leadership and corporate citizenship; (2) Boards and directors; (3) Audit committees; (4) The risk governance;

(5) The ICT governance; (6) Compliance with laws, codes, rules, and standards; (7) Internal audit; (8) Governing stakeholder relationships; as well as (9) Integrated reporting and disclosure. In respect of the new requirements in ICT governance, the King III Code on Governance has clearly demonstrates the tasks of the boards and management through seven principles that cover several themes of the code, as displayed in Table 3.3.

Table 3.3 King III Code on Governance of ICT

Principles		**Recommended Practice**	
King III Section	Principle	Sub section	Practice
5.1	The board should be responsible for information technology (IT) governance	5.1.1	The board should assume the responsibility for the IT governance and place it on the board agenda
		5.1.2	The board should ensure that an IT charter and policies are established and implemented.
		5.1.3	The board should ensure the promotion of an ethical IT governance culture and awareness on IT language.
		5.1.4	The board should ensure that an IT internal control framework is adopted and implemented.
		5.1.5	The board should receive independent assurance on the effectiveness of the IT internal controls.
5.2	IT should be aligned with the performance and sustainability objectives of the company	5.2.1	The board should ensure that the IT strategy is integrated with the company's strategic and business processes.
		5.2.2	The board should ensure that there is a process in place to identify and exploit opportunities to improve the performance and sustainability of the company through the use of IT.
5.3	The board should delegate to management the responsibility for the implementation of an IT governance framework	5.3.1	Management should be responsible for the implementation of the structures, processes and mechanisms for the IT governance framework.
		5.3.2	The board may appoint an IT steering committee of similar function to assist with its governance of IT.
		5.3.3	The CEO should appoint a Chief Information Officer (CIO) responsible for the management of IT.
		5.3.4	The CIO should be a suitably qualified and experienced in accessing and interacting regularly on strategic IT matters with the board and/or appropriate board committee and Executive management.

Source: South African Qualifications Authority, SALGA (2012).

Table 3.3 King III Code on Governance of ICT (continued)

Principles		**Recommended Practice**	
King III Section	Principle	Sub section	Practice
5.4	The board should monitor and evaluate significant IT investments and expenditure	5.4.1	The board should oversee the value delivery of IT and monitor the return on investment from significant IT projects.
		5.4.2	The board should ensure that Intellectual Property (IP) contained in information systems is protected.
		5.4.3	The board should obtain independent assurance on the IT governance and controls supporting outsourced IT services.
5.5	IT should form an integral part of the company's risk management	5.5.1	Management should regularly demonstrate to the Board that the company has adequate business resilience arrangements in place for disaster recovery.
5.6	The board should ensure that information assets are managed effectively	5.6.1	The board should ensure that there are systems in place for the management of information which should include information security, information management and information privacy.
		5.6.2	The board should ensure that all personal information is treated by the company as an important business asset and is identified.
		5.6.3	The board should ensure that an Information Security Management System is developed and implemented.
		5.6.4	The board should approve the information security strategy and delegate and empower management to implement the strategy.
5.7	A risk committee and audit committee should assist the Board in carrying out its IT responsibilities	5.7.1	The risk committee should ensure that IT risks are adequately addressed.
		5.7.2	The risk committee should obtain appropriate assurance that controls are in place and effective in addressing IT risks.
		5.7.3	The audit committee should consider IT as it relates to financial reporting and the going concern of the company.
		5.7.4	The audit committee should consider the use of technology to improve audit coverage and efficiency.

Source: South African Qualifications Authority, SALGA (2012).

In fact, a company‘s most valuable strategic asset is its information and if not managed properly, it can worsen the process of achieving company‘s desired outcome. Meanwhile, the ISO/IEC 27001 of Information Security Management System (ISMS) is designed to help companies in ensuring that their information resources are effectively managed and remain secure. Thus, the development of Information Security Policy ensures that effective documented security control is in place that applies to house employees, as well as to suppliers and others with businesses related to company.

Table 3.4 ISO/IEC 27002 Control

ISO/IEC 27002 Control			
Sections	**Clauses**	**Sub Sections**	**Control Objectives**
5	Information Security Policies	5.1	Management direction for information security
6	Organization of Information Security	6.1	Internal organization
		6.2	Mobile devices and teleworking
7	Human Resource Security	7.1	Prior to employment
		7.2	During employment
		7.3	Termination and change of employment
8	Asset Management	8.1	Responsibility for assets
		8.2	Information classification
		8.3	Media handling
9	Access Control	9.1	Business requirements of access control
		9.2	User assess management
		9.3	User responsibilities
		9.4	System and application access control

Source: ISO/IEC 27002: 2013[7].

[7] http://www.iso27001security.com/html/27002.html

Table 3.4 ISO/IEC 27002 Control (continued)

ISO/IEC 27002 Control			
Sections	**Clauses**	**Sub Sections**	**Control Objectives**
10	Cryptography	10.1	Cryptographic controls
11	Physical and Environmental Security	11.1	Secure areas
			Equipment security
12	Operations Management	12.1	Operational procedures and responsibilities
		12.2	Protection from malware
		12.3	Backup
		12.4	Logging and monitoring
		12.5	Control of operational software
		12.6	Technical vulnerability management
		12.7	Information systems audit considerations
13	Communications Security	13.1	Network security management
		13.2	Information transfer
14	System Acquisition, Development and Maintenance	14.1	Security requirements of information systems
		14.2	Security in development and support processes
		14.3	Test data
15	Supplier Relationships	15.1	Information security in supplier relationships
		15.2	Supplier service delivery management
16	Information Security Incident Management	16.1	Management of information security incidents and improvements
17	Business Continuity Management	17.1	Information security continuity
		17.2	Redundancies
18	Compliance	18.1	Compliance with legal and contractual requirements
		18.2	Information security reviews

Source: ISO/IEC 27002: 2013.

Furthermore, the ISO/IEC 27001 does not mandate specific information security controls as it only formally defines the mandatory requirements for ISMS. However, ISO/IEC 27002 does indicate suitable information security controls within ISMS, whereby companies are free to implement controls as they see fit. The latest revision (as of January 2015) of ISO/IEC 27001 was published in 2013, namely ISO/IEC 27001: 2013, incorporates a section called Annex A that has information security control objectives and information security controls, derived from and aligned with ISO/IEC 27002: 2013 sections 5 to 18, as depicted in Table 3.4.

Next, the latest version of ISO/IEC 24762 is developed to offer guidance to firms on the provision of ICT Disaster Recovery Services (ICT DR) within the context of business continuity management. This standard supports the operation of Information Security Management System (ISMS) to helps companies in ICT protection and recovery strategy to ensure effective business continuity. Data of a company might be at high risk with improper data backup or disaster recovery solution. Loss of data arising from the use of ICT resources can cause major losses for companies, hence should be avoided wherever possible.

3.5.1.2 ICT Governance from the Malaysian Perspective

Furthermore, the advent of ICT has brought about a phenomenal change in business environment (Weill, 2004; Weill & Ross, 2004). This cloud phenomenon reinforces the need of ICT governance for optimum ICT performance (Milne & Bowles, 2009) and to create value for companies (Van Grembergen & De Haes, 2010; Silvius, Waal, & Smit, 2009; Guldentops, 2004). Thus, both private and public sector companies need good ICT governance (Ali, Green, & Parent, 2009) to ensure that their ICT strategies are aligned, directed, and monitored to support their business goals and objectives (Chun, 2005; ITGI, 2003).

In Malaysia, several ICT frameworks have been developed by the Malaysia Administrative Modernization and Management Planning Unit (MAMPU) as baselines for ICT governance, but the MAMPU model did not specifically integrate each framework into a single adequate ICT governance practices model (Maidin & Arshad, 2010). Besides, past studies also found that the adoption of ICT governance practices and its acceptance in Malaysian companies is rather low (Kaur et al., 2012; Othman et al., 2011; Teo & Tan, 2010). For instance, prior studies on electronic manufacturing companies (Tan, Eze, & Teo, 2008), as well as manufacturing and industrial service companies (Teo & Tan, 2010) in Malaysia found that the level of awareness for ICT governance framework was discouraging and room for improvement is available to familiarise with the technicalities of ICT governance framework. Besides, Othman et al., (2011) examined the level of IT governance adoption and maturity level among 51 organizations from various sectors in Malaysia. The survey results showed that about 50% of the organizations were less matured in their IT governance practice and further suggested the low adoption of IT governance practices by the sample.

Next, according to the Malaysian Code on Corporate Governance (MCCG) 2012, under principle 7.2, the board of directors from listed companies are encouraged to effectively leverage ICT in order to empower their shareholders with timely and comprehensive dissemination of information via various ICT channels (MCCG, 2012). The elements of board charter should also be addressed by companies to ensure effective ICT use. However, no exemplar standard or framework is available to support such requirement. Hence, in realizing Malaysia‘s Vision 2020, the Malaysian Public Sector ICT Strategic Plan, the former Director-General of MAMPU, Dato‘ Mohamad Zabidi Zainal (2011), stated that the Malaysian government has fostered continuous effort in empowering the Malaysian Public Sector ICT strategic direction (ISP). Figure 3.3 shows seven strategic objectives to be achieved in the Malaysian Public Sector ISP (2011-2015), where the objectives revolve around ICT governance.

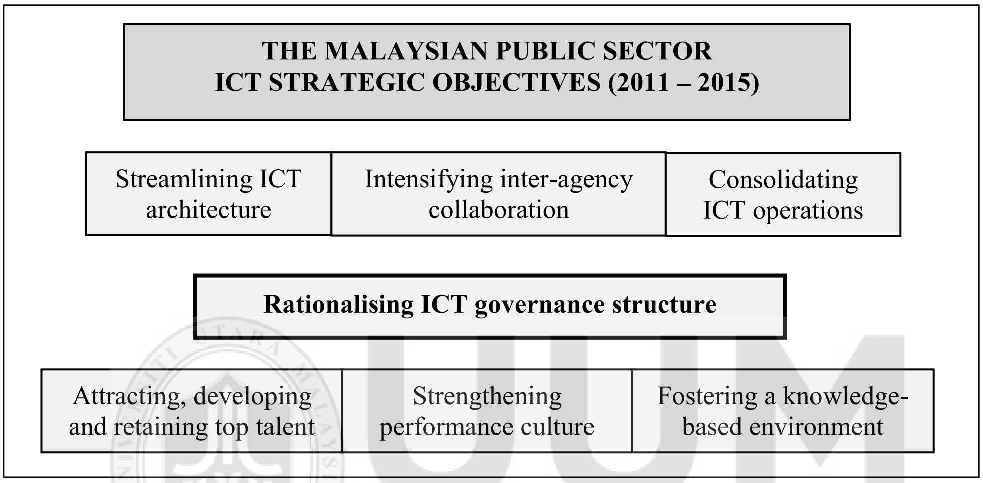

Figure 3.3: The Malaysian Public Sector ICT Strategic Objectives (2011 – 2015)
Source: The Malaysian Public Sector ICT Strategic Plan (2011 – 2015).

Apart from the pillar of change management, Figure 3.4 illustrates that ICT governance is another important pillar in the Malaysian Public Sector ICT Framework in determining a strategic direction at every stage of ICT implementation. This ICT Framework identifies several components in an integrated innovation infrastructure and information structure to support both short and long term growth, as well as the development of the Malaysian Public Sector ICT capability. In addition, the Malaysian Public Sector ICT strategic plan (2011-2015) also highlights five important areas in ICT governance, as proposed by ITGI (2008) that need to be highlighted in order to attain ICT strategic objectives. Each focus area of ICT governance presents a distinct value proposition, as demonstrated in Figure 3.5.

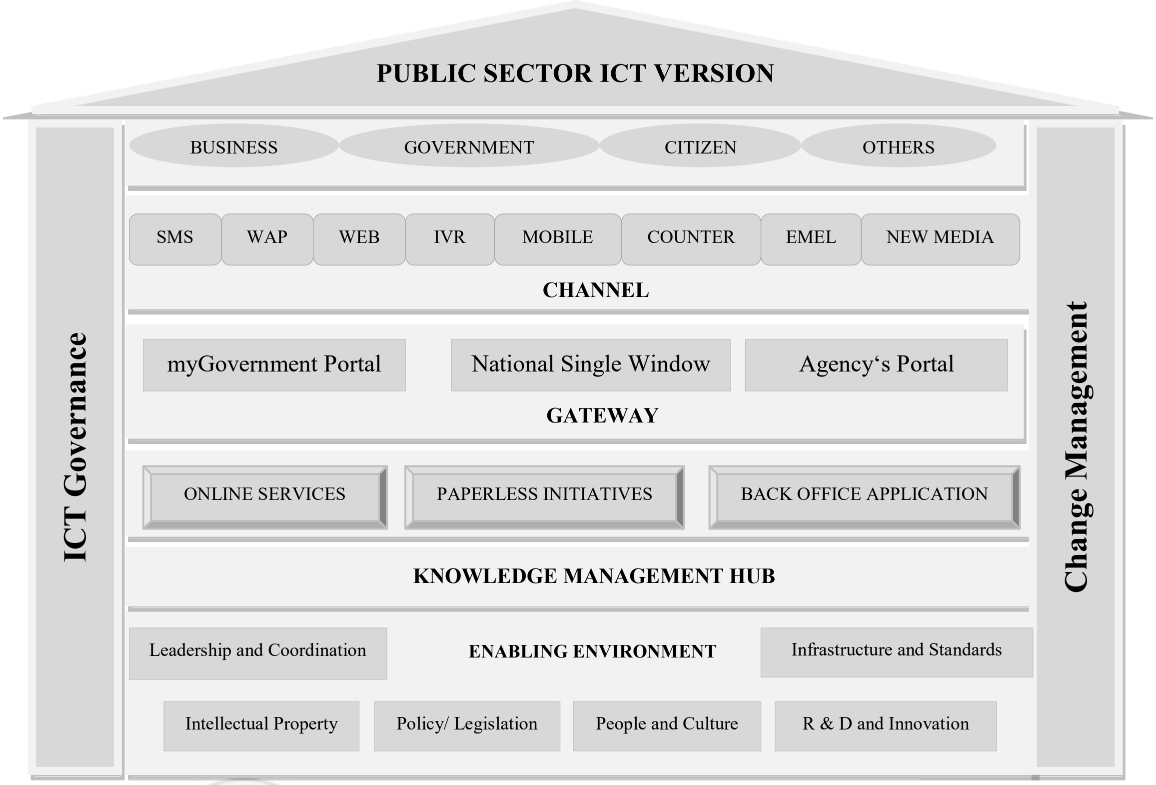

Figure 3.4: The Malaysian Public Sector ICT Framework
Source: The Malaysian Public Sector ICT Strategic Plan (2011 – 2015).

As the critical national information infrastructures (CNIIs) have become larger and more complex; defending the entire infrastructure is essential to prevent any issue that can cause a domino effect and further affect other sectors. Moreover, the mandatory imposed in 2010 by the Malaysian government required all public sector CNIIs related organizations[8] to be ISMS and certified to MS ISO/IEC 27001:2007 by 2013. Furthermore, the Malaysian CyberSecurity (2015) asserted that CNIIs are comprised of IT assets, systems, and functions vital to the nation, whereby any destructive action would result in devastating impacts on national economic strength, defence and security, national image, the continuous abilities of the government to function, as well as in managing citizen health care system. On top of that, Othman and Chan (2013), from their observation regarding CNIIs' ISMS compliance, only 14 out of 300

[8] It refers to all the Malaysian critical sectors including the Government, financial and ICT sectors to reduce risks of cyber security incidents (KPMG, 2015; JPM, 2010) under the provisions in the Electronic Government Activities Act 2007, the Financial Services Act 2013 as well as the Communication and Multimedia Act 1998.

listed CNIIs in Malaysia are certified by ISO/IEC 27001. Of that, only 6 public sector agencies are certified to ISO/IEC 27001.

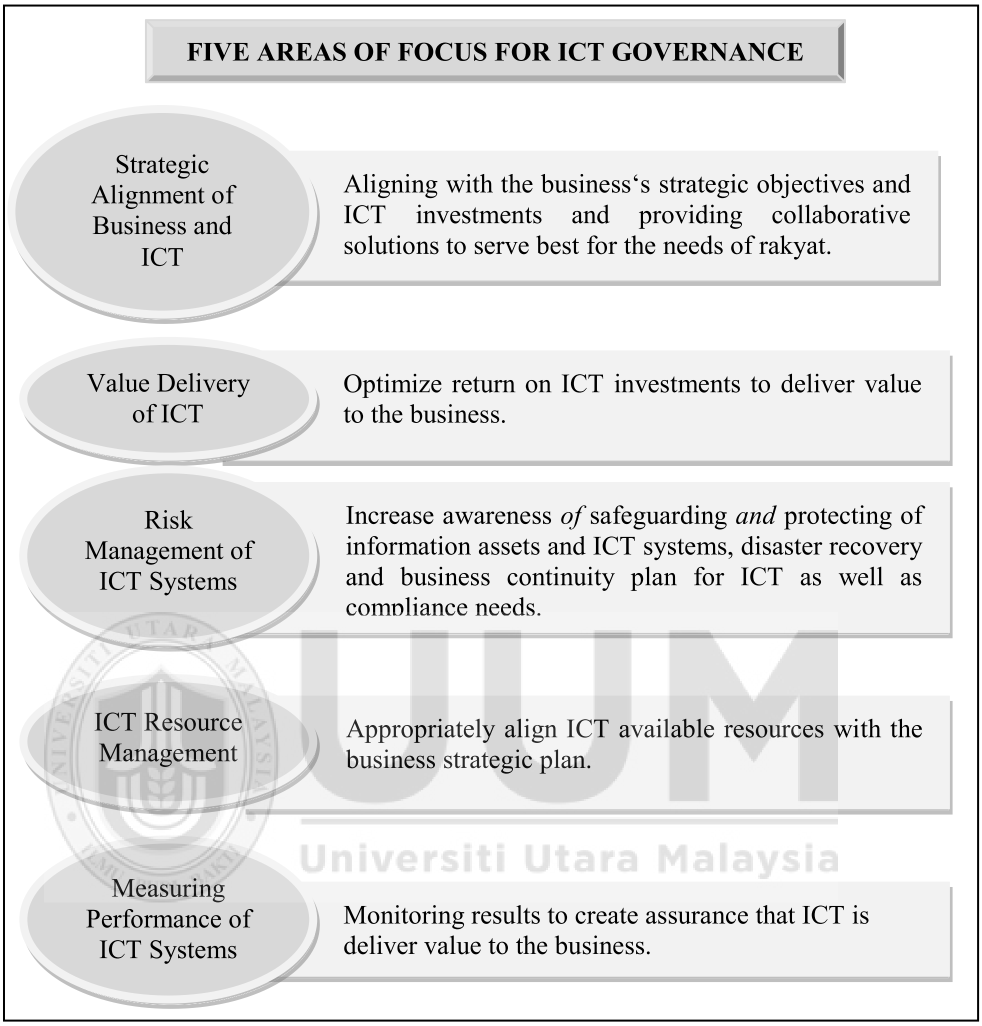

Figure 3.5: Five Areas of Focus for ICT Governance
Source: The Malaysian Public Sector ICT Strategic Plan (2011 – 2015).

Even with many well-established frameworks, tools, and standards of ICT governance available, the Malaysian government agencies are still insufficiently comprehensive in serving and managing their own systems in-house (Hamim & Sulaiman, 2015). Due to such critical situation, Hamim and Sulaiman (2015) proposed an in-house system development governance framework for the Malaysian Public Service Department (MPSD), as given in Table 3.5 by adapting some related values from the established framework, including IT governance, COBIT® 4.1, and 3P Model frameworks. The combination of these three general frameworks is believed to offer a proper guideline to the Malaysian government agencies to enhance their strategy to help bridge the gap communication between IT and business people, so that every participant involved in the framework can understand clearly their own roles and responsibilities during each stage of information system development.

Table 3.5 A Proposed In-House System Development Governance Framework

<table>
<tr><th colspan="3">A Proposed In-House System Development Governance Framework</th></tr>
<tr><th>IT Governance</th><th>COBIT® 4.1</th><th>3P Model</th></tr>
<tr><td>Outcomes:
• Value delivery
• Risk management</td><td>Four domains:
• Plan and organize
• Acquire and implement
• Deliver and support
• Monitor and evaluate</td><td>Processes
(Governance mechanisms include maturity assessment, strategic alignment, service management, risk management and performance management)</td></tr>
<tr><td rowspan="2">Driver:
• Strategic alignment
• Resource management
• Performance measurement</td><td>34 IT Control Objectives</td><td>People
(Governance structures include business monarchy, IT monarchy, federal, IT duopoly and anarchy)</td></tr>
<tr><td>Metrics
Benchmarking (Capability Maturity Model)</td><td>Portfolio
(Governance areas include IT infrastructure, IT applications, IT projects and IT services)</td></tr>
</table>

Source: Adapted from Hamim and Sulaiman (2015)

3.5.2 Issues Associated with ICT Implementation Failure

Over the years, the acquisition and implementation of ICTs have been faced with many challenges. Besides, many recent studies have shown a number of ICT projects that have either failed completely or exceeded their budget and deadlines. The continuous high failure level of ICT projects, thus, should be a serious concern for businesses at present times because the process of acquiring and implementing ICT usually involve large initial capital investments.

For example, Solon (2015) highlighted the UK government ICT spending, which was investigated using a wide range of departments and wasting more than £100 million in taxpayers' money on failed or cancelled IT projects from 2013 until 2014. For instance, about £56.3 million was wasted for in-house system development in the Ministry of Justice. The £27.2 million spent on the My Benefits Online (MyBOL) project to assist claimants to access their claims via online system was also not successfully managed, whereas £4.7 million was wasted on electronic patient records development for the North Midlands and East of England.

Table 3.6 Project Resolution Results from CHAOS Research for years 2004 to 2012.

	2004	**2006**	**2008**	**2010**	**2012**
Successful	29%	35%	32%	37%	39%
Failed	18%	19%	24%	21%	18%
Challenged	53%	46%	44%	42%	43%

Source: The Standish Group Report (2013).

Besides, another surprising project resolution resulted from CHAOS Research conducted by the Standish Group (2013) from 2004 until 2012, as depicted in Table 3.6, revealed disturbing results about the accomplishment of ICT projects in US and European firms, while the 2013 survey report, which is based on the 2012 CHAOS results, revealed that 39 per cent of ICT projects in all companies of all sizes had been successful, which meant they delivered on time, on budget, as well as with required features and functions. Unfortunately, the remaining 43 per cent and 18 per cent were challenged (ICT projects with exceeding budget, delayed, and failed in meeting the required features and functions) and failed (cancelled projects prior to completion or delivery and never used), respectively. Although the 2012 results showed an improvement in ICT projects, the success and failure rates for ICT projects were insignificant. The 39 per cent of success rate for ICT projects was still low compared to 61 per cent that reflected failed or challenged ICT projects.

Moreover, based on the sample of 1,471 ICT projects in US and UK companies, Flyvbjerg and Budzier (2011) discovered that the average cost overrun of projects was 27%. However, the researchers were more alarmed by the fact that one in six projects had cost overruns of 200% on average and almost 70% experienced schedule overrun. Meanwhile, another 2011 research was conducted in *consultation* with the *Victorian Auditor-General's* Office (VAGO) to investigate the ten high risk and complex projects, which involved high dollar investment across a range of departments and agencies in the Victorian public sector (Victorian Ombudsman, 2011). The study depicted that all ten ICT-enabled projects failed in meeting expectations and ran an over budget. The original budget for these projects totalled up to $1.3 billion; but additional cost of $1.44 billion was added to the projects due to failure in meeting delivery schedule.

Meanwhile, from the Malaysian context, about RM2.59 million of ICT investment was wasted via several ICT project software programs (Pharmacy Enforcement Management System and Pharmacy Management System) approved by the Malaysian Health Ministry. Thus, the Ministry of Health has ended its contract with the company that developed the systems due to the failed projects (Bernama, 2012). Moreover, Goh Thean Eu, who is a technology business journalist of the Digital News Asia (2015), reported a recent case of ICT project failure in Malaysia experienced by YTL

Communications Sdn Bhd in 2014. The company received a great deal of attention in the press as its ability to reach breakeven target by the end of 2016 was questioned.

Other than that, the Malaysian Ministry of Education was awarded the 1BestariNet project worth about RM663 million to YTL Comms in 2011. However, in 2014, the Ministry fined the company with RM2.4 million for failing to provide 10,000 schools with the 1BestariNet e-learning solution. In an attempt to prevent a similar disaster from happening again, many companies have learnt the lessons from past projects, hence putting pressure on them to address the issues or factors that contribute to ICT project failures. In fact, prior studies have extensively pinpointed the factors that contributed to ICT project failure (Standish Group, 2014; Nawi et al., 2012; Al-Ahmad, et al., 2009). Al-Ahmad et al., (2009) classified six domain factors that contributed to ICT project failure, including project management, top management, technology, organizational factors, complexity factors, and processes.

Additionally, Table 3.7 presents the ICT project failure and the classified failure factors developed by Nawi et al., (2012). The researchers analysed over 28 symptoms attributed to ICT project failure in the Malaysian public sector and classified the symptoms into three major types of project failure, namely project failure (a project that fails in meeting the agreed specifications like functional requirements, budgets, or completion deadline), system failure (an improperly-working control system where the system did not end up being used in the way intended), and user failure (a system that fails to solve problem of user due to recalcitrance, lack of training and ability of staff, as well as intricacy of the new system) (Goldfinch, 2007; Wilson & Howcroft, 2002).

Meanwhile, the Standish Group (2014) listed several factors that contributed to each ICT project success, fail, and challenge, as presented in Table 3.8. These factors were analysed and ranked by IT executive managers, who were interviewed to respond to the survey. Among the many factors that contribute to ICT failure, the most frequently cited causes found in past studies were closely related to human failure factors, such as lack of user participation, lack of technology competencies, lack of executive management support, lack of planning, and lack of ICT management. As a conclusion, human factors should be addressed carefully to ensure that ICT projects can successfully deliver the required outcomes on time, budget, as well as the overall ICT requirements and specifications.

Although previous studies have highlighted many critical success factors of ICT implementation, many projects have continuously failed. By looking at the potential of ICT is increasingly in doubt, serious attention must be given to ensure that the implementation of ICT is accompanied by proper governance oversight roles in the right direction. Since most factors presented in previous studies displayed association with human factors, the next section shall focus on how issues surrounding ICT could be related to corporate governance practices and how this relationship can lead towards better firm performance.

Table 3.7 ICT Project Failure and Classified Failure Factors

	Failure Factors Dimensions		Classified Symptoms from the Field into Failure Types		
			Project Failure	**Systems Failure**	**User Failure**
1	Project management factors	1	Lack of user involvement		
		2	Mismanagement of project risk		
		3	Inadequate estimation of work		
		4	Breaching of contract		
		5	Lack of project plan		
		6	Lack of skills and knowledge		
		7	Inadequate ICT background for Project Managers		
2	Top management	1	Incompetent in making decision on selecting ICT projects		
3	Technology factors	1		The design and technology used not in line with the current technology	
		2		Low quality of the end products	
		3		Low or no compatibility between new system and the existing system	
		4	Insufficient hardware to interact with the systems		
4	Organizational factors	1	Inadequate cost estimation		Lack of ICT manpower in several public agencies
		2	Reduction of project cost		Resistant to adapt to the new systems
		3	Full of bureaucracy (exm; for decision making)		
		4	Process of project payment not smooth		
5	Complexity/ Size factors	1	Project too big and complicated (ambitious)		
		2	Unrealistic expectations from project champion		
6	Process factors	1	No study methodology in place	No feasibility study and BPR process are conducted	User requirement not met
		2	No project selection process carried out		
		3	End user does not involve in user acceptance process		
		4	No systematic and appropriate project evaluation process		
		5		Ineffective communication among vendors and users	

Source: Nawi et al. (2012).

Table 3.8 Factors Associated with the ICT Project Success, Fail and Challenge

Factors Associated with the ICT Project Success, Fail and Challenge			
Project Success Factors		**Project Challenged Factors**	**Project Impaired Factors**
1	User involvement	Lack of user input	Incomplete requirements
2	Executive management support	Incomplete requirements and specifications	Lack of user involvement
3	Clear statement of requirements	Changing requirements and specifications	Lack of resources
4	Proper planning	Lack of executive support	Unrealistic expectations
5	Realistic expectations	Technology incompetence	Lack of executive support
6	Smaller project milestones	Lack of resources	Changing rquirements and specifications
7	Competent staff	Unrealistic expectations	Lack of planning
8	Ownership	Unclear objectives	Didn‘t need it any longer
9	Clear vision & objectives	Unrealistic time frames	Lack of IT management
10	Hard-working, focused staff	New technology	Technology illiteracy

Source: The Standish Group (2014)

3.5.3 Issues Associated with ICT Implementation Failure in Relation to Corporate Governance

It is a fact that many companies have invested heavily in ICT with massive capital. Ensuring that ICT investment does meet the objectives and requirements of a company, effective ICT investment management and oversight are highly emphasized. This requires good cooperation between the board and its management in establishing an investment management process to prevent from agency conflict. Based on the ICT investment management (ITIM) framework developed by the United States General Accounting Office, an organization should, among other things, establish an enterprise-wide investment review board to be responsible in defining and implementing ICT investment governance policies and procedures (U.S. GAO, 2004).

Hence, the role of the board is essential in ensuring that investment decision is swiftly aligned with the company's strategic plan to accelerate business growth, improve or change current operations, as well as to boost company performance.

Although the US GAO's ITIM model (2004) has been widely acknowledged as the best solution for investment management (Heino, 2011), the Library of Congress, which is the world's largest library, failed to meet its investment objectives to provide its resources available, as well as being useful to Congress and the American public. About $119 million was invested in ICT in 2014 by the Library, but unfortunately, it was confronted with several conflicting issues that hindered its effectiveness to achieve the investment objectives (U.S. GAO, 2015). The Library had its own policies and procedures to manage its ICT resources, but several weaknesses were identified, such as strategic planning, poor investment management, lack an integrated approach to information security and privacy, overlapping service management system, and absence of ICT leadership to focus on ICT management, which contributed to its implementation shortcomings (U.S. GAO, 2015).

Arguably, the increasing ICT projects failure, as discussed in past studies (U.S. GAO, 2015; Solon, 2015; Standish Group, 2013; Bernama, 2012; Flyvbjerg & Budzier, 2011; Victorian Ombudsman, 2011), is closely related to human weaknesses in managing ICT project. Since all decisions related to achievement of ICT goals and strategies are decided by the boards, relying solely on the ICT executive management welcomes problems. The boards should also need to diversify their knowledge and area of expertise by expanding their understanding about ICT. Besides, the board expertise in ICT is crucial in determining the direction of ICT project progress, which will help the management to clearly understand the investment goals, thus aiding the company to enhance its operational performance.

In addition to the issues addressed above, issues related to the boards' capabilities, particularly when dealing with ICTs, are often disputed. Birmingham (2015), for instance, in his article, released the survey results conducted by Roger Sharp, the chairman of Asia Pacific Digital specialist Group, that only 10% out of 800 resumes of over 800 directors from top 20 companies in Australia, New Zealand, Singapore, and Hong Kong claimed to have discernible technology capabilities, either based on their level of equivalent education or technology working experience. His discussion strongly emphasized the lack of technology capabilities, which appears to be a huge part of the problem associated at the board level. Their area of expertise is mostly found in accounting and law, while having limited exposure to technology development.

Another recent survey carried out among 204 board members, as conducted by Cohn and Robson (2011) under the Oliver Wyman's Global Risk Centre and the National Association of Corporate Directors (NACD), revealed that about 51% or half of the board members did not receive sufficient information to perform their ICT oversight duties. In fact, only 16% of the board members had extensive ICT experience as a CIO or senior ICT executive in their early career. From this survey, Figure 3.6 portrays many types of factors that can be considered as stumbling blocks for boards in succeeding their ICT management. The nine categories of factors identified hindered the board level to perform effectively the ICT governance, in which the factor of insufficient IT expertise among boards emerged as the largest factor contributing to higher rates, in comparison to the rest.

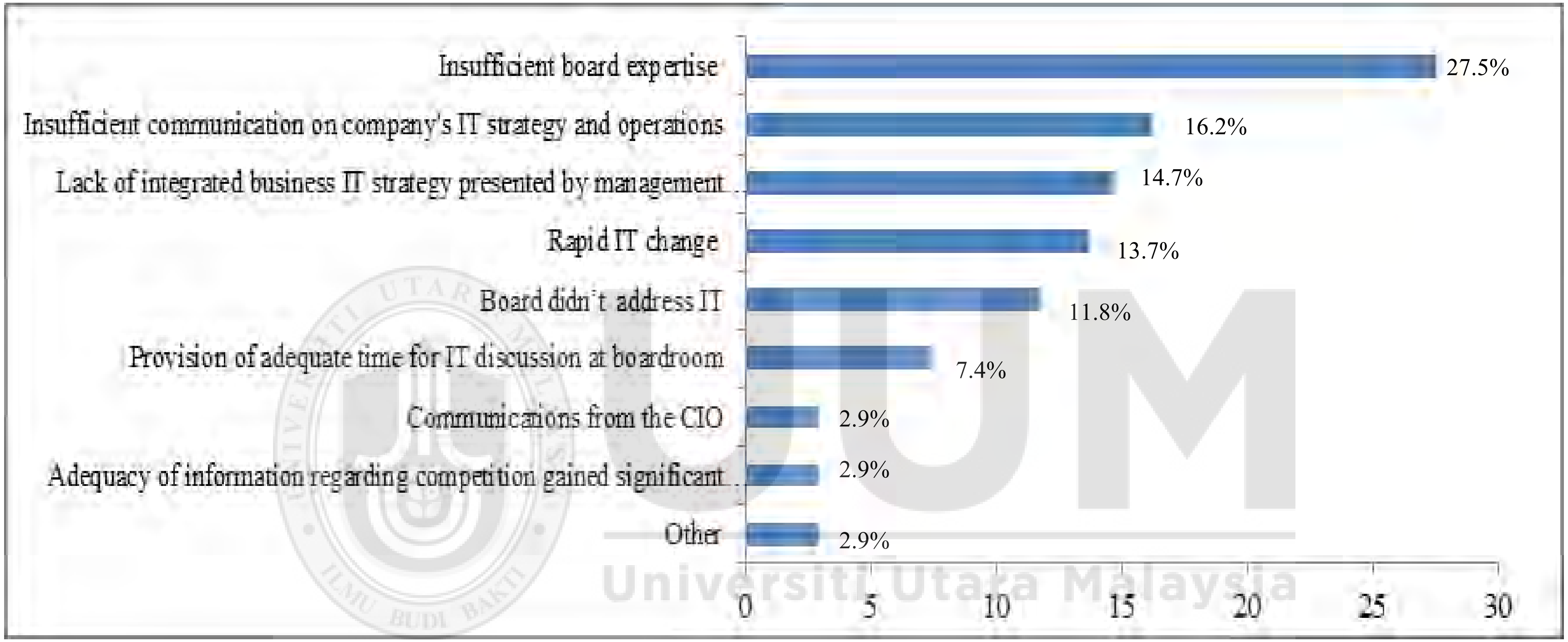

Figure 3.6: Stumbling Blocks for Boards
Source: NACD/ Oliver Wyman

Besides, Nolan and McFarlan (2005) argued that the degree of technology expertise and boards' competencies were still alarmingly low, hence putting company at high risk. More than half of the corporate's spending had been invested in corporate information assets, but they still fell into default mode of applying good governance and practices in the corporation. In fact, only a few understood the full degree of their operational dependence on technologies. Various factors have been listed in past studies that hinder companies' effort to implement effective ICT governance. These failure factors can be a good lesson for companies to avoid from potential problems that may affect their performance. Moreover, ICT experts have highlighted the need for ICT professionals or a special committee to develop an ICT strategic plan and structure, aiding companies to deal with sticky situations (Chandhoke, Dreischmeier, Rehberg, & Pasini, 2015; Chou, 2014). If companies are to develop their efficiency control of ICT and make their necessary contribution to increase firm performance, good governance of ICT must also become an integral part of the company's governance structure.

3.5.4 The Effect of ICT Governance on Firm Performance

Studies on ICT effects on firm performance are of interest to many scholars (Kaur et al., 2012). The successful application of ICT is characterized by good ICT governance (Neff, Hamel, Herz, Uebernickel, & Brenner, 2013; Zhang & Chulkov, 2011; Zhang & Chulkov, 2008; Weill, 2004; ITGI, 2003), hence could enhance firm performance (Neff et al., 2013; Flores, Sommestad, Holm, & Ekstedt, 2011; Lazic et al., 2011a; Lazic et al., 2011b; Boritz & Lim, 2008). Besides, effective ICT governance is a critical success factor for a company's ICT performance (Zhang & Chulkov, 2008; Bates et al., 1996), which is in line with Weill's argument (2004) that by ―specifying the framework for decision rights and accountabilities to encourage desirable behaviour in the use of ICT." Moreover, ICT governance is a subset of corporate governance and hence, should be addressed like any other board's strategic agenda (ITGI, 2003) to bring in positive effect on firm performance, as proven from past studies (Neff et al., 2013; Flores et al., 2011; Lazic et al., 2011a; Lazic et al., 2011b).

Appendix III presents the literature review of the effect of ICT governance on firm performance. Due to the frequent failure of ICT projects identified from prior studies, many companies have begun considering the importance of having proper ICT governance in place to minimize risks and to maximize returns (Spafford, 2003). Moreover, although many organizations realize the significant contribution of ICT governance practice on their business performance; past studies have shown that ICT governance adoption level has remained low (Kaur et al., 2012; Othman et al., 2011; Teo & Tan, 2010; Guldentops, 2007). For instance, some ICT governance factors, such as committee structure and corporate collaboration, exhibited significantly positive effect on firm performance, however, Kaur et al., (2012) revealed a weak effect between ICT governance effectiveness (measured by ICT processes, structures, and relational mechanisms) and the performance of Malaysian listed firms. Van Grembergen and De Haes (2010) explored the relationship between Enterprise Governance of IT (EGIT) practices and business performance from varied worldwide regions and varying industries. COBIT and Val IT were used as proxies to measure EGIT in this study. The results, however, found little evidence to support a direct link for EGIT practices with business performance.

On top of that, Guldentops (2007) addressed seven principles of Val IT, which can be applied in value management processes and practices. The Val IT principles were highlighted to ensure that the value creation potential of ICT investments in a company is maximized at an affordable cost and at an acceptable level of risk. Besides, face-to-face interview sessions with 15 Chief Information Officers (CIOs) were carried out to investigate the adoption level of these principles. Nonetheless, the adoption level of Val IT principles has yet to be looked into and the CIOs asserted to do so in the future. Nevertheless, past studies revealed that some companies did benefit from the implementation of ICT good governance practices.

Moreover, several researches determined the effect of ICT governance on firm performance, but it was found that companies deploying ICT governance methods gained greater profits and growth rates than those pursuing similar strategies, but without ICT governance support (Weill & Ross, 2004). Besides, good implementation of ICT process associated with dissemination of ICT knowledge among top management is vital, especially on firm performance (Boritz & Lim, 2007). Boritz and Lim (2007) further highlighted the contribution of top management's IT knowledge and the application of IT governance mechanisms (IT strategy committee and CIO) on the performance of 84 US public companies. The results revealed that the implementation of IT governance mechanisms and IT knowledge possessed by the top management level contributed to higher firm financial performance. Hence, involvement of top management is vital in terms of knowledge contribution and abilities towards IT implementation, which lead to better firm performance.

Meanwhile, weaknesses in company ICT control complicate the implementation of IT governance mechanisms (IT processes, IT structures, and IT relational mechanisms), thus deteriorating firm performance (Boritz & Lim, 2008). Boritz and Lim (2008) further asserted that firm financial performance could deteriorate dramatically due to significant IT control weaknesses. However, the existence and effectiveness of IT governance mechanisms were associated with highly reducing the likelihood of a firm reporting material IT control shortcomings, leading to enhanced firm financial performance. As investment in ICT has become more pervasive and has a significant impact on firm performance (Zhang & Chulkov, 2008), it needs to be governed via proper implementation of ICT governance mechanisms (Samuwai, Prasad, & Heales, 2011).

In fact, the area of ICT governance has been widely discussed over the last two decades (Balocco, Ciappini, & Rangone, 2013). However, some researchers argued that the relationship between ICT governance and firm performance has yet to be unexplored (Lazic et al., 2011a; Lazic et al., 2011b; De Haes & Van Grembergen, 2009). Meanwhile, Lazic et al., (2011a) proposed a theoretical framework that elaborated the relationship between IT governance and firm performance, which demonstrated a positive relationship between IT governance and firm performance with moderating variables of IT relatedness and business process relatedness, where the result of this study is in line with that of Neff et al., (2013). In another study, Lazic et al., (2011b) again conducted a study on the direct impact of IT governance maturity upon business firm performance with several mediating variables (IT relatedness, business process relatedness, and resource relatedness) and a moderating variable (Absorptive Capacity of IT Department). All variables, as a result, displayed positive effects on firm performance, except resource relatedness that showed unconfirmed effect on firm performance.

Jamba, Tsokota, and Mamboko (2013), in addition, extended the study of IT governance mechanisms by introducing outcome metrics (Bowen, Cheung, & Rohde, 2007) other than IT governance processes and structures by weighing in the influential factor of board members on the effectiveness of organizations. In fact, the study revealed that involvement of senior management in engaging with ICT governance structures, processes, and outcome metrics at the corporate level had been indeed essential and positively contributed to organization effectiveness. In other past researches, as companies' information assets are exposed to varied conceivable threats; making decisions concerning investment in information security (IS) is essential to mitigate threats, manage incidents, and avoid negative consequences on business objectives (Flores et al., 2011; Tsiakis & Pekos, 2008), which all together can improve firm performance (Tsiakis & Pekos, 2008). Other than that, Tsiakis and Pekos (2008) proposed security mechanisms to help companies in evaluating their dimensions security properties via confidentiality, integrity, authentication, availability, and accountability for potential risk reduction purposes. Apart from focusing on the importance of IS products like antivirus and firewall software to protect against unauthorized access, the study also concentrated on how IS investment can create business value to the company.

Furthermore, companies should realize the importance of investing in IS as it helps them to avoid losses due to viruses and monetize the loss of security services. Besides, Clader and Watkins (2008) argued that IS is indeed essential for every business long term success. The authors further proposed the use of IT governance standard of ISO 27000 as a framework to fulfil general objectives related to IT governance to ensure safety, privacy, and confidentiality of information assets. Meanwhile, Flores et al.,

(2011) suggested a single IT governance framework and asserted that investment made on IT governance control objectives (COBIT) could strengthen IS objectives.

Discussions around ICT governance understandably revolves around its demonstrating of ICT governance model in discussing the related standards and implementation, its mechanisms, as well as several strategic issues and impact on businesses and organizations. However, what is rarely discussed in the context of ICT governance is the board of directors. Meanwhile, based on Candor Governance Specialists, with the application of King Code III, ICT governance is ultimately the responsibility of board of directors in ensuring that their business and ICT strategies are delivered within an appropriate internal control system and adequately governed. Since companies have invested in ICT and exposed to high risks, involvement of boards is important to ensure apt use of resources, management of investment, mitigation of risks, realization of benefits, and safe assets (Estrada, 2010; ITGI, 2003). Besides, studies on board of directors in ICT governance responsibilities are often too narrowly conceptualized in the area of corporate governance research (Estrada, 2010).

On top of that, Estrada (2010), through his quasi-experimental approach study, highlighted the importance of IT structure within company corporate governance framework to improve their performance metrics. This study also stressed on the important need of ICT skills proficiency among boards of companies to bring good effect upon business value. The results of this study, nonetheless, had been expected to be biased towards a positive effect on companies incorporating aligned IT governance and corporate governance practices to enhance board contributions. Meanwhile, from the review of ICT governance studies, one can conclude that the involvement of board of directors in engaging ICT issues is crucial instead of relying too much on management involvement and oversight (Coats, 2015). Besides, many boards rely on their ICT department, technical advisers, and outsource consultants to assess company technology needs. Too often, boards relying on other ICT expertise suggest high risks (Bravard, 2015), and thus, raise the question if the boards have enough competencies to govern ICT. Given that previous studies have discussed the lack of ICT competencies among boards (Birmingham, 2015; Cohn & Robson, 2011; Nolan & McFarlan, 2005), Deloitte and Leblanc emphasized the need for boards with diverse ICT expertise, especially in ICT governance. Thus, this study focused more on boards with diverse ICT expertise.

3.6 Boards with Diverse ICT Expertise

The preceding discussion that emphasizes on the performance of the boards in dealing with rapid and revolutionary changes in ICT seems very doubtful. The boards are at risk in identifying the present and future ICT issues, as well as in making decisions to enhance problem-solving performance in potentially affected areas of operations (O'Donohue, Pye, & Warren, 2009). With increasingly complex and sophisticated ICT systems and components deployed by many companies to date, there is a dire need to look for individuals with exceptional inter-personal skills competencies. Although the boards, generally, do not get involved in ICT activities and operations, effective ICT implementation would not be achieved if the boards have insufficient ICT knowledge and skills. Hence, sufficient board oversight and monitoring in place with diverse expertise, particularly in the ICT, should facilitate the identification of the problem, thus helping the company in deciding how to address the problems.

Moreover, according to Alan Castleman, the Chairman of the Board Advisory Group, an effective board is composed of diverse capabilities (knowledge, skills, and experience), which is appropriate for any board, whether commercial or non-commercial, depending on the nature of the organisation, its purpose, its shareholding or membership, and the nature of the business. Moreover, board of directors refers to strategically important role for companies as it strives to remain at the leading edge in ICT integration into business operations. As companies become increasingly supported by ICT, the ability to draw on a wide range of diverse perspectives in terms of knowledge, experience, and skills among board of directors is crucial to company success. As board diversity has been accepted as an important aspect for the development of effective corporate governance (Plessis, Du, Saenger, & Foster, 2012), its significance should be seen as opportunities for companies to make best use of ICT, thus helping them to boost their performance. Before delving deeper on the board diversity literature and its effect on firm performance, it is important to comprehend some related concepts of board diversity.

According to O‘Reilly, Williams, and Barsade (1998), ―diversity is understood as a diverse group if it is comprised of individuals with varied characteristics on which they base their own social identity." As such, Gardenswartz and Rowe (2008) shaped the diversity dimensions into four layers: organizational, external, internal, and personality dimensions. Organizational dimensions are concerned about cultural aspect found within a work setting, while external dimensions refer to the aspect of life where individuals have control over, which might change over time and usually form the basis for decisions on careers and work styles. Next, the internal dimensions, also known as core dimensions, are attributed to relatively uncontrollable elements like race, age, and gender, compared to external dimensions. As for personality, which is a hidden diversity dimension, is encompassed in all individual aspects that can be described as personal style with differing personalities.

In the context of corporate governance, the concept of board diversity refers to board composition and the combination of various boards attributes, characteristics, and expertise in relation to board process and decision-making (Van der Walt & Ingley, 2003). Besides, it is vital for companies to have boards with diverse expertise for they have been appointed to act on behalf of the company shareholders to make most business decisions. Boards with diverse expertise are believed to improve all facets of company performance and ultimately to enhance the value of shareholders‘ investment via better governance. However, no uniform concept of board diversity (ACCA, 2015; Murphy, 2015) is aligned to date so as to conform to the requirement of ICT governance board. As board diversity is a crucial issue in the present corporate governance practice, particularly with ICT, the concept of board diversity should be extended to suit the needs of ICT governance (Deloitte, 2015; Leblanc, 2012).

The notion of board diversity is further fine-tuned in this study to suit what would constitute a board with ideal diversity by weighing in other factors, including business model, ethics, policies, and industry specific needs from time-to-time. In an overview of diversity in ICT landscape, the original concept of board diversity shall still remain. Besides, several types of board diversity of expertise are introduced to cater to the ICT needs at the board governance level in assessing its effect upon firm performance. In general, past studies have been conducted to assess the effect of board diversity on firm performance, but to date, none had determined the effect of boards with diverse ICT expertise. Thus, this study generalises the idea from various contexts of related studies, to determine if there are similar side effects that can be used to assess the effect of boards with diverse ICT expertise on firm performance.

As depicted in *Appendix IV*, recent studies have evaluated the effect of board diversity on firm performance and obtained inconclusive results. Some results were positive (Thanh Tu, Huu Loi, & Hoang Yen, 2015; Marimuthu, 2008), while negative (Al-Musali & Ku Ismail, 2015; Eulerich, Velte, & Uum, 2014; Tarus & Aime, 2014) and mixed (Cimerova, Dodd, & Frijns, 2015; Abdullah & Ku Ismail, 2013; Galia & Zenou, 2013; Darmadi, 2012; Van Ness, Miesing, & Kang, 2010; Marimuthu & Kolandaisamy, 2009a; Marimuthu & Kolandaisamy, 2009b) for other studies, depending on the level of analysis and diversity type. Although past studies have proven the positive effect of ICT on firm performance, its implementation has yet to prove success and led to decrease firm performance. Therefore, by putting in place appropriate ICT governance mechanism, board governance can help companies via proper ICT implementation. In fact, the composition of individual board of directors (Fama & Jensen, 1983) itself determines the effectiveness of board governance practice, especially from the light of ICT governance.

Besides, according to Leung (2015), there are several important qualitative ideas that companies should comprehensively comprehend about the trades-off of board diversity. Moreover, having diverse group of individuals with varied backgrounds and experiences offer the best fodder to critical thinking and discussion, which would reduce suffering from groupthink; thus generating more creative results and solutions. In fact, the benefit of having various characteristics within the board of directors would be advantageous for companies to access to various resources that make it possible for better connection with other potential individuals to spark growth for the development of companies. For instance, boards with financial industry experience could help companies gain access to specific investors, while those with political background help companies to deal with regulators or win government contracts.

Nevertheless, Leung (2015) also argued that having a diverse board could create potential conflict among its members, especially when it involves new directors with diverse background and expertise, in comparison to the existing board members who might be less diverse. This situation would cause them to split into subgroups, thus reducing group cohesiveness and impairing trust among its members, which can cause reluctance to discuss or share information with the board. Another critical issue that involves the appointment of unqualified directors may affect effectiveness, especially at the boardroom decision-making processes, as well as lack of capabilities to provide adequate oversight of company operations and its management. Besides, researchers also highlighted the possibility of conflict of interests and agenda pushing to occur. Meanwhile, some tend to push their own personal agenda within their capacity. As such, board diversity is exposed to more risks and challenges if it experiences prolonged conflict of interest among its members. This situation, therefore, can potentially lead to agency problem, resulting from conflict of interest among individual board, instead of maximizing the interests of shareholders. Furthermore, the board may also potentially ignore the underlying important criteria or attributes of successful directors in fulfilling the requirement of board diversity. Hence, in avoiding the highlighted risks, the board has to take seriously these costs when implementing measures to diversify (Leung, 2015).

Furthermore, as an alternative to the agency theory perspective, Daily, Dalton, and Cannella Jr (2003) proposed resource dependency theory to offer more productive results for board‘s monitoring role. The proponents of this theory depict that board of directors, as important providers of resources to the company, such as connections to external stakeholders, including regulators, suppliers, and financiers, as well as to advice and counsel (Pfeffer & Salancik 1978). As they are considered important, diverse boardroom composition should be addressed by companies to enhance their board effectiveness (the Financial Reporting Council, 2011). Thus, apart from the agency theory, the resource dependence theory was also considered in this study to enhance the overall company functions. As the topic of boards with diverse ICT expertise has become a spotlight issue within the present corporate governance practice, the following discussion focuses on examining this phenomenon.

The principle 4.2 of the MCCG (2012) has underlined the vital need for board expertise in terms of knowledge and skills to aid them to effectively carry out their responsibilities. Empirically, the concept of expertise has been viewed based on two factors; (1) excellence, referring to years of practice, and (2) professionalism prevailed in domains-specificity related to fields of work (Mieg, 2009). In the context of technology expert, expertise is described based on several criteria, such as years of practice, professional criteria like ―graduates degrees, training experience, publication record, membership in professional societies, licensing, etc.” and finally, the fact that experts ―held-down jobs in operational settings” (Hoffman, Shadbolt, Burton, & Klein, 1995). Moreover, it has been argued that board members should have an appropriate mix of expertise to add value in the execution of governance function (Reilly, 2003), especially in enhancing firm performance.

From the resource dependency perspective, knowledgeable and skilful board members are considered as a company‘s strategic resource that offers strategic direction to effectively execute board governance function (Daily et al, 2003). Having boards with superior expertise, such as years of practice and professional criteria (graduates degrees, training experience, publication record, membership in professional societies, licensing, etc.), as described by Hoffman et al., (1995), brings good value to the company due to their abilities to effectively respond to challenges that may arise. However, only several of the expertise criteria had been deemed as appropriate for this study.

3.6.1 Boards with ICT Educational Background

Educational background through literature has been viewed as a measure of knowledge, skill-based, and cognitive abilities held by individuals (Hambrick & Mason, 1984). The notion of educational background is understood as graduate degrees (Hoffman et al., 1995) and formal education an employee has completed (Kvålshaugen, 2001). Meanwhile, Schneider (2011) defined educational attainment as the highest level of education indicated either by the highest educational qualification (vocational or academic) achieved or by the number of years of education or schooling an individual successfully completes. Those educated are more informed and capable at managing companies than their less-educated counterparts. Moreover, according to Sebora and Wakefield (1998), having a slate of directors with good educational background is better at handling companies.

These days, as ICT emerges as a part of execution of company‘s strategic direction, boards must understand the strategic level; both opportunities and clouds on the horizon that shift to technology. This has led many experts to argue if all board members should indeed have good expertise skills and knowledge in the ICT field or otherwise (at least one of the board members).

Some experts, in the light of board oversight role in technology strategy, emphasized the importance of technological knowledge and skills among the board members, inclusive of those with non-technological background so as to ensure that any ICT-related issues can be dealt effectively without placing full responsibility in managing executives; thus hindering the consequences of agency problem (Proust, Samuel, Ben-Meir, & Walduck, 2014). Similar to accounting and legal fields, technology also deals heavily with intricate issues, where board knowledge and skills in technology are needed to address emerging technology issues.

Moreover, some experts have argued that the requirements of ICT knowledge and skills are critically needed by technology-based companies (Cloyd, 2013). Alan Castleman claimed that diverse expertise of boards is definitely required in any type of industries, depending on the nature of companies, their purposes and strategic objectives, as well as the nature of the business. Since ICT is a great enabler for all types of companies to leapfrog its competitors, it must not be longer viewed as a back-room function (Chou, 2014). In fact, Chou (2014) asserted that it is time for all companies (regardless of the type of industry) to have ICT expertise among board members to effectively govern their ICT matters, including its strategic decisions, risk management, and monitoring ICT implementation as the issue of boards' incapability to deal with ICT matters has been identified as a contributing factor to ICT failure.

Moreover, a recent study showed that diverse educational levels of boards led to lower firm value (Sitthipongpanich & Polsiri, 2013), whereas other previous studies displayed positive effect of boards' educational background on firm performance

(Francis, Hasan, & Wu, 2014; Gîrbină, Albu, & Albu, 2012; Anderson, Reeb, Upadhyay, & Zhao, 2011; Darmadi, 2011; Cheng, Chan, & Leung, 2010). For instance, Cheng et al., (2010) found that university degrees held by board chairpersons were positively associated with firm financial performance across 5,339 listed Chinese firms from the China Stock Market and Accounting Research Database, as well as the Taiwan Economic Journal Database, from 1999 until 2005.

Meanwhile, Darmadi (2011) examined the relationship between boards of commissioner (BOC) educational backgrounds and firm financial performance across 160 Indonesian listed firms. Furthermore, with regard to the educational attainment of BOC members, the result of the study revealed that postgraduate degree (a proxy of board educational background) positively influenced firm performance, which is in line with a study conducted among Romanian companies (Gîrbină et al., 2012). Anderson et al., (2011), on the other hand, found that diverse board educational backgrounds contribute to higher firm value among 615 industrial firms in the Investor Responsibility Research Centre (IRRC) director database from 2003 until 2005. The researchers further argued that boards with diverse educational background would complement each other in advising and monitoring top managers, thus leading to increased firm value.

On top of that, Francis et al., (2014) investigated the effect of directors from the academic background on corporate governance and firm performance across 1,500 S&P firms from 1998 until 2011. The study revealed that the presence of directors from academia in the boardroom was associated with higher firm performance. In terms of their effect upon corporate governance practices, the roles of academic directors in monitoring and advising displayed significantly positive effect upon various company decisions, including acquisition performance, earnings quality, and stock price informativeness. From the light of technology, greater educational level among employees was positively associated with various types of innovation and improvement exhibited in past studies (Barroso, Villegas, & Pérez-Calero, 2011; Dalziel, Gentry, & Bowerman, 2011; Lin, Lin, Song & Li, 2011; Talke, Salomo, & Rost, 2010; Wincent, Anokhin, & Ortqvist, 2010; Escribá-Esteve, Sánchez-Peinado, & Sánchez-Peinado, 2009), which leads to increment in R&D investment (Chen, 2012).

As technology becomes more advanced and complicated, studies have shown that board of directors with greater educational level possesses greater openness to the development of innovation (Chen, 2012; Talke et al., 2010; Barroso et al., 2011), being more competent in facilitating the evaluation of research projects that could lead to better innovation management (Dalziel et al., 2011) that is likely to understand and absorb needs of new technologies (Lin et al., 2011), the ability to analyse information appropriately in accordance with knowledge (Wincent et al., 2010), as well as developing insights in methods when solving problems related to complex issues of technology (Escribá-Esteve et al., 2009). Although the highlighted prior studies of the effect of board educational background on firm performance had not been based on board ICT educational background, the overall findings can give a real impression of boards with diverse educational background for application in this study.

3.6.2 Boards with ICT Professional Qualification

The second criterion of boards with diverse areas of expertise refers to ICT professional qualification. Professionalism is engagement for a profession, for instance, by setting or defining professional standards of a field or developing organizational and educational structures (Mieg, 2009). In fact, the term ‗professional qualification' has been viewed through domain-specificity of expertise in relation to occupational groups and fields of work that consist of writing significant textbooks, establishing professional methods, founding or managing professional associations or professional schools, or even exhibiting the best professional practice (Mieg, 2008). This criterion should be understood as much as possible due to the probability that there have been doubts among companies to make a decision whether to obtain an academic degree or professional credentials among the board members. The decision whether to pursue academics or professional credentials should not be one that is intricate. Instead, acknowledging the significant characteristics that sets them apart is the most important aspect that needs to be understood in this essential decision-making process.

Furthermore, Balthazard (2010) has differentiated the terms ‗academic' and ‗professional qualification' from several features, such as warrants of competence, best practice analysis, annual renewal fee in maintaining qualified designation, professional conduct and accountability, recertification, practice of ethical accountability, credentials assessment and recognition, experience requirements, as well as jurisdiction and authority of credential verification, as presented in Table 3.9. As for the concept of professional qualification, one can conclude that an individual is considered as an expert in the field of work when its expertise is recognized by the professional and regulatory bodies. Their expertise is recognized via professional certification to demonstrate a designation earned by a person to assure his/her qualification to perform a job or task related to his/her respective field.

Table 3.9 Differences between Professional and Academic Qualifications

Features	Professional Qualifications	Academic Qualifications
'Warrants of competence' or 'warrant of expertise'	The professional credentials' knowledge and skills have been warranted by the professional bodies as safe and appropriate practice of the trade or profession	There is no such warrant of competent recognized on academic credentials to practice a trade or profession.
'Warrants of competence' or 'warrant of expertise'	The professional credentials' knowledge and skills have been warranted by the professional bodies as safe and appropriate practice of the trade or profession	There is no such warrant of competent recognized on academic credentials to practice a trade or profession.
Best practice analysis	The professional designations being always accompanied by best practice analysis to lead the certified professionals on what they have to know or be able to do	Rare formal and systematic practice analysis on academic credentials.
Professional conduct and accountability	The professional bodies are responsible for the conduct of their professional members and some requirements, standards and assessment protocols have been stated for the purpose of protecting the public.	Academic institutions are not responsible of their graduates' conducts.
Annual renewal fee for maintaining qualified designation	The professional association or regulatory body had imposed annual renewal fee for maintaining the tile of credential professional designations.	No payment has been imposed by the academic institution on academic credentials to maintain their academic credential after their academic conferment.
Recertification	The professional credentials are required to recertification their professional designations in order to maintain the level of their competencies for competent practices.	The competencies of academic credentials are forever maintained and no expiry date.
Recourse	A disciplinary action will be imposed on a certified member if he or she is subjected to the professional misconduct.	Academic institutions do not have such mechanisms.
The practice of ethical accountability	Professional associations and regulatory bodies are, in fact, offering _warrants of appropriate professional behaviour,' which includes not only competence but professional ethics and behaviour as well.	Educational institutions do not set out rules of conduct that graduates must abide by after graduation. The terms _warrant of competence' or _warrant of expertise' are too narrow really.
The credentials assessment and recognition	The professional regulatory bodies are solely as warrantor of competence of their professional members.	Such educational programs developed in the educational institutions have to meet the educational requirements and approved by the certifying bodies.

Source: Balthazard (2010)

Table 3.9 Differences between Professional and Academic Qualifications (continued)

Features	Professional Qualifications	Academic Qualifications
Experience requirements	Some minimum of educational requirement is needed.	The educational institutions do provide various practical experiences to their academic credential, however, the experience requirements of professional and trade designations are typically much more extensive than academic programs.
The authority of credential jurisdiction	There is only one professional association or regulatory body that will issue a given professional credential.	Academic credentials, such as B.Comm., B.A., B.Sc., MBA, Ph.D., are granted by a number of different academic institutions each accredited to issue such credentials.
The authority of credential verification	In respect of the Canada practices, the Canada Federal and Provincial legislator will be responsible to verify and to assure that individuals who claimed that have been granted a professional designation to be always in the form of a signed release. Indeed, professional registers are, by law, public documents.	

Source: Balthazard (2010)

As some companies operate in a rapidly changing environment and continuously embrace cloud technology, due attention should be given to some technical aspects. Although the integration of cloud system is a daunting task, its implementation can run smoothly if it is accompanied by overseeing their careful planning, execution, and monitoring ICT, besides being supported by professional and talented individuals (Katz, 2015). Moreover, through the lens of agency theory, the supervisory and advisory roles of professionally qualified ICT or technology experts on the board serve the interests of shareholders via stewardship and alleviation of asymmetric information. Besides, ICT professionals are described as individuals responsible for dealing with emerging technologies, developing technology systems to solve business problems, and providing technical support to end users (Rutner, Reimenscheinder, O'Leary-Kelly & Hargrave, 2011). However, within the context of ICT professional among boards, the skills they possessed are not up to expectation, as described by

Rutner et al., (2011), since ICT-related activities are implemented at the management level. Meanwhile, Norlan and McFarlan (2005) stressed that qualified ICT board is crucial as their professional levels of knowledge and skills in ICT to drive decisions, to control costly projects, and to carve out competitive advantage.

Furthermore, only a handful of studies have looked into the effect of boards‘ professional qualifications on firm performance. However, Rad, Locke, and Reddy (2012) discovered positive effect for professional membership of institute director on firm‘s financial performance for all listed companies in the New Zealand stock market. Based on the new rules of the Securities and Exchange Commission (SEC) introduced in December 2009, the rules are concerned with the needs of ICT expertise among the company‘s board of directors (Trautman, 2012; Trautman & Altenbaumer-Price, 2011). The SEC, hence, suggested that every board should have at least two qualified finance professionals and qualified ICT professionals in strengthening the company's ICT governance to address costly private and regulatory lawsuits related to the increasing cyber issues faced by many companies. On top of that, a study conducted by Cloyd (2013) showed that about 56 per cent of directors claimed that audit committee held the ICT oversight responsibility since the committee is often involved in assessing company risk management process. One-quarter of directors handed ICT oversight role to the full board, while 7 per cent of directors looked at the separation of board-level risk committee. However, Cloyd (2013) argued that regardless of whether the full board or a committee is given the oversight responsibility, the board should consider if it is necessary to have qualified ICT professionals in the boardroom or to hire external ICT experts.

Furthermore, various regional and international initiatives have assisted in determining the skills needed in upgrading the quality of ICT profession, along with global recognition of the profession. Moreover, the Information and Communications Technology Council (ICTC) is a non-profit international organization that promotes and facilitates informal exchange of ideas, knowledge, and experiences on management, inclusive of ICT use worldwide. Moreover, this ICTC offers a variety of ICT professional certifications in the form of ICTC Certification program through its adopted open process, which is of utmost importance for any candidate contemplating a career move in ICT profession. Besides, Information Security Penetration Testing Professional (sp^2), Computer Information Forensics Investigator (CIFI), as well as Intellectual Property Management and Digital (MIP), are some of the certificates provided by ICTS. With various professional ICT certifications offered, the board of directors are exposed to many opportunities to develop their knowledge and expertise to drive and be accountable for the whole company in the light of ICT. Besides, having qualified boards in ICT is believed to advise the company on ICT priorities, make decisions on strategic issues, and drive compliance with agreed actions.

3.6.3 Boards with ICT Industrial Experiences

The industrial experience possessed by the board is another criterion of board expertise highlighted by Hoffman et al., (1995) and Mieg (2009) to prove that they are really competent and skilled in their respective industries. In precise, it also refers to the behaviour of an individual with the skill of field of knowledge gained over the years of actual practice; thus portraying an impact on the increased level of understanding and mastering for that individual in the field of industrial undertaking (Doe, 2014). Moreover, the rapid shift in the corporate ICT landscape requires the board of directors to seriously focus on the need to have a board member with extensive experience in ICT among their ranks. Board of directors involved in the technology industry is seen as one with extensive insight on the intersection of technology contents that can help to strengthen board ICT governance in ICT strategic decision-making, besides providing critical views in addressing issues and risks associated with ICT.

Hence, by increasing the proliferation of new technologies, technology leaders have begun to realize the importance of investing in technology as it emerges as a key profit driver for many firms. Although companies do realize the importance of ICT for their business performance, many boards of directors still face issues in comprehending ICT (Nash, 2012). The impact of the 2007 and 2008 financial crisis increased concern about the lack of industrial experience on corporate boards (Pozen, 2010), which led to the need of sufficient and relevant industry experience amongst board members (Lowe, 2015; Deloitte, 2014; Bertsch, 2011). Moreover, prior studies have given much focus on board independence, which has shifted to the need of industry experience on the criteria of the board (Bertsch, 2011).

In fact, the attribute of board with industrial experience is the most significant criterion for each individual in the board for subject matter knowledge comes to the fore (Deloitte, 2014). In addition, Simon Lowe, who is a partner and the chairman of the Governance Institute at Grant Thornton UK LLP, from his interview sessions with over 1,800 business leaders (across 36 economies) and 82 in-depth discussions with board of directors, discovered that 60 per cent of company management teams agreed that the criterion of relevant industry experience is the top attribute that should be possessed by a board member, while 62 per cent of board members themselves have recognized the importance of relevant industry experience.

Next, Leblanc, a Canada‘s leading expert in the field of corporate governance, has highlighted issues related to companies‘ failure in achieving high performance due to the impact of vulnerable attributes of corporate boards. Leblanc (2012) stressed on two major factors that contributed to the failure of a company, which are due to self-interest and lack of courage (e.g. boards were not truly independent, lack of recent and relevant industry experience, and lacked leadership) among the board of directors. Meanwhile, based on the RSA Group (leading global Life Sciences Executive Search and Interim Management Specialist), a Non-Executive Directors‘ Survey 2014 found that 70 per cent out of 153 non-executive directors responded on the need of industry experience criteria for newly hired NEDs.

According to the report issued by Deloitte Centre for Corporate Governance and the Society of Corporate Secretaries and Governance (2014), the three most sought-after board skills are based on related industry experience, c-level experience, and international business experience. Based on responses from the surveys conducted, the trend displays that boards with industry experience are a priority among many companies. Besides, in the context of corporate governance practice, boards with industry experience are deemed as important by their expertise in serving two broad functions: (1) as a senior management adviser and responsible in setting strategic and operational direction of the company, and (2) monitoring senior management activities (Brickley & Zimmermann, 2010). In precise, the boards‘ monitoring function and their ability to mitigate agency problems have appeared to be the focus of vast empirical literature pertaining to corporate governance (Drobetz, Meyerinck, Oesch, & Schmid, 2014).

Moreover, studies have proven that boards with relevant industry experiences were exceptional for monitoring function (Wang, Xie, & Zhu, 2013). Other than that, Wang et al., (2013) argued that the presence of boards with relevant industry experience curtailed firms‘ earning management and reduced the tendency for firms to commit financial fraud, thus increasing the effectiveness of boards‘ role in corporate governance practice. Meanwhile, Kang (2014) proposed the independent directorship experience to boost the monitoring board measure of board independence, instead of a conventional measure commonly used by past studies to determine the aspect of effectiveness in board monitoring. The result of the study strongly portrayed that increment in firm value was strongly affected by the presence of experienced independent directors. Other study has also confirmed that higher proportion of boards with experience gained from upstream (supplier) and downstream (customer) industries was associated with higher firm values, lower inventories, shorter cash conversion cycles, and higher accounts payable (Dass, Kini, Nanda, Onal, & Wang, 2014).

In addition, Drobetz et al., (2014) focused on the correlation between boards with industry experience and firm value, instead of other risks associated with corporate governance issue, such as earnings management and financial fraud. They also found a robustly positive link between board director with industry experience and firm value, which was measured using financial data of Tobin‘s Q. Next, Von Meyerinck, Oesch, and Schmid (2015) revealed that the companies‘ announcement of higher returns was significantly related to board of directors with industry experience. Hence, it can be concluded that the criterion of industry experience amongst board members could enhance firm performance.

3.6.4 Boards with ICT-Related Trainings

Another area of ICT expertise that has to be emphasized for board is ICT training. Good corporate governance practice must be sufficiently equipped with adequate training or any development program to ensure that the boards do remain qualified and effective in guiding their company‘s success. Meanwhile, in the context of human resource management, the term ‗training‘ is viewed as a field concerned with organizational activity aimed at getting better performance from individuals and groups in organizational setting (Peteraf, 1993). Fleagen (2010) viewed training and development (T&D) program as two different entities, in which training as a process of learning a sequence of programmed behaviour in order to improve the employee‘s performance on the current job and to prepare them for an intended job. On the other hand, development programs do not only improve job performance, but also develop employee‘s personality.

In fact, individuals do not only become more matured regarding their potential capacities, but also become better individuals. Fleagen (2010) also argued that both the employees‘ T&D programs are intended to benefit the company, as T&D programs produce better trained employees with superior knowledge and skills, which are less likely to involve in operational mistakes; thus leading to better performance and profits for the company (Nguyen, Truong, & Buyens, 2010). Besides, Mohd Noor and Apadore (2014) claimed ICT training as a comprehensive training from basic to advanced ICT skills and may include training to master a software system.

However, limited evidence was found for the effect of board training on firm performance. For instance, Wu (2013) found that board training was positively related to some firm financial performance measures[9], but the results showed insignificant effect of board training on the market-based measures of Tobin's Q and stock returns. Besides, recent surveys were conducted to determine the most required skills in the present job market and found that technology or ICT skills drew the most interest from employers to be the most valuable for employees in the present job market (Brooks, 2016; Foster, 2015). Through the analysis of skills and employment history among 259 LinkedIn members, Brooks revealed that 20 of the top 25 skills, including area of expertise in digital and online marketing, retail payment and information systems, database management software, information security, software engineering management, web programming, data engineering and data warehousing, etc., are most in demand by many employers in 2013, which involved technology.

Furthermore, Foster (2015) emphasized the important need of sophisticated technology know-how, especially in cybersecurity amongst board of directors regardless of industry type to cater to technology demand in firms. This requirement is in line with the recommendations given by panels that consist of a group of leading technology experts that the company's boards have to really comprehend the scope of ICT, especially cybersecurity. Since most business processes receive significant effect of cybersecurity threats, the panels addressed that it was time for the board of directors to make changes in their efficiency towards controlling and monitoring ICT, especially in dealing with ICT risks. As such, expertise among ICT boards can be

[9] Board training has shown a significantly positive effect on ROA, ROE, and cash-based measure if cash-flow assets, but no effect was found between sales-based measures of the sales-to-equity ratio and profit margin (Wu, 2013).

enhanced via participation in ICT T&D programs to align their skills and knowledge with present ICT development.

Hence, due to limited evidence to support the boards' training and its effect on firm performance, other related studies with similar effects were also considered in this study. For example, the positive quality of employees' development was strongly supported from past studies by providing a well-conceived training program (Muzaffar, 2014; Ameeq & Hanif, 2013; Amin et al., 2013; Iqbal, Ahmad, & Javaid, 2013; Jagero, Komba, & Mlingi, 2012; Singh & Mohanty, 2012; Sultana, Irum, Ahmed, & Mehmood, 2012; Khan, Khan, & Khan, 2011; Appiah, 2010; Tharenou, Saks, & Moore, 2007). It is viewed as how well employees perform tasks assigned to them against the performance mechanism or standard specified by the company as a way to assess quality of work (Salleh, Yaakub & Dzulkifli, 2011).

Moreover, past studies have argued that firm performance rely on employees' performance, as human resource capital plays an important role in improving firm performance, which can be realized from the provision of adequate training to employees (Khan et al., 2011; Appiah, 2010; Tharenou et al., 2007). In fact, Seleim, Ashour, and Bontis (2007) found that employee training had a positive relationship with firm performance, while other studies found that employee performance was unaffected by training programs (Imran, Maqbool, & Shafique, 2014; Kum, Cowden, & Karodia, 2014). Next, Kum et al., (2014) discovered that the failure of company in providing T&D programs contributed to the non-effectiveness of employees' performance. This results in lack of employees' right skills, attitudes, and capabilities that could deteriorate company's performance.

Moreover, some prior studies have confirmed a positive impact of training programs provided to employees on firm performance (Nguyen et al., 2010; Vlachos, 2009; Bauernschuster, Falck, & Heblich, 2008; Zulkifli & Duasa, 2008; Forth & Mason, 2004). Forth and Mason (2004) found that structured ICT training positively and significantly affected company‘s sales performance. This evidence was stronger in the restricted sub-samples, when compared to the full matched sample of establishments. Meanwhile, Zulkifli and Duasa (2008) examined the determinants and the impact of training on company performance among Malaysian status companies (MSC). The authors found that the MSC trained employees displayed more significant effect on the profitability of companies than the amount invested in training programs. Furthermore, Bauernschuster et al., (2008) discovered positive effect of training on employee creativity and innovation, while Vlachos (2009) found that the company‘s T&D was highly correlated to overall firm performance improvement.

3.7 Ownership Structures

Ownership structure has become an increasingly important phenomenon in corporate governance practice as it has important implications for firm performance (Lee & Lee, 2014). Theoretically, the concept of ownership of firms originated from Adam Smith (1776), which was attributed to inefficiencies of ownership arrangements that resulted in separation of owners from managers. Hence, this Smith‘s concept suggests that managers, in turn, routinely control assets over which they have no direct ownership interests of the company would not make the same decision nor exercise the same care as would the company owner. His line of thinking is consistent with the theory of agency proposed by Berle and Means (1932) and Jensen and Meckling (1976). Berle and Means (1932) predicted that the separation of ownership that could be observed via ownership concentration should either improve or deteriorate firm performance.

Moreover, Fama and Jensen (1983) and Fama (1980) asserted that agency conflicts could be mitigated through separation of management from control aspects during the decision-making process. The probability of top management to get involved expropriating of shareholders‘ wealth might be reduced and the viability of the board as a market-induced mechanism in enhancing their monitoring and oversight control can be done by including external board of directors (Fama, 1980). Furthermore, the theory of agency depicts that conflict of interest might arise between internal owners (managers) and external shareholders when managers begin getting involved in self-interest activities (Fama & Jensen, 1983; Jensen & Meckling, 1976).

The ownership structure is often thought as a significant aspect in corporate governance to mitigate conflict of interests between shareholders and managers (Hu & Izumida, 2009; Sulong & Nor, 2008). Besides, the OECD has raised questions on the weaknesses of corporate governance practices dealing with agency-related conflicts, especially in nations with concentrated ownership structures and poor protection for minority shareholders‘ right in developing countries (Oman & Blume, 2005). Hence, there is a need for proper design of corporate governance features that can protect the rights of minority shareholders in emerging economies (Oman & Blume, 2005; Lemmon & Lins, 2003).

Other than that, Hu and Izumida (2009) argued that firm performance could be enhanced via effective control through firm ownership structure, as the structure has essential impacts upon firm strategy, including investment decision, takeover, compensation schemes, and management successions. However, Sulong and Nor

(2008) stressed that benefits from improved firm performance might not be the same for all firms as their incentives vary with respect to the type of ownership structure and dividends. As such, the following discussion reviews past studies that cover several types of ownership structures, including concentrated, managerial, government, and foreign types, as well as their association to firm performance.

3.7.1 Concentrated Ownership

According to Gürsoy and Aydoğan (2002), ownership structure is viewed as ownership concentration and mix. Ownership concentration denotes the distribution of shares owned by a certain number of individuals, institutions or families, whereas ownership mix refers to the presence of certain institutions or groups like government or foreign partners among the shareholders. Ownership concentration has been widely looked into and has resulted in mixed findings in recent studies. La Porta et al., (1999) further asserted two different ownership structures; diffused ownership that is highly adopted by developed countries like US and UK, whereas other nations like the continental and East Asian countries, except Japan, that typically focus on concentrated ownership. Besides, prior studies have also raised several issues regarding ownership concentration.

In addition, Shleifer and Vishny (1986) claimed that concentrated ownership has become a useful mechanism in good corporate governance practice due to its ability in monitoring agents' activities via block holders to mitigate any potential agency risk between internal and external owners. Besides, researchers also argued that it also able to facilitate provision of capital, maximize shareholder value, and thus, lead to better productivity performance. Nevertheless, the opponents of this structure argued that ownership concentration could potentially reduce managers' incentives to acquire information, constitute an expropriation risk that might deprive of ownership rights among minority shareholders (Denis & McConnell, 2003; La Porta et al., 2000; La Porta et al., 1999) as large shareholders might be costly due to drawbacks of diversification and reduction in risk tolerance (Demsetz and Lehn, 1985).

Appendix V presents sample studies of the effect of concentrated ownership upon firm performance. In fact, some studies have reported a positive relationship between ownership concentration and firm performance (Basyith et al., 2015; Zakaria et al., 2014; Alimehmeti & Paletta, 2012; Garcı´a-Meca & Sa´nchez-Ballesta, 2011; Sulong & Mat Nor, 2010; Ganguli & Agrawal, 2009; Sulong & Mat Nor, 2008; Haniffa & Hudaib, 2006). Meanwhile, Haniffa and Hudaib (2006) indicated that Malaysia achieved better accounting performance with concentrated ownership, but it did not reflect in market value. The positive result implied that the concentrated ownership provides sufficient incentives in line with manager's interest, along with those of shareholders, thus resulting in enhanced firm performance.

Next, Garcı´a-Meca and Sa´nchez-Ballesta (2011) discovered that Spanish firms experienced positive value due to ownership concentration, but high levels of concentration led the controlling owners to misuse their position that destroyed market value. Furthermore, Sulong and Mat Nor (2008) found that highly concentrated ownership has been commonly practised among Malaysian listed firms, hence resulting in the positive but insignificant correlation between ownership concentration and firm performance, which is consistent with the initial hypothesis that higher practice of ownership concentration would lead to agency problem and increase agency costs; subsequently would potentially lower firm value.

Besides, Ganguli and Agrawal (2009) established a significantly positive relationship between firm performance and concentrated ownership in the mid-cap Indian listed companies. The nature of corporate ownership in Indian firms was dominantly concentrated on domestic individuals and promoter groups, large family-owned companies or the state, in which most companies have become publicly traded companies as a result of the Indian government‘s privatisation initiatives (Balasubramaniam & Anand, 2013). This type of ownership structure is ultimately controlled by a few individuals (e.g. family membership) or also known as ‗controlled group,' which holds relative incentives to monitor firm performance given their substantial portion of their investment in the firms, in contrast to the widely held firms with dispersed shareholders. Nonetheless, opponents argued that this entrenchment ownership can lead to greater stability through efficient performance monitoring, thus ensuring better firm performance.

In addition, Sulong and Mat Nor (2010) argued that concentrated ownership by block holders act is deemed as an essential governance mechanism in protecting shareholder‘s interests, besides improving firm valuation. Furthermore, Alimehmeti and Paletta (2012) have proven that higher concentration of ownership increased shareholder‘s power and control; aligning the interests of managers and shareholder, which could increase firm value. Meanwhile, Zakaria et al., (2014) argued that firm with high ownership concentration would focus more on monitoring and maintaining firm performance in facing unstable economic environment, instead of focusing on shareholder‘s interest. Moreover, in the context of firm performance, one can conclude that ownership concentration is an internal corporate governance mechanism that reduces the likelihood of managerial opportunism involving fraud and embezzlement of firm resources for personal interest between internal and external ownerships. As such, Basyith et al., (2015) discovered significantly positive relationship between block holder owners and firm performance, suggesting that the larger the block holder ownership, the less conflict between majority and minority shareholders to occur.

On the contrary, some studies have displayed negative effect of concentrated ownership on firm performance (Lee & Lee, 2014; Mule et al., 2013; Fauzi & Locke, 2012; Wahla et al., 2012; Tam & Tan, 2007). Tam and Tan (2007), in their investigation of the impact of ownership concentration on firm performance from 1994 until 2000 across 150 listed firms, found that the level of ownership concentration had a negative effect on the performance of Malaysian public listed firms due to inefficient protection offered to minority shareholders. Moreover, Mule et al., (2013) found that the negative effect of ownership concentration on firm performance was attributed to the majority power held by large shareholders that exposed them to more incentives to extract private benefits at the expense of minority shareholders (Shleifer & Vishny, 1986).

Besides, Wahla et al., (2012) found no evidence that firm performance could be affected by concentrated ownership, which is in line with Demsetz and Lehn (1985), who also found no correlation between ownership concentration and firm performance. Meanwhile, studies conducted in other developed countries like Korea and New Zealand discovered a negative relationship between ownership concentration and firm performance (Lee & Lee, 2014; Fauzi & Locke, 2012). Consistent with Darmadi (2012), based on a sample of Indonesian public listed companies, Fauzi and Locke (2012) also obtained identical result that showed negative impact of block holder ownership on firm performance in New Zealand. They argued that due to the nature of ownership structure that concentrated on the higher level of block holder ownership, the more potential New Zealand firms faced agency problem. In another study, the result of direct effect showed that ownership concentration had a significantly negative effect on Korean firm performance (Lee & Lee, 2014). This result is supported by the managerial entrenchment theory, where firm performance can be adversely affected by a certain range of highly concentrated ownership due to management entrenchment behaviour.

3.7.2 Managerial Ownership

Issues related to conflict of interest, inherent in the principal-agent relationship, was initiated by Berle and Means (1932), while Jensen and Meckling (1976) later proposed an idea to involve managers as part of the team owners to get along in making management decisions to create better value for firm performance. However, based on the standard of agency theory, division between ownership and control can lead to firm inefficiencies (Fama & Jensen, 1983). For instance, Kräkel (2004) claimed that these inefficiencies are magnified when the conflict involves managers and shareholders for several types of conflicts of interest: First, managers may prefer to make decisions that contradicts with the best interests of the shareholders via inefficient use of firm resources for their self-benefits; second, when the responsibility of making decision is delegated among managers, which is usually accompanied by some managerial incentives to constrain the management to act in their best interest in ensuring sustainable firm performance through a balance of trade-off between managerial incentives and efficient risk sharing. However, inefficiencies of risk sharing can lead to increased agency costs as a consequence of separating ownership and management. Lastly, managers are supposed to make inefficient takeover decisions.

Additionally, Jensen and Meckling (1976) asserted that increment in manager's ownership share in the company has the potential to reduce agency problem in the agency relationship in order to align their interest with external shareholders. Through the incentives given, the manager is believed to utilize her/his expertise, hence increasing the firm value as long as they are still bound by contracts. The positive agency relationship is potentially important in promoting good governance practices in the firm, which builds confidence among the present and future investors as a good indicator in improving firm performance. Although managerial ownership is seen as a controversial issue, its overall effect depends on the strength of the incentive alignment and entrenchment effects, which could potentially lead to serious agency conflicts (Demsetz, 1983; Fama & Jensen, 1983). However, studies on the effect of managerial ownership on firm performance in *Appendix VI* exhibits positive findings from several prior studies (Zakaria et al., 2014; Fauzi & Locke, 2012; Uwuigbe & Olusanmi, 2012; Din & Javid, 2011).

Besides, Din and Javid (2011) found positive result between managerial ownership and firm values. Managerial ownership was negatively affected by firms' leverage, hence supporting the argument that lower leverage level led to high profitability when firms engaged in low manager ownership program. The result also showed that firms' managerial ownership concentration was significantly negative in its association with firms' dividend policy, which supported the prediction of agency theory that firms with high managerial ownership might reduce the possibility of asymmetric information to occur, thus decreasing the effectiveness of firms' dividend policy.

Other than that, Uwuigbe and Olusanmi (2012) examined the relationship between board ownership (management ownership) and performance at the Nigerian financial sector. The result showed that managerial ownership enhanced the Nigerian financial sector performance from the managerial incentives provided to motivate managers in doubling their efforts to enhance firm performance. Next, Fauzi and Locke (2012) asserted that higher managerial ownership is indeed an important mechanism to curtail agency problems and hence, increase firm performance among New Zealand and US firms, respectively. Meanwhile, Zakaria et al., (2014) found a significantly positive influence of managerial ownership on firm performance at the Malaysian Public Listed Trading and Services Firms, depicting that increment in manager‘s share enhanced firm performance.

Moreover, past studies have shown the negative effect of managerial shareholdings on firm performance, which contradicts the expectation that managerial ownership can positively influence firm performance. According to Haniffa and Hudaib (2006), managerial ownership, nonetheless, had been observed as unsuitable for sparking growth on the Malaysian firm performance due to the possibility of managers who hold shares in the existing shareholders to get involved in more risky strategies that could detriment firm performance. Besides, Sulong and Mat Nor (2010) claimed that significantly negative result of the relationship between managerial ownership and firm value was attributed to the onset of managerial entrenchment practice that increased managerial ownership level, hence could cause deterioration in firm value.

Meanwhile, Basyith et al., (2015) and Wahla et al., (2012) revealed a negative relationship between those two variables. Wahla et al., (2012) argued that the negative finding was because ownership concentration focused more on manager ownership among existing shareholders, exposing them to high probability to involve in misappropriating firm resources for their self-interest. Next, Nath et al., (2015) examined the link between board ownership (one of the board attributes) and firm‘s financial performance in the Bangladeshi pharmaceutical industry. The findings of this study, however, showed mixed results, while board ownership was positively related to firms‘ ROA, but negative for Tobin‘s Q because all focus was given to family ownership, hence the possible lagging in monitoring and transparency of firms.

3.7.3 Government Ownership

Apart from ownership and managerial ownerships, the study on government ownership has become imminent especially in market capitalization after the Asian financial crisis that took place from 1997 until 1998 (La Porta et al., 1999). In fact, different countries use different terms for their government-owned firms. Meanwhile, government-controlled companies in Malaysia and Singapore are known as Government Linked Companies (GLCs), while their investment companies are known as Government Linked Investment Companies (GLICs). As for China and Soviet Union, these companies are known as State-Owned Enterprises (SOEs) and Government-Owned-Corporations (GOCs).

Furthermore, OCED (2013) depicted that Malaysian GLCs are referred to companies with some primary commercial objectives, where the Malaysian government owns a direct controlling stake like the ability to appoint board members and senior management to make major decision for GLCs, such as business strategy, contract awards, restructuring and financing, acquisitions and divestments; either directly or via GLICs. Besides, GLICs allocate some or all funds for GLCs investment. Through

GLICs, the Malaysian government has the authority to approve appointments of board members and senior management, who are responsible to directly report to the government, besides providing funds for operations and/or guaranteeing capital (and some income) placed by unit holders.

In Malaysia, seven GLICs hold a direct control on many listed GLCs, besides having a minority stake in several other listed companies, such as Khazanah Nasional Bhd, Kumpulan Wang Amanah Pencen (KWAP), Lembaga Tabung Angkatan Tentera, Lembaga Tabung Haji, Menteri Kewangan (Diperbadankankan) (MKD), Permodalan Nasional Berhad (PNB), and Employee Provident Funds (EPF) (IMF, 2013; OECD, 2013). Moreover, GLCs are an important instrument in the development of the Malaysian economy (OECD, 2013; Lau & Tong, 2008). Although GLCs employed only 5 per cent of the national workforce at the firms listed on the Malaysian stock market, its contribution was approximately 36 per cent and 54 per cent, respectively of the total market capitalization of Bursa Malaysia and the benchmark Kuala Lumpur Composite Index (OECD, 2013).

Moreover, past studies have also asserted that the principal-agent problem could occur in the relationship between government ownership and firm performance. According to Buchanan and Tullock (1962), the pioneer of the constitutional choice theory, government players refer to politicians, public servants (bureaucrats) or other political actors, who are tempted to engage in manipulating government ownership to attain their own career goals, instead of maximizing social welfare of the general public. Besides, there is no assurance that the firm performance will be enhanced as ownership rights are practiced under state bureaucrats who lack incentives to perform efficiently. As such, Boycko, Shleifer, and Vishny (1996), in their analysis of the effects of privatization, claimed that the critical agency problem is a result of inefficient public firms, where agency problem has been widely associated with political involvement, instead of management.

Furthermore, employment issue has also been highlighted as the main issue that is mismanaged by politicians, particularly for their political reasons, which could halt the operations in a firm. Privatization, at first glance, is seen as a strategy that could reduce employment issue unless its implementation is not influenced by any political interest. However, the government subsidies are commonly used by politicians to convince managers in keeping up employment, whilst at the same time, to satisfy their political purposes. Hence, one can conclude that the subsidies thrive not because they generate good corporate governance, but because they maximize benefits of politicians.

Moreover, Zakaria et al., (2014) stressed that GLCs also hold significant shares in Malaysian listed companies. In accordance with the Malaysian government requirements, GLCs are seen as a perfect instrument to achieve the redistributive objective of the New Economic Policy (NEP), as well as to drive economic growth (Menon & Ng, 2013). The influence of GLCs in some sectors is seen as crucial to further stimulate private investment activities to improve firm performance. In fact, the ten-year Transformation Programme established in May 2004, which was introduced by the Malaysian government through its three underlying principles emphasized on performance focus, nation building, and good governance; thus providing benefits to all stakeholders as this transformation program is believed to help both GLICs and GLCs to continuously strive for greater performance.

In addition, many studies have been conducted in recent years to examine the effect of government ownership on firm performance, as depicted in *Appendix VII*, which produced varying results. Thus, consistent with the goal to achieve the Transformation Program, recent studies have discovered the positive effect of government intervention on Malaysian firm performance (Najid & Rahman, 2011; Mohd Ghazali, 2010; Sulong & Mat Nor, 2010; Lau & Tong, 2008). On top of that, it has been argued that firms backed by the government supports could be better and efficient in facing challenges, besides putting effort to enhance the firm as a basis of equality and stability of the economy (Zakaria et al., 2014).

Furthermore, Goh, Khan, and Rasli (2013) have confirmed the results on two various types of state ownership; where the profit-oriented state ownership was positively related to firm performance, while insignificant for the non-profit oriented state ownership. The researchers also argued that intervention by government offers both types of firms with adequate resources and credit financing. However, inefficiency in the non-profit state ownership firms was due to the issues associated with free riders, bureaucracies, and political intervention in firm management. Another two studies conducted in China and Vietnam in 2013 demonstrated result in the form of U shape. Phung and Hoang (2013) found that the state ownership might be useful for firms to increase their performance by its advantages; but the performance would be severely affected if supported by highly concentrated state ownership, which hints involvement of political motivations, instead of commercial ones. Other than that, Tran et al., (2014) found that increased state ownership in larger firms enhanced firm performance for the aspects of profitability and efficient use of labour in Vietnam.

Moreover, some evidences from past studies support the arguments highlighted by empirical researchers, who view that government ownership has a detrimental effect on firm performance (Boycko et al., 1996; Buchanan & Tullock, 1962). Furthermore, as GLCs are often viewed to be profit inefficient, as compared to private firms (Musallam, 2015a), it was found that the private-controlled funds ownership had a significantly positive impact on firm accounting performance, instead of government-controlled funds (GCFs). The researcher also believed that GCFs holding of shares was in the national interest and not as inclusive a goal as that of maximizing the wealth of shareholders. However, Musallam (2015b) obtained mixed results in his study as only two GLICs (Permodalan Nasional Berhad and Lembaga Tabung Angkatan Tentera) exhibited significantly positive effect on market performance, while the other five GLICs (Employee Provident Fund, Lembaga Tabung Haji, Kumpulan Wang Amanah Pencen, Khazanah Nasional Bhd, and Menteri Kewangan (Diperbadankan)) did not display any effect on market performance.

In fact, the strong dominance of GLC demonstrated a discernible negative effect on the performance of Malaysian listed companies (Zakaria et al., 2014; Menon & Ng, 2013; Tam & Tan, 2007). According to Menon and Ng (2013), private firms were less willing to make investments when the share of GLC revenue dominated the industry. However, the performance of private investment was not significantly affected if GLC dominance is absent. Such concentration should be on divestment strategy to reduce intricacy and to improve capital allocation in private firms. Furthermore, according to PEMANDU‘s Economic Transformation Program, the purpose of the divestment strategy is to reduce the role of GLC in private sectors, as well as to generate more opportunities to encourage the private sector to take lead as the key driver of Malaysian economic growth. Besides, Zakaria et al., (2014) have supported the previous findings (Menon & Ng, 2013) that poor firm performance was negatively affected by the ambiguity of government ownership and control, as well as agency issues.

3.7.4 Foreign Ownership

Based on the Legal Information Institute (LII) (2011), under section 120.37, foreign ownership refers to more than 50 per cent of the outstanding voting securities of the firm acquired by one or more foreign persons, who are defined under the LII section 120.16 as any natural person who is not a lawful permanent resident or not protected. In addition, foreign persons also refer to any foreign companies, business association, partnership, trust, society or any other entity that is not incorporated or organized to run business in that country. In general, foreign ownership involves investment made by multinational corporations, which is usually referred as companies that conduct economic activities in more than a country to inject long term investments in foreign countries in the form of foreign direct investment (FDI) or acquisition (Chau, Esther; Wu, Jayce, 2013)[10].

As such, a significant effect of FDI on economic growth, particularly in East Asian countries, has been remarkably stable during the global financial crisis that took place from 1997 until 1998 (Loungani & Razin, 2001), which is often seen as an important catalyst for economic growth among developing countries as it stimulates domestic investment in host countries. Evidently, Wacker (2011) found that FDI played a positive role in boosting the trading capacity of developing countries. In respect of FDI in Malaysian companies, the United Nations Conference on Trade and Development (UNCTAD) 2015 World Investment Report claimed that Malaysia has

[10] https://en.wikipedia.org/wiki/Foreign_ownership

been ranked the fifth largest recipient of FDI inflows in East and Southeast Asia, which is also known as the most favoured destination for FDI by 15 multinational companies from 2015 until 2017. The sectors that have benefited greatly from the FDI are manufacturing, finance and insurance, ICT, mining, oil and gas, as well as agriculture sectors (Bank Negara, 2014). Moreover, recent evidence reported by the Malaysian Department of Statistics (DOS) in 2015 revealed that the FDI significantly contributed to the positive investment inflow in Malaysia. The report revealed that the FDI increased to 12,488 MYR million in the second quarter of 2015 from 9,888.26 MYR Million in the first quarter of 2015.

Most FDI is engaged by firms and multinational corporations (Pettinger, 2012; Zekos, 2005; Dunning, 1993) capable of providing capital, managerial expertise, and also exert monitoring activities on managers to enhance corporate governance and efficiency (Sulong & Mat Nor, 2008). In fact, the significant contribution of FDI inflows to domestic investment has made it a crucial source for developing countries. Besides, developing countries with weak financial institutions, as well as low corporate governance and accounting standards, are more inclined to possess multinational corporations' ownership advantage via acquisition of their patent to increase the share of their capital inflows in the form of FDI (Loungani & Razin, 2001).

Multinational corporations also have significant ownership interests in their subsidiaries listed on the Bursa Malaysia (Sulong & Mat Nor, 2008). Since FDI has been identified as an important indicator to boost the Malaysian economic growth (Tanggapan, Geetha, Mohidin, & Vincent, 2011) with the joint effort of various incentives and policies introduced by the Malaysian government to attract foreign investment, it is indeed an opportunity to foreign multinational corporations to greater expand their ownership in Malaysian firms.

In fact, *Appendix VIII* presents the effect of foreign ownership on firm performance and displayed that the effect of foreign ownership had been accepted as an important indicator as it enhanced Malaysian firm performance (Musallam, 2015b; Zakaria et al., 2014; Mohd Ghazali, 2010; Sulong & Mat Nor, 2010). Moreover, Musallam (2015b) indicated that two Malaysian GLICs' performance, namely Permodalan Nasional Berhad and Lembaga Tabung Angkatan Tentera, were positively affected by foreign ownership due to good quality monitoring control among foreign investors (Mohd Ghazali, 2010; Sulong & Mat Nor, 2010). Furthermore, Zakaria et al., (2014) found that foreign ownership did not affect firm performance before the subprime crisis period from 2005 until 2006; but the result was positive for subprime crisis from 2009 until 2010.

Additionally, Zakaria et al., (2014) concluded that firm performance would turn better with the association of high levels of foreign ownership as it could provide firms with financial support, transfer of technology, and expertise (Uwuigbe & Olusanmi, 2012). Besides, some past studies reported a negative effect of foreign ownership on firm performance within the context of developing countries (Darmadi, 2012; Lau & Tong, 2008; Sulong & Mat Nor, 2008). Moreover, firm market performance was found to have a significantly negative effect on foreign ownership (Sulong & Mat Nor, 2008), but nil association between these two variables in other studies (Lau & Tong, 2008; Darmadi, 2012).

3.8 Summary of the Chapter

This chapter goes beyond the discussion of several sub-topics that revolves around corporate governance of ICT (CGICT) literature. First, the chapter explains the concept of corporate governance, some issues related to the present corporate governance practices, literature evidences of the effect of corporate governance on firm performance, as well as the correlation between corporate governance and CGICT. In precise, several issues linked to ICT in the relationship with corporate governance are also discussed, including issues related to ICT governance standards, ICT implementation failure cases, and ICT failure associated to corporate governance practices. Following the discovery in numerous ICT failure cases, corporate governance experts have emphasized several important needs to be weighed in for the present corporate governance practices so as to ensure proper ICT implementation. Apart from paying attention to the discussion of the best practice for ICT governance, this chapter also provides a review of boards with diverse ICT expertise and their effects on firm performance, as emphasized by corporate governance experts. In addition, the literature review on corporate governance, specifically on ownership structure from the light of firm performance, is discussed at the end of the chapter. The next chapter sheds light on the research framework and the methodology employed in this study.

CHAPTER FOUR

RESEARCH FRAMEWORK AND METHODOLOGY

4.1 Introduction

Based on the review of literature in the preceding chapter, Section 4.2 presents and discusses the research framework of the study. Following the research framework, the relevant hypotheses were then developed. Next, Section 4.3 presents the arguments behind the development of each hypothesis. Moving on, Section 4.4 explains the selection of data samples for this study, while Section 4.5 provides elaboration on each measurement used for dependent, independent, and control variables. After that, Sections 4.6, 4.7, and 4.8, respectively, look into panel data, model specification, and data analysis procedures employed in this study. Lastly, the chapter ends with a summary, as depicted in Section 4.9.

4.2 Research Framework

Figure 4.1 illustrates a diagrammatic representation of the research framework examined in this study. The diagram shows all the variables investigated in the study. Based on the framework, the potential variables used to explain the effect on firm performance are comprised of ICT investment (ICT spending functions as a proxy), ICT governance standards (the adoption of ICT governance processes, the presence of ICT governance committee structure, and the presence of ICT senior management), boards with diverse ICT expertise (boards with ICT education background, boards with ICT professional qualification, boards with ICT industrial experiences, and boards with ICT-related training), as well as ownership structures (concentrated ownership, managerial ownership, government ownership, and foreign ownership), which are the independent variables, while firm performance as the dependent variable.

Meanwhile, the controlled variables, i.e. board independence, board size, leverage, and firm size, are also included in the analysis. Moreover, based on prior studies, these variables were embedded for they have been proven to influence firm performance. In fact, the research framework was developed based on agency theory and resource dependency theory as underpinning theories for this study to determine the effects of the potential variables on firm performance. In general, these two theories are further elaborated in the following paragraphs.

In general terms, agency theory suggests that a principal-agent relationship occurs between shareholders as principal and board of directors as agents of the company; thus responsible in managing the overall operations in the best interest of shareholders‘ goals (Fama & Jensen, 1983; Jensen & Meckling, 1976). Plus, in carrying out this responsibility, as the boards are excluded from company‘s daily operations; the managing agents are appointed to run the business of the company on a daily basis. In this case, boards act as principal, whereas managing agents, such as Chief Executive Director (CEO) or Chief Technology Officer (CTO), act as agents.

The theory further suggests that agency problems may arise due to separation of ownership between principal and agents. Hence, the agency problem is a critical issue in implementing the best corporate governance practice within a company. Based on the agency problem, agents may act in their personal benefits, instead of in the best interest of their shareholders. This situation places the principal in a difficult situation to monitor the agents after acquiring more power (e.g. the ability to overrule any company decisions), such as knowledge and expertise, in the respective area of industry compared to principals.

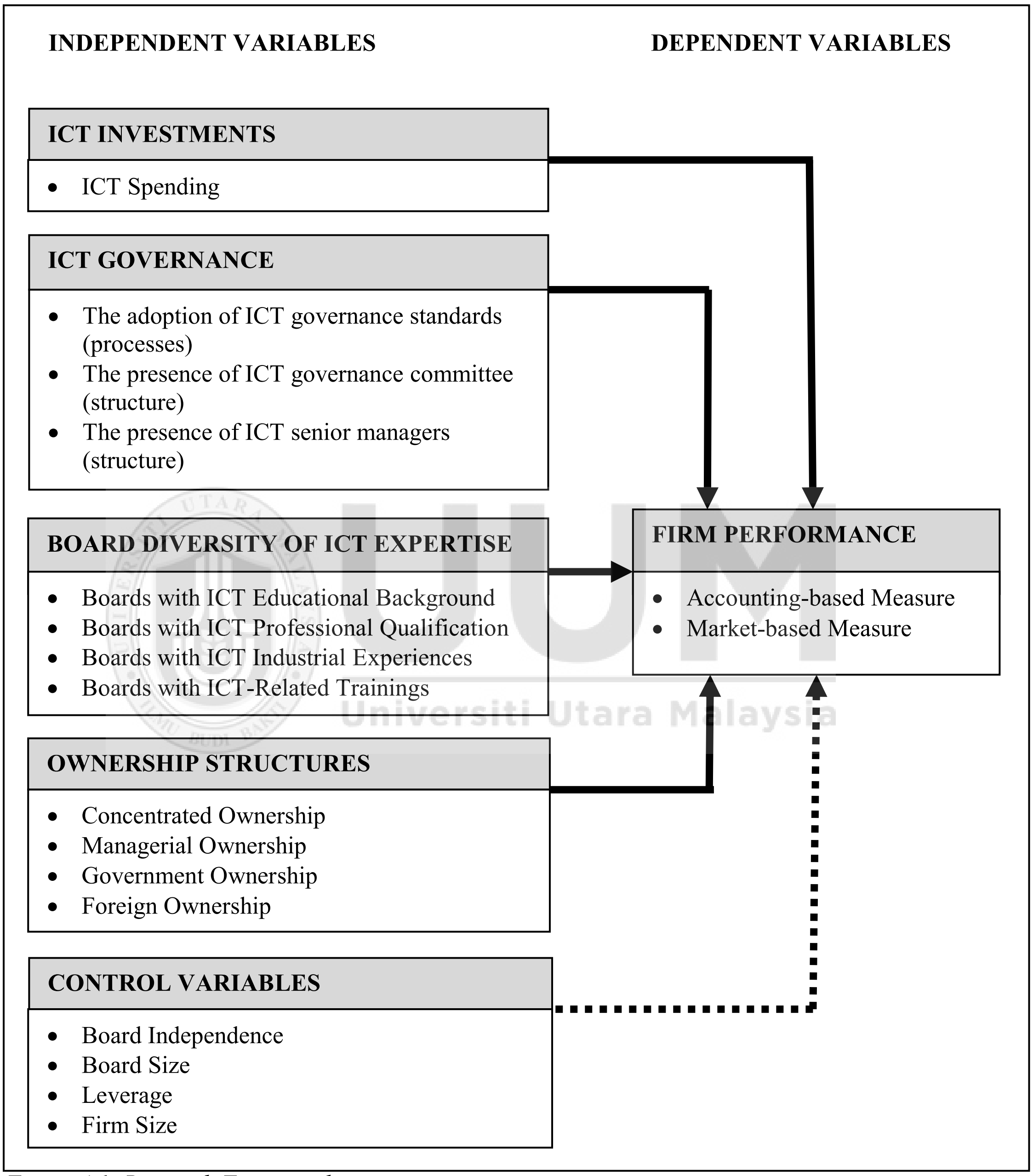

Figure 4.1: Research Framework

Besides, undue reliance solely of boards on managers for their expertise on certain area (e.g. ICT) creates agency problem and hence, lead to bad corporate governance practices. Boards are concerned about their lack of competence in that area, thus leading them to become dependent on their managers' expertise, while the managers are dependent on the boards for promotion and higher incentives; creating interdependency on power over each other (Emerson, 1962). Companies in this situation have to bring in resources that could alleviate unbalance power rise in the principal-agent relationship, which could help them in better practicing their corporate governance practice. Furthermore, as highlighted in the preceding discussion, Daily et al., (2003) proposed the resource dependency theory (RDT) as an alternative to the agency theory.

From the light of RDT, a company is characterized as an open system, dependent on contingencies in the external environment (Preffer & Salancik, 1978). According to RDT, a company should have control of its critical resources in order to avoid dependence on other parties. For that purpose, board of directors play an important role in bringing in external resources to reduce the rise in potential transaction costs in the interdependent relationship. The theoretical perspective had been chosen in this study after weighing in the view of Preffer and Salancik (1978), in which RDT appears to be the strongest theory to support the effect of board diversity on firm performance. In short, as this study is comprised of several topics related to ICT investment, corporate governance variables like ICT governance mechanisms, boards with diverse ICT expertise, and ownership structures; both theories are believed to possess the ability to further explain the effects of each variable on firm performance.

4.3 Hypotheses Development

4.3.1 ICT Investment and Firm Performance in the Malaysian Technology-Based Sector

Technology or ICT resources are crucial for technology-based sector as a strategic resource to attain sustainable high performance (Straub et al., 2006). Basically, the Malaysian technology sector had been selected in this study because the description and the nature of the companies within this sector are closely related to ICT components (TRBC, 2015; Mohd Noor & Apadore, 2014; PIKOM, 2014; 2013; 2012; Paytas & Berglund, 2004). In fact, spending on tangible (e.g. hardware, key data, and network) and intangible ICT assets (e.g. licenses, R&D, patents, and computer software) should be seen as investment (Haskel & Wallis, 2010), instead of cost. Nonetheless, with a well-thought-out strategy, these assets can become highly valuable to firm performance. Moreover, the RDT proposes that the key for company survival relies on its ability to acquire and maintain resources, such as personnel, information, raw materials, and technology. Hence, this study suggests that ICT investment has a significant effect on the performance of companies in the Malaysian technology-based sector. As such, the following hypothesis is developed:

> H_1: Investment in ICT spending has a significant effect on firm performance in the Malaysian technology-based sector.

ICT is renowned as a project that involves various types of risks with high failure rate in its implementation (Pourdarab, Nosratabadi, & Nadali, 2011). However, shareholders especially, often prefer to get involved in high-risk investment projects that promise high payoffs upon successful implementation although with low probability (Duran & Lozano-Vivas, 2015). Thus, in accomplishing the desires of shareholders to invest in ICT, the board of directors is responsible for all investment matters, which are inclusive of monitoring and ensuring that the management actions are indeed consistent with their interest to maximize profits. This situation is in accordance with the agency theory that suggests a principal-agent correlation, especially when the boards (principals) engage managers (agents) to run the business, thus raises the need to monitor their performances so as to ensure that they act in the interest of the owners (shareholder) (Jensen & Meckling, 1976).

Besides, past studies have investigated the effect of ICT investment on firm performance from different perspectives, such as ICT budgets, ICT spending (hardware and software, training, and other ICT-related equipment), ICT services, ICT outsourcing, and ICT branches. In fact, the hypothesis developed in this study assessed the contribution of ICT to firms on the basis of ICT spending by weighing in the expenditure incurred on ICT-related equipment like hardware, software, and other ICT appliances. However, the results from past studies are inconsistent due to several reasons, for instance, varied types of measurements for ICT investment, different types of segmentation for industry and nation development (either developing or developed countries), as well as ignorance of time-lag effect of ICT investment on firm performance.

Moreover, it has been argued that the initial period of ICT spending lowers the profit gained by firms in the same period (Ugwuanyi & Ugwuanyi, 2013; Anderson et al., 2003) due to substantial amount of investment incurred for ICT acquisition (Anderson et al., 2003). Although ICT investment incurred in the initial period (period *t*) displayed positive effect on firm performance in period *t*, the result only revealed positively small coefficient of ICT investment (Anderson et al., 2003).

Besides, the investment returns are not immediately apparent to investors (firms investing in ICT) because for ICT investment, in general, time lag exists between the moment an investment is made and the payback (Yaylacicegi & Menon, 2004; Brynjolfsson & Hitt, 2003; Dedrick, Gurbaxani, & Kraemer, 2003; Kohli & Devaraj, 2003; Devaraj & Kohli, 2000; Brynjolfsson & Hitt, 1993; Brynjolfsson, 1993; Brynjolfsson et al., 1989). Consistent with the real effect of ICT investment discussed in past studies, despite of exhibiting significant effect of ICT investment on firm performance, this study suggests that ICT investment incurred in year *t* would not positively affect firm performance in order to support the first hypothesis (H_1) of ICT investment. Thus, the following hypothesis is developed:

> H_{1a}: Investment in ICT spending in year *t* has a negative effect on firm performance in the Malaysian technology-based sector.

Moreover, some studies have adapted the element of time-lag effect of ICT investment on firm performance, which exhibited positive results. For example, some studies showed that the best return of ICT investment to companies was only derived either after a lag of four (Zhang et al., 2012) or five years (Yaylacicegi & Menon, 2004) from the date of its implementation. Although a study with the consideration of model 1-lag failed to prove the positive effect of ICT investment on firm performance (Beccalli, 2007), some studies did find that lag of 1 to 2 years (Hung et al., 2012; Brynjolfsson et al., 1989), lag of 2 years (Francalanci & Galal, 1998), lag of 2 to 3 years (Brynjolfsson & Hitt, 2003; Brynjolfsson & Hitt, 1993), and even 4 years to exemplify the positive effect of ICT investment on firm performance (Anderson et al., 2003).

After considering several positive arguments for the time-lag analysis, as well as the positive views from both theories pertaining to the effect of ICT investment on firm performance, this study believes that ICT investment incurred in year t-1, t-2, and t-3 would positively affect firm performance in the Malaysian technology-based sector. Furthermore, even though past findings have proven that positive effect of ICT investment on firm performance took place after a lag of 4 and 5 years of investment made, this study proposes ICT investment incurred in lag of one year until three years[11]. In order to further support H_1, the next three hypotheses, which consist of ICT investment incurred in year *t-1*, *t-2*, and *t-3*, are developed as follows:

> H_{1b}: Investment in ICT in year *t-1* has a positive effect on firm performance in the Malaysian technology-based sector
>
> H_{1c}: Investment in ICT in year *t-2* has a positive effect on firm performance in the Malaysian technology-based sector
>
> H_{1d}: Investment in ICT in year *t-3* has a positive effect on firm performance in the Malaysian technology-based sector.

4.3.2 Corporate Governance in the Malaysian Technology-Based Sector

This research design classifies the corporate governance issue within the Malaysian technology-based sector into several aspects: (1) ICT governance mechanisms; (2)

[11]According to the Malaysian Ministry of Finance (2014), the Accelerated Capital Allowance (ACA) on computers and information technology assets are written off within a period of two years while the ICT assets' useful life of three years is a common practice for the Malaysian Tax Income Purposes.

Boards with diverse ICT expertise; and (3) ownership structures. Accordingly, under the context of ICT governance, first, the study examined the effects of ICT governance, including ICT governance processes and structures, on the performance exerted by firms in the Malaysian technology-based sector. Second, this study examined the effect of boards with diverse ICT expertise, including boards with ICT educational background, boards with ICT professional qualification, boards with ICT industrial experiences, as well as boards with ICT-related training on the performance of firms in the Malaysian technology-based sector. Third, the study also looked into the ownership structures, including concentrated ownership, managerial ownership, government ownership, and foreign ownership on the performance of firms in the Malaysian technology-based sector, primarily to identify the true nature of practices held by corporate entities in the context of Malaysian technology-based sector.

4.3.2.1 ICT Governance Mechanisms

4.3.2.1.1 The Adoption of ICT Governance Standards in the Malaysian Technology-Based Sector (Processes)

In respect of ICT governance mechanisms, its adoption has been acknowledged as an important driver in generating good corporate governance and best practices among firms to achieve effective ICT governance (Neff et al., 2013; Zhang & Chulkov, 2011; Zhang & Chulkov, 2008; Weill, 2004; ITGI, 2003). Besides, as part of corporate governance practices (Van der Walt et al., 2013; SALGA, 2012; Mueller et al., 2008; Carroll et al., 2004; ITGI, 2003), poor conduct of ICT governance could lead a firm to performance badly (Van der Walt et al., 2013). In fact, at these present times, ICT management has become more complex and tougher for business firms to deal with in their business operations. As for the current regulatory and business environment, a prudent firm would seek better formalization of ICT governance standards and framework to help the company to be aligned with the company‘s decision made for ICT planning, policy, and operations; in meeting business objectives, assessing effective risk management, as well as effective utilization of management resources.

As many boards were found to lack in competencies when dealing with ICT-related decisions (Birmingham, 2015; Cohn & Robson, 2011; Nolan & McFarlan, 2005), a question arises if their role is sufficient to monitor the actions taken by the management in line with the best interests of the company in terms of ICT strategy (Posthumus & Solms, 2008). Besides, their vulnerability is known as the principal-agent problem. This problem, however, can be expressed via moral hazard and adverse selection, where boards may not be necessarily involved to ensure that ICT delivers its value (moral hazard) and may not know the degree of company‘s reliance on ICT (adverse selection). As such, this could lead to ineffective management decision-making in ICT due to board vulnerability. Moreover, Posthumus and Solms (2008) claimed that the adoption of ICT governance standards and framework would be the best solutions to mitigate agency problem by empowering the effectiveness of the boards' role in monitoring so as to be aligned with the company's strategy.

In the RDT, Singh, Power, and Sum (2010) viewed that ISO standard as a tool that companies can use to deal with conditions in their business environment. Consistent with this theory, the adoption of ICT governance standards and framework is essential to enhance effective ICT compliance culture within an organization so as to satisfy best practice for ICT governance (Ali et al., 2009). For instance, COBIT, ITIL, and other ICT standards like IT Service Management and IT Governance (ISO/ IEC TC

1/SC 40), as well as Information Security Techniques (ISO/IEC JTC 1/SC 27), are some useful tools that could assist in the design and implementation of ICT governance framework that consist of some unique advantages and focuses, depending on specific firm needs, as well as the most suitable standard for a firm's business environment (Leonida & Mulligan, 2005).

In addition, several studies discovered a positive correlation between the existence of ICT compliance culture and the level of ICT governance effectiveness (Simonsson, Johnson, & Ekstedt, 2010; Ali et al., 2009; De Haes & Van Grembergen, 2009), while others found that the adoption of ICT governance standards and frameworks had a positive impact on firm performance (Neff et al., 2013; Flores et al., 2011; Lazic et al., 2011a; Lazic et al., 2011b; Simonsson et al., 2010). Moreover, as business corporations rely heavily on technology, it is inevitable for threats from cyber adversaries continue to grow. Moreover, the evolving cyber landscape has the potential to create a large scale of cyber-attacks that may have an adverse impact upon corporate performance. Apart from the initiatives taken to alleviate cyber-risks by other developed countries, such as Australia, US, and UK; Malaysia also has taken proactive actions to address cyber issues.

Other recent studies have also claimed that the adoption of ICT governance is still relatively low in Malaysia (Kaur et al., 2012; Othman et al., 2011; Teo & Tan, 2010). Despite the low adoption level of ICT governance standards or framework in Malaysian practices, this study asserts that the mandatory compliance of ISMS[12] certified by ISO/IEC 27001, which was imposed by the Malaysian government since 2010 to all critical sectors including the government; both financial and ICT sectors

[12] ISMS refers to Information Security Management System.

have displayed positive effects on the performance of firms in the Malaysian technology-based sector. Thus, the next hypothesis developed is as follows:

H_2: The adoption of ICT governance standards or framework (processes) has a positive effect on the performance of companies in the Malaysian technology-based sector.

4.3.2.1.2 The Presence of ICT Governance Committee Structures in the Malaysian Technology-Based Sector

The ICT governance committee structure is responsible for ensuring effective ICT governance and maximizing value from ICT investments to generate high payoff for companies. In fact, the scope of responsibilities shouldered by ICT governance committee has to be broadened and not only focus on strengthening ICT strategy when assisting the board, but also capable in helping a board in terms of ICT value, risks, and performance. In fact, ICT governance committee structure refers to the functions belonging to ICT Steering Committee (De Haes & Van Grembergen, 2015; Zhang & Chulkov, 2012; Ali et al., 2009; Bowen et al., 2007; Ali & Green, 2005; De Haes & Van Grembergen, 2004; Van Grembergen et al., 2004; Peterson, 2003), as well as other ICT committees, such as ICT Strategy Committee (De Haes & Van Grembergen, 2015; Ali et al., 2009; Boritz & Lim, 2008; Ali & Green, 2007; Boritz & Lim, 2007; Ali & Green, 2005; De Haes & Van Grembergen, 2004; Van Grembergen et al., 2004; Peterson, 2003) and ICT audit committee (De Haes & Van Grembergen, 2015), as some common types of committees employed to investigate their influence on corporate performance (Boritz & Lim, 2008; Boritz & Lim, 2007) and level of ICT governance effectiveness (Ali et al., 2009; Ali & Green, 2007; Bowen et al., 2007; Ali & Green, 2005).

Furthermore, the ICT Strategy Committee is a more strategic-oriented part of the board members (De Haes & Van Grembergen, 2015) to provide insight and advice to the board in ensuring that ICT is indeed well-aligned with the business direction and the strategic objectives outlined by the company (Ali et al., 2009; ITGI, 2003). Meanwhile, the ICT audit committee is an independent committee at the board level that is responsible to overview (ICT) assurance activities (De Haes & Van Grembergen, 2015). Having these ICT committees at the board level is essential to prevent agency problem from occurring between agent (management level) and boards so as to maximize the interests of shareholders. Furthermore, the agency problem may occur when top managers at the management level seek to maximize their own benefits since they have the ability (knowledge and expertise) to operate in their own self-interest, instead of in the best interests of the firm due to asymmetric information (managers‘ knowledge and expertise in ICT are better than those of boards).

Moreover, past studies found that the presence of ICT committee structure has reduced ICT control weaknesses from occurring in a company, thus increasing firm financial performance (Boritz & Lim, 2008; Boritz & Lim, 2007). However, the adoption of ICT governance structure is still low as far as the Malaysian practice (Kaur et al, 2012) is concerned. Nonetheless, although much spending has been focused on acquiring ICT assets, many companies are still struggling in their best implementation of ICT. Hence, this study believes that the presence of ICT governance committee at the board level functions as an internal control mechanism on behalf of the shareholders to better serve in all ICT-related matters, instead of solely relying on the management‘s knowledge and expertise in implementing ICT. Hence, this study argues that the presence of ICT governance committee structure, such as ICT strategy committee or (ICT) audit committee, will help companies in the technology sector improve their ICT performance and lead to better firm performance. Thus, the hypothesis developed is as follows:

> H_{3a}: The presence of ICT governance committee structure has a positive effect on firm performance in the Malaysian technology-based sector.

On top of that, several experts have suggested that the success of ICT governance requires not only participation of board of directors, but also management involvement to ensure if the implementation of ICT is sustained and extended in line with company‘s strategies and objectives (De Haes & Van Grembergen, 2004; ITGI, 2003). This is consistent with the agency theory that suggests a positive relationship between principal (boards) and agents (management) that could lead to better firm performance. On the other hand, Norlan and McFarlan (2005) stressed that lack of ICT literacy within the board of directors to ask intelligent questions should not only stop at ICT risks and expenses, but also competitive risk, which leads to their dependence on Chief Information Officer (CIO) to deal with critical corporate information assets. This shows that the involvement of senior management, such as ICT steering committee composed of CIO or Head of ICT department (Zhang & Chulkov, 2012), plays a significant role in overseeing major projects, managing priorities, and allocating resources with guidance from the ICT Strategy Committee.

Moreover, the ICT steering committee is management-oriented (De Haes & Van Grembergen, 2015) that supports information systems planning and management, besides being a responsible team to link ICT strategy with business strategy by setting strategic directions for companies, as well as by matching their concerns with technological potential and building commitment (De Haes & Van Grembergen, 2015; Ali et al., 2009; ITGI, 2003). This steering committee is composed of CIO (De Haes & Van Grembergen, 2015) or Head of ICT department (Zhang & Chulkov, 2012), as well as other executives like ICT Project Committee, ICT Security Committee, and Architecture Steering Committee (De Haes & Van Grembergen, 2015), who are responsible in offering administrative and technical support to facilitate the functions of ICT governance committee at the board level (Zhang & Chulkov, 2012).

Moreover, as technology disruption pushes board members to govern their businesses in a more strategic direction, the CIO is viewed as an absolutely key contributor in guiding them towards the shift in their ICT conduct. Besides, the CIO focuses on system and network availability to both enhance and support business objective. However, with the current cyber threats in the present business environment, ITGI (2006) emphasized on the need of Chief Security Officer (CSO) to strengthen their ICT governance focus on security of data, information, and privacy within a company. Moreover, past studies highlighted that the involvement of senior management in ICT governance issues has contributed immensely to organizational effectiveness (Jamba et al., 2013; Ali et al., 2009; Ali & Green, 2005). Consistent with the agency theory, this study predicts that the presence of ICT senior managers in guiding the ICT governance committee at the board level should bring about a positive effect on firm performance (Kaur et al., 2012; Boritz & Lim, 2008; Boritz & Lim, 2007), particularly those in the Malaysian technology-based sector. The following hypothesis is developed to explain the positive prediction of this part of the study.

H_{3b}: The presence of ICT senior manager has a positive effect on firm performance in the Malaysian technology-based sector.

4.3.2.2 Boards with Diverse ICT Expertise

4.3.2.2.1 Boards with ICT Educational Background

Sole reliance on management expertise in managing ICT-related matters can also potentially lead the managers to act in their personal benefits due to lack of board expertise in ICT. Besides, the agency theory has clearly defined the nature of agency problem in the relationship between managers and boards, especially in ICT decision-making if dependency exists just on one hand to manage all ICT matters. This phenomenon offers an undesirable impact on firm performance. Hence, it is essential to have board members with diverse educational background, especially in ICT knowledge, to avoid poor ICT governance practices that can lead to poor business performance.

To date, the role of the board of directors in overseeing company‘s ICT activities has become more complex as they have to always cope with fast advancing ICT development, together with a complicated subject matter and highly technical language used to describe the emerging technologies and the evolving risks in ICT environment (Cloyd, 2013). For instance, Cloyd (2013) conducted a survey among over 860 public company directors and discovered that many board members faced difficulties in comprehending ICT-related risks and opportunities due to limited knowledge and skills on the subject matter that hindered them to perform better in their ICT oversight role. Besides, Proust et al., (2014) asserted that ICT knowledge and skills are important determinants for boards to monitor effectiveness as they have better understanding on how ICT is managed. If the board is insufficiently competent in handling ICT, these factors would continuously lead to failure in company performance. In another instance, the positive effect of boards with diverse educational backgrounds on firm performance has been proven by many (Francis et al., 2014; Gîrbină et al., 2012; Anderson et al., 2011; Darmadi, 2011; Cheng et al., 2010). Nevertheless, in the context of R&D investment, past studies have shown that education levels acquired by boards have contributed to R&D innovation and improvement (Barroso et al., 2011; Dalziel et al., 2011; Lin et al., 2011; Talke et al., 2010; Wincent et al., 2010; Escribá-Esteve et al., 2009), thus suggesting them to invest more in R&D (Chen, 2012). Based on the agency theory and RDT, this study believes that boards with ICT educational background have adequate competencies to ensure if the firm‘s ICT strategy is properly aligned with the firm‘s overall strategic plan, so that any ICT-related matters could be implemented in a more effective manner, hence leading the firm towards better performance. Thus, the following hypothesis is developed:

> H_4: Boards with ICT educational background have positive effects on firm performance in the Malaysian technology-based sector.

4.3.2.2.2 Boards with ICT Professional Qualification

Similar to education background, board of directors with professional qualifications is essential for the growth of a firm because these dynamic and professional board members are recognized as individual experts with all-around skills, knowledge, and understanding in directing and leading companies to best practices, mainly to improve firm performance. Meanwhile, in the context of ICT, as professional qualifications in other fields, such as accounting, legal, architectural, and engineering; ICT professional qualifications have also been established to develop the ICT professional skills among individuals. While the opponents of ICT professional certification have claimed a waning interest in certification due to dumping of ICT professional credentials on the present market; the continuously emerging new technologies have exhibited a constant need for competent individuals who can cope with technological changes (Katz, 2015).

Moreover, along with the rapid progress of various types of technology, the emergence of various ICT institutions that offer a wide range of professional ICT certifications are of no exception. In addition to the initiatives taken by ICTC[13], the existence of other ICT international institutions, such as the International Information Systems Security Certification Consortium (ISC) and the ISACA[14], also play an important role in offering a warrant of competence to one as a certified professional in the field of ICT. For instance, the ISC offers Certified Information Systems Security Professional (CISSP), while the ISACA offers five ICT professional certifications; Certification of Information Systems Auditor (CISA), Certification of Information Security Manager (CISM), Certification of Governance of Enterprise IT (CGEIT), Certification of Control Objectives for Information and Related Technology (COBIT) 5, as well as Certification of Risk and Information Systems Control (CRISC).

On top of that, as technologies continue to evolve, the boards face greater ICT challenges as they have oversight duties and responsibilities to deal with numerous critical issues related to ICT. To achieve the goal of ICT implementation, ICT

[13] ICTC refers to Information and Communications Technology Council.
[14] ISACA refers to Information Systems Audit and Control Association.

governance demands full commitment at the very top. With that, a few studies have reported the positive effect of boards with professional qualifications on firm performance (Padgett, 2014; Yasser et al., 2014; Letting et al., 2012; Bennedsen et al., 2007). Despite of these limitations, the theory of agency and RDT add that having qualified ICT boards among board members is indeed vital as they hold a professional designation of ICT. Their ICT professional qualification clearly portrays their high level of ICT competence and should improve their company‘s strategic planning, as well as ICT oversight that can bring a positive effect on firm performance. This leads to the development of the following hypothesis:

> H_5: Boards with ICT professional qualifications have positive effect on firm performance in the Malaysian technology-based sector.

4.3.2.2.3 Boards with ICT Industrial Experiences

Having a board made up of the right people with extensive experience in ICT is critical in this present competitive business environment. In fact, highly effective boards include a mix of directors with ICT experiences to fulfil their essential oversight roles, which is crucial in ICT corporate governance. Moreover, although issues pertaining to the lack of boards‘ experience in ICT are an old issue highlighted in prior studies as a contributor to the failure in the technology age (Broadbent, 2003); this issue has remained relevant since the failure of ICT implementation has escalated. In fact, a study conducted by the Accenture Global Research (2015) found that only 6 per cent of board of directors and 3 per cent of CEOs at the world‘s leading banks possessed professional technology experience.

In addition, the results also revealed that more than two-fifth (43 per cent) of the banks had no boards, while nearly one-third (30 per cent) had only one board member with technology experiences. After the 2008 financial crisis, the main focus of many shareholders has shifted from board independence to the significant need of boards with industrial experiences (Drobetz et al., 2014). This phenomenon has sparked awareness for the need of boards with industrial experiences within organizations in these recent times (Lowe, 2015; Drobetz et al., 2014; Deloitte, 2014; Bertsch, 2011; Pozen, 2010). Thus, the board of directors must give serious attention to the need of skilled and experienced boards in ICT to properly govern the ICT within companies, especially to achieve their best business outcomes. Furthermore, these board members with ICT industrial experiences are capable to increase their monitoring and oversight role in the ICT governance to alleviate the potential agency problems, thus enhancing the corporate governance practices and leading to better firm performance.

Besides, prior studies have proven that companies backed by experienced board members had been well-managed to improve their performances (Von Meyerinck et al., 2015; Dass et al., 2014; Drobetz et al., 2014). Based on previous studies, one can conclude that the contribution of boards with industrial experiences has significantly improved firm performance, which is in accordance to the RDT and agency theory. Besides, the criterion of boards with ICT industry experiences has the potential to lead a firm towards better performance through their prior experience at the firm, where they sit on the board or due to prior experience in the industry (at other firms in the focal industry). Thus, this study believes that boards with ICT industrial experiences would be able to positively affect firm performance. The next hypothesis is given as follows:

H$_6$: Boards with ICT industrial experiences have positive effects on firm performance in the Malaysian technology-based sector.

4.3.2.2.4 Boards with ICT-Related Trainings

Employee training is a human capital investment incurred by businesses to develop employees‘ skills so as to improve business operations. As such, the agency theory depicts that the principal (employer) monitors the performance of agents (boards) and uses incentives to strengthen the boards‘ development skills aimed at achieving the goals outlined in spite of employees‘ self-interest (Levinthal, 1988). With that, the continuous ICT training programs provided by the companies would be able to improve the knowledge and skills of the board in executing ICT governance responsibilities. Besides, shareholders do often look at the development of technology as an opportunity to maximize return from the investment for the long term growth of the company. Hence, boards play an important role to ascertain that the technology investment can generate better returns to fulfil the desires of shareholders. Therefore, in order to keep the companies on the right track with technology competition, boards should always be aware of the changes in technological development. Meanwhile, for the purpose of achieving this business goal, board training is indeed a complementary to keep the boards updated with recent technologies.

Furthermore, from the perspective of RDT, ICT-related training may provide a source of competence that is needed by the board of directors in a firm. Board of directors, thus, should be adequately trained in the ICT field for lack of proper ICT training can bring about poor business operations. Hence, appropriate ICT training for the board could improve firm performance due to the ability of the board members in coping with the rapid changes in ICT development, as well as their superior competencies in managing ICT-related risks. Furthermore, although some board members might already have extensive skills, knowledge, and experience in their particular area of expertise (e.g. legal, financial, management, etc.), several questions arise, ‗Why is it important to undertake ICT training at the governance level?', and ‗Is the company unable to rely on at least one or two of the board members who are qualified in the ICT field to achieve the objectives of ICT implementation?'

In addition, Yardley (2014) emphasized that gaining new or enhanced learning about ICT is a must for every board member regardless of their credentials, intelligence, and area of expertise. These T&D programs allow all board members to govern ICT in a more effective manner without placing full responsibility on a single individual who is expert in ICT to avoid the consequences of agency problem. To date, studies on the effect of boards with ICT-related training on firm performance have yet to be conducted. However, some studies can be used to support this argument. For instance, Mohd Noor and Apadore (2014) revealed positively weak correlation between ICT-related training and ICT investment within the Malaysian context. Furthermore, prior studies have proven that trainings provided to employees could lead to better firm performance (Vlachos, 2009; Bauernschuster et al., 2008; Zulkifli & Duasa, 2008; Forth & Mason, 2004). Although the listed studies on the relationship between training and firm performance is not focused on the board of directors; these studies have demonstrated a positive effect on firm performance, regardless of employees' level. Moreover, since training is an important medium for human capital development (Muzaffar, 2014; Ameeq & Hanif, 2013; Amin et al., 2013; Iqbal et al., 2013; Jagero et al., 2012; Singh & Mohanty, 2012; Sultana et al., 2012; Khan et al., 2011; Appiah, 2010; Tharenou et al., 2007), in conjunction with the two theories applied, this study predicts that board participation in ICT-related training can produce a positive effect on firm performance. Thus, the following hypothesis is developed:

H_7: Boards with ICT-related training have positive effects on firm performance in the Malaysian technology-based sector.

4.3.2.3 Ownership Structures

4.3.2.3.1 Concentrated Ownership

The literature suggests that firms with wide ownership diffusion have the tendency to underperform (Berle & Means, 1932) due to agency conflicts that arise from the divergence of interests between various agents. When a firm is dominated by large shareholders, the probability of expropriation among minority shareholders is high. The conflicts of interest between those large and minority occur when the large shareholders pursue their personal goals, instead of maximizing profit, or if they reduce managerial incentives (La Porta et al., 2000; La Porta et al., 1999; Shleifer & Vishny, 1997; Demsetz, 1983). This situation leads to the conclusion that the domination of large shareholders within a firm may lower the value of the firm, instead of improving their monitoring and supervision control. Moreover, past studies have shown that the presence of ownership concentration has led to deterioration in firm performance (Lee & Lee, 2014; Mule et al., 2013; Fauzi & Locke, 2012; Wahla et al., 2012; Tam & Tan, 2007; Demsetz & Lehn, 1985).

While the proponents of ownership concentration argued that this ownership could lead to good corporate governance practices via better monitoring control (Ganguli & Agrawal, 2009; Shleifer & Vishny, 1986), besides reducing the potential agency conflicts that may arise in the relationship between controlling and minority ownership within a firm (Alimehmeti & Paletta, 2012; Garcı´a-Meca & Sa´nchez-Ballesta, 2011; Sulong & Mat Nor, 2008; Shleifer & Vishny, 1986). This best practice is also able to enhance shareholders' value (Sulong & Mat Nor, 2010; Shleifer & Vishny, 1986), thus leading to better firm performance (Alimehmeti & Paletta, 2012; Sulong & Mat Nor, 2010). In addition, several researchers revealed that the contribution of block holder owners in ownership concentration increases the effectiveness of management role to work for the best interest of the shareholder, which also reduces the occurrence of agency conflict between the majority and minority shareholders (Basyith et al., 2015; Shleifer & Vishny, 1986).

Meanwhile, the RDT depicts that concentrated ownership by large shareholders is also important for company technology development due to strong incentives and capacity to monitor management, which offer strong support for firms to focus on technological investment, hence leading to better performance (Choi et al., 2012). Meanwhile, from the technology perspective, Choi et al., (2012) asserted that large shareholders are also known as focus group and will not simply sell their substantial holdings as they seriously consider the long term prospect of technological investment. Thus, based on RDT and agency theory, this study predicts that ownership concentration can positively affect the performance of firms in the Malaysian technology-based sector. The hypothesis developed is as follows:

> H_8: Concentrated ownership has a positive effect on firm performance in the Malaysian technology-based sector.

4.3.2.3.2 Managerial Ownership

Apart from the ownership concentration, managerial ownership has also been identified as a common practice among public listed companies in Malaysia (Zakaria et al., 2014; Sulong & Mat Nor, 2008). According to Sulong and Mat Nor (2008), studies on the relationship between managerial ownership and firm performance have been extensively observed since Demsetz and Lehn (1985) found insignificant result between managerial ownership and firm‘s return on equity. Meanwhile, according to the agency theory, managerial ownership can mitigate issues related to managerial myopia in public companies through management incentive alignment so as to induce managers to act in the best interest of the owners (Jensen & Meckling, 1976). In precise, the theory predicts that firms with high managerial ownership levels exhibit high performance due to incentive effect (Jensen & Meckling, 1976).

In contrast to the assertion made by Jensen and Meckling regarding managerial ownership, Morck et al., (1988) claimed that the higher the ownership of internal directors, the higher the tendency for occurrence of moral hazard and information asymmetry problem between internal and external directors. This is in line with the theory of managerial entrenchment, where managers seem to have more power to use the firm to benefit their personal wealth, instead of the interest of external shareholders. This makes it difficult for external shareholders to adequately monitor their management that appears to be less transparent, hence could lead to the potential occurrence of principal-agent problem and moral hazard.

Furthermore, recent studies on the implications of managerial ownership upon firm performance have resulted in negative findings (Basyith et al., 2015; Wahla et al., 2012; Sulong & Mat Nor, 2010; Sulong & Mat Nor, 2008; Haniffa & Hudaib, 2006).

Increase in managerial ownership led those internal to act based on self-interest (Wahla et al., 2012) due to lack of monitoring and transparency of firms (Nath et al., 2015), hence lower firm performance. Although these studies produced contradictory results, others consistent with prior arguments depicted that having ownership of the firm via given incentives may encourage internal directors to perform their work in line with the interest of other owners (Morck et al., 1988; Fama & Jensen, 1983) and reduce agency costs, thus increment in firm performance. The results of these findings confirm past findings that higher managerial motivates those insiders to double their efforts (Uwuigbe & Olusanmi, 2012) and to reduce the tendency of agency conflicts (Fauzi & Locke, 2012; Din & Javid, 2011), hence increment in firm performance (Fauzi & Locke, 2012; Uwuigbe & Olusanmi, 2012). This study also believes that the interest of both owners and those insiders is aligned with various incentive systems given to those insiders. Furthermore, Sulong and Mat Nor (2008) argued that with shared interest between both parties, opportunistic behaviour by the large owners or insiders can be reduced efficiently. Back to Jensen and Meckling's argument, high managerial incentives may induce higher managerial effort to maximize the value of firm, thus improving firm performance. Thus, the next hypothesis developed is:

> H_9: Managerial ownership (insider) has a positive effect on firm performance in the Malaysian technology-based sector.

4.3.2.3.3 Government Ownership

Issues related to government ownership are frequently controversial, besides reflecting conflicting interests and values. Besides, endless discussions have highlighted the significant contribution of government ownership as a helping hand in offering financial support in the form of capital subsidies, which is useful for firms to increase their performance (Phung & Hoang, 2013). On the other hand, it has been argued that government‘s shareholding in companies is a means used by the government to grab profits earned by firms to the benefit of politicians and bureaucrats, instead of commercial motivations (Phung & Hoang, 2013). Additionally, the opponents of government ownership asserted that the purpose of government ownership is political motivation, instead of maximizing profits for firm (Najid & Rahman, 2011). This resulted in the reduction of firms‘ incentives to exercise proper governance practices, consequently leading to poor firm performance.

Moreover, the Malaysian government has also been acknowledged as a large shareholder in the Malaysian public listed companies (Sulong & Mat Nor, 2008). The high capitalization of government-controlled institutions‘ shareholdings in the Bursa Malaysia stock market indicated that any price movement in these shares would significantly affect the index movement. This positive contribution of government ownership contributes to positive signals to the growth of the firm‘s profits. In fact, Zakaria et al., (2014) have confirmed the positive results for the correlation between government ownership and firm performance within the Malaysian context. Meanwhile, based on RDT, Choi et al., (2012) asserted that dependency of a company on government ownership as a resource-rich external could enhance the stability of a firm in controlling its scarce technological and financial resources. Furthermore, the internalization effort of valuable resources and company networks provided by the government would reduce the external contingencies of a firm (Pfeffer & Salancik, 1978). Besides, this ownership also opens up more chances for companies to engage in national R&D projects, besides giving advantages to both parties the benefits of the investments made (Choi et al., 2012). Moreover, based on the RDT and agency theory, this study believes that firm performance within the Malaysian technology-based sector can be positively improved by the share of government ownership as the government has adequate resources and the ability to monitor decisions made by the company. Hence, the next hypothesis is as given below:

H_{10}: Government ownership has a positive effect on firm performance in the Malaysian technology-based sector.

4.3.2.3.4 Foreign Ownership

From the perspective of agency theory, since foreign ownership holds large shareholding, the monitoring role could be performed in a more effective manner over domestic companies under such ownership. In precise, foreign-owned company acts as a parent company (principal), besides holding large shareholding and dominance over the company, as well as its subsidiaries (agents). Thus, agency conflicts occur when conflicting interests spark in the relationship between the parent and the subsidiary companies. The subsidiary tends to pursue its own interests, instead of the interest of parent company, thus creating a potential agency problem between both parties. Besides, Chang and Taylor (1999) have reported that the severity of agency problem to occur between the parent and subsidiary companies demands monitoring control and supervision role from the parent company.

Meanwhile, the RDT depicts that the resources that belong to the parent company are important outsourcing mechanism that aids financing to its subsidiaries (Choi et al., 2012; Pfeffer & Salancik, 1979; Pfeffer, 1972) when the financial performance is poor. Although the opponents of this theory view that the resources provided by the parent company are inefficient (Rajan, Servaes, & Zingales, 2000; Scharfstein & Stein, 2000) and as a means used by the parent to exploit the subsidiary capabilities (Mastsusaka, 2001), Mudambi and Pedersen (2007) argued that the empire of the parent company's expansion on its subsidiaries abroad is primarily for the purpose of adapting the products developed in their home countries to conform to local tastes and customer needs, as well as the adaptation of processes to local resource availabilities and production conditions. Such situation generates dependency by subsidiaries on the expertise of their parent company. Moreover, several studies have proven that the integration between subsidiaries and the parent generates a positive impact, where some business operations performed by the subsidiaries displayed positive improvement through increment in technology innovativeness as an important tool for their growth strategy to enter into new markets, to increase its existing market share, and to provide the firm with competitive advantage in innovation of the country they are located (Pearce, 1999; Zander, 1999).

Moreover, past studies have exhibited a positive relationship between foreign ownership and firm performance (Musallam, 2015b; Zakaria et al., 2014; Phung & Hoang, 2013; Choi et al., 2012; Uwuigbe & Olusanmi, 2012; Mohd Ghazali, 2010; Sulong & Mat Nor, 2010). Meanwhile, from the context of technology, foreign ownership is seen as crucial in funding companies with strong resources, inclusive of financial support, technology expertise, and technical collaboration that can encourage domestic companies to invest more in technology development (Choi et al., 2012; Uwuigbe & Olusanmi, 2012). Hence, this study predicts that foreign ownership, by virtue of its resources and capabilities, would be able to bring a positive effect on the performance of companies in the Malaysian technology-based sector. Thus, the next hypothesis is:

H_{11}: Foreign ownership has a positive effect on firm performance in the Malaysian technology-based sector.

4.4 Sample and Data Collection

In this study, the secondary source had been employed to gather data for both dependent and independent variables. Data were collected from annual reports obtained from the website of Malaysia Exchange (*Bursa Malaysia*), in adhering prior studies (Makinde, 2014; Ugwuanyi & Ugwuanyi, 2013; Hung et al., 2012; Zhang et al., 2012; Ekata, 2011; Jun, 2008; Beccalli, 2007; Yaylacicegi & Menon, 2004). Besides, using quantitative approach, this study used the balanced panel data that covered a five-year period (2010 to 2014). All data were retrieved from the financial year end annual reports published by the sample. Moreover, information pertaining to ICT governance standards or frameworks, boards with diverse ICT expertise, and ownership structures was manually collected by examining the disclosures presented in annual reports available on the Malaysia Exchange website.

Additionally, this study had weighed in some factors regarding the selected period of ICT data. The International Accounting Standards (IAS) 38 Intangible Assets was issued in 1998 by the International Accounting Standards Board (IASB). However, its implementation is not practised in Malaysia (Jaafar & Halim, 2013). The selected periods has also taken into consideration the post period of International Financial Reporting Standard (IFRS) implemented in Malaysia on or after 1st January 2006. The IFRS requires reporting entities in Malaysia to prepare their financial reports in accordance with the adopted new and improved Financial Reporting Standards. Furthermore, according to Jaafar and Halim (2013), no specific standard is available, primarily for intangible assets within the pre-IFRS period.

Meanwhile, the post-IFRS period incorporates both intangible and tangible assets, particularly those related to ICT to be treated under FRS 116 Property, Plant, and Equipment (PPE) or as an intangible asset under the FRS 138 Intangible Assets, which refers to an entity that uses judgement to assess the element that is more significant (MASB, 2011)[15]. Upon effective implementation of IFRS in Malaysia, some companies have begun to improve their financial reporting disclosure by voluntarily disclosing their ICT disclosure[16].

Besides, apart from the initiatives of the Malaysian government to spur ICT development in the 10th Malaysia ICT Plan, which is a continuation from the 9th Malaysia Plan through the incentives of Accelerated Capital Allowance (ACA)[17] given to companies that incur expenditures in acquiring ICT facilities, the selected periods also included the mandatory compliance of ISO/IEC 27001 of Information Security Management System imposed by the Malaysian government in 2010 across all critical sectors, including the Government, as well as financial and ICT sectors.

[15] The Malaysian Accounting Standard Board (2011) classifies intangible ICT assets based on, for example, computer software for a computer controlled machine tool that cannot operate without that specific software, which turns to be an integral part of the related hardware and it is treated as property, plant, and equipment. The same applies to the operating system of a computer. When the software is not an integral part of the related hardware, the computer software is treated as an intangible asset.

[16] An additional review has been conducted on 74 companies in the Malaysian technology-based sector over the periods 2006 to 2009, to see the trend of ICT financial disclosures (especially in the classes of Property, Plant and Pquipment as well as Intangible Assets) after the commencement date of IFRS. The sample of 74 companies refers to the total companies in the Malaysian technology-based sector with complete annual reports from the financial year end 2010 to 2014 as presented in Table 4.1. Out of 74 companies, 37 companies have been recognized as appropriate sample for this study while another 37 companies have been rejected due to lack of ICT financial disclosures in their financial reports especially in the items of property, plant and equipment as well as in the treatment of intangible assets. The company‘s financial report is considered inappropriate and will be rejected from this study if : (1) it is either the company that made the ICT investment (ICTI) activities, but the amount related to ICTI was not recorded in the annual report, or; (2) the company did the ICTI activities, but the amount related to ICTI was not properly recorded in the annual report (e.g. table of Property, Plant, and Equipment (PPE) and Intangible Assets did not specifically separate the amounts between ICT and other assets, such as office equipment).

[17] The Accelerated Capital Allowance (ACA) provides an initial 20% and an annual 40% allowance which is effective for the Year of Assessment (YA) 2009 until the exemption period of YA 2016 (Malaysian Investment Development Authority, 2015).

Moreover, by considering that most companies are still within the transitional period of improving their financial reporting (Jaafar & Halim, 2013) and ICT disclosure, ICT data retrieved from the financial year end from 2010 to 2014 had been looked into.

Table 4.1 Data Sample of the Malaysian Technology-Based Sector from 2010 to 2014

Particulars	**Main Market**	**ACE Market**	**Total of Companies**	**Total of Observations**
The MPLCs with complete annual reports from the financial year end 2010 to 2014	700	77	777	3,885
Companies in the Malaysian technology sector from the financial year end 2010 to 2014	35	68	103	515
Companies in the Malaysian technology sector with **incomplete annual reports** from the financial year end 2010 to 2014	8	21	29	145
Companies in the Malaysian technology sector with **complete annual reports** from the financial year end 2010 to 2014	27	47	74	370
Companies with **improper ICT records** from the financial year end 2010 to 2013	13	24	37	185
Companies with **proper ICT records** from the financial year end 2010 to 2014	14	23	37	185
Total companies discarded (outliers)	1	3	4	20
Final sample of the Malaysian technology-based sector	13	20	33	165

Note: MPLC refers to the Malaysian Public Listed Companies and total observations refer to the number of companies multiplied with 5 periods of annual reports).

Table 4.1 presents the data sample of the Malaysian technology-based sector from the financial year end of 2010 to 2014 derived from the initial sample population of the Malaysian Public Listed Companies (MPLCs) in the *Bursa Malaysia*. The main industries listed on the *Bursa Malaysia* are close-ends funds, construction, consumer products, finance, hotels, industrial products, exchange traded funds, infrastructure project companies, mining, plantation, properties, real estate investment trust, special purpose acquisition companies, technology, and trading/services. The table also shows that 777 companies with complete annual reports for 2010 until 2014 had been selected through the initial sample. Out of these, 700 companies were listed on the Main Market, while 77 companies in the ACE Market[18].

Meanwhile, according to Goatham (2009), the ICT sector has been identified as the largest contributor to the failure rates of ICT implementation. At present, no specific ICT sector is listed in the *Bursa Malaysia* website, which can be employed as sample in this study. Furthermore, due to absence of the ICT sector in the *Bursa Malaysia*; the Malaysian technology-based sector had been selected for further research. According to Thomsom Reuters Business Classification (TRBC), firms linked to the technology-based sector are closely engaged with ICT components, such as those in manufacturing of electronics and semiconductors, communications equipment, software creation, computer hardware, and technology-related office equipment, as well as providers of consultation and ICT services (TRBC, 2015), including ICT usage (TRBC, 2015; Mohd Noor & Apadore, 2014; PIKOM, 2014; 2013; 2012; Paytas & Berglund, 2004), which can be attributed to the nature of the ICT sector.

This study began by identifying companies listed under the Main Market and the ACE Market in Malaysian technology-based sector from 2010 to 2014, while excluding those from the non-technology sector. Besides, it has been reported that a total of 103 companies in the technology sector had been available during that period. Out of these, 35 companies were listed in the Main Market, while the other 68, in the ACE Market. From the 103 companies, 74 were identified as companies with complete annual reports from 2010 to 2014 after excluding 29 companies that displayed

[18] The ACE Market, which stands for ‗Access, Certainty, and Efficiency', refers to the new name for the formerly known MESDAQ (Malaysian Exchange of Securities Dealing and Automated Quotation) market.

incomplete annual reports. Next, from the total of 74 companies with 370 data observations, 37 companies with 185 observations in the technology sector were determined as companies with proper ICT records, while 36 companies with 180 observations were rejected due to the lack of ICT disclosures[19] for the period of 2010 to 2014. As such, four cases[20] were detected as outliers, while 20 observations were discarded from this study to generate balanced data[21]. Therefore, the final samples of 33 companies with 165 observations were identified for analyses in this study.

4.5 Measurement of Variables

The following sections describe the methods applied to generate the variables used in the analyses. The methods used to construct the variables are described in Section 4.5.1, whereas ICT investment, ICT governance mechanisms, boards with diverse ICT expertise, and ownership structures, as independent variables, are elaborated in Section 4.5.2, and Section 4.5.3 discusses the control variables. After that, the operationalization of all variables is included in the analyses, as presented in Table 4.2. Other than that, justifications for the methods used are also provided.

[19] Several reasons for the lack of ICT disclosure refer to: (1) It is either the company that made the ICT investment (ICTI) activities, but the amount related to ICTI was not recorded in the annual report, or; (2) the company did the ICTI activities, but the amount related to ICTI was not properly recorded in the annual report (e.g. table of Property, Plant, and Equipment (PPE) and Intangible Assets did not specifically separate the amounts between ICT and other assets, such as office equipment).

[20] In this study, four cases refer to the four different companies that have been detected as outliers.

[21] Basically, a balanced panel is used in this study after taking into account the IFRS implementation on 1st January 2006, the Malaysian government's initiatives in the 9th and 10th Malaysian Plan, and the mandatory compliance of ISO / IEC 27001 imposed by the Malaysian government on the Government, financial and ICT sector in 2010 which is dicussed in the sub-section 4.6. Besides that, the purpose of remaining a balanced panel dataset is to provide more reliable and stable dataset due to pooling individual and time dimension as well as to better capture the dynamic adjustment (Jager, 2008).

4.5.1 Dependent Variable: Firm Financial Performance

In general, performance measures used by most firms are intended to ascertain the attainment of their business objectives through effective operation vital for profitability and resilience. The one thing that matters more to firms is the changes that take place in their profitability (Al Ehrbar, 2011). In this study, financial performance measures had been applied to reflect changes that took place in the firm financial condition. The financial performance measures were used to capture the economic consequences of business firms upon the decisions made by the management of the sample. Basically, employees from all firms make decisions and use resources that would eventually influence the financial outcomes of the firm. Upon identifying the efficacy of firm, the financial outcomes are the common measures used to evaluate firm performance.

Hence, for the purpose of this study, firm performance measures from the standpoint of those internals (management) and externals (investors), as proposed by prior study (Black, Love and Rachinsky, 2006), considered two types of financial performance measures, namely accounting-based and market-based measures. The accounting-based measures capture data on ROA and ROE to demonstrate the view of the insiders (Marshall, McManus, & Viele, 2014), while the market-based measure employed Tobin‘s Q to represent the views of externals concerning the effects of ICT and corporate governance mechanisms. Besides, the adoption of these two financial performance measures, after considering the views given by empirical researchers, accounting-based measures are relevant for past/short term financial performance, while market-based measures are meant for future/long-term financial performance

(Zhang et al., 2012; Merchant & Van der Stede, 2007; Ittner et al., 2003; Hoskisson et al., 1994; Kaplan, 1984).

Accounting-based measures have been widely used in prior studies to evaluate the profitability of firms and generally, represent financial ratios per percentage for past financial performance (Gral, 2013). Basically, the profitability ratios like ROA and ROE were used to evaluate the ability of firms to generate operational profits from the assets invested (Marshall et al., 2014). These two dependent variables are present in almost all firm performance analysis. With that, ROA was selected for this study due to its ability to provide a better view of the fundamentals of the business, including asset utilization. In fact, Milano and Cavasino (2014) suggested that the increasing focus on ROA measure has led to higher total shareholder returns, which drives to better share-price performance. They also claimed that ROA measures, instead of the other measures, such as profits and profit margins; are able to demonstrate firm‘s ability to generate greater value for the firm, as well as to its shareholders.

ROA is measured through earnings before interest expenses and taxes (EBITs), divided by the firm‘s average total assets by following the measurement proposed by Marshall et al., (2014). The researchers asserted that using total assets is unsuitable because it reports on the total at one point in time derived from a single year-end balance sheet. Besides, profit is earned during the entire financial year, thus it should be related to the average assets for the entire year by averaging the assets reported at the beginning and at the end of the year. The researchers also expressed that using the profit for the period per se as the amount of return is also unsuitable because the total assets could have been financed by a variety of sources; some tax-deductible, while others are not. Moreover, ROA has been extensively used to represent firm‘s profitability in past studies of ICT, as well as its effect on firm performance (Arabyat, 2014; Makinde, 2014; Ugwuanyi & Ugwuanyi, 2013; Hung et al., 2012; Ekata, 2011; Liang et al., 2010; Zehir et al., 2010; Jun, 2008; Beccalli, 2007; Shin, 2006; Lim et al., 2004; Anderson et al., 2003; Weill, 1992). Moreover, the only common rule is that higher ROA values indicate the efficiency of a firm in utilizing its assets to serve in the interest of the shareholders (Ibrahim & Abdul Samad, 2011), thus giving the firm more leeway to reward shareholders in term of profits derived from the invested assets (Haniffa & Hudaib, 2006). On the other hand, lower ROA values refer to the inefficient use of firm's assets due to ineffective management and governance mechanisms in place.

Apart from using ROA, this study also focused on Return on Equity (ROE), which refers to Earnings after interest expenses and taxes (EAITs) (also refers to profit for the year), divided by the average of shareholders' equity, as depicted in the measurement model proposed by Marshall et al., (2014). Nonetheless, the ROE and ROA are not related to each other as one measures after-tax calculation, while the other, before-tax calculation. However, Marshall et al., (2014) asserted that the trend of each measurement can be compared. The ROE reflects the ability of the management to utilize shareholder's equity whether to improve the return earning or to retain the firm in a good position. Moreover, the ROE functions as a vital reference for the present shareholders and prospective investors as it relates to the earnings to owners' investment, which refers to owners' equity in the assets of the entity. Like ROA, the higher the value of ROE, the more effective the governance mechanisms and management at employing shareholders' capital to generate profit. On the other hand, the lower the ROE, the less effective the governance mechanisms, thus could lead to inefficient management, hence failure in generating profit for shareholders.

Therefore, the better the management of shareholder‘s equity, the more profitable the firms will generate in term of ROE, which could lead the firm to perform better. The ROE has also been used as a standard measure of profitability in other ICT investment studies that reflect the past performance of firm (Arabyat, 2014; Makinde, 2014; Hung et al., 2012; Ekata, 2011; Jun, 2008; Beccalli, 2007; Shin, 2006; Lim et al., 2004), as well as the effect of corporate governance studies on firm performance (Haider et al., 2015; Johl et al., 2015; Yusoff et al., 2015; Wahba, 2015; Aggarwal, 2013a; Aggarwal, 2013b; Wan Yusoff & Alhaji, 2012; Ibrahim & Abdul Samad, 2011; Sami et al., 2011). The reliance on accounting-based measure, in addition, has been criticized on the grounds that the accounting earnings alone were inadequate to reflect market value (Lubatkin & Shrieves, 1986). Besides, in measuring firm performance, market-based measure has been accepted as one of the best proxies of financial performance measurement, especially in the context of ICT investment. Furthermore, since the initial investment costs of ICT incurred are huge and its implementation is rather time-consuming, the return value of ICT is only noted after a few years from the moment ICT investment is made (Zhang et al., 2012; Yaylacicegi & Menon, 2004; Brynjolfsson & Hitt, 2003; Dedrick et al., 2003; Brynjolfsson, 1993). Moreover, market measurement can better explain the effect of long-term investment on firm performance (Zhang et al., 2012; Merchant & Van der Stede, 2007; Ittner et al., 2003; Hoskisson et al., 1994; Kaplan, 1984).

On top of that, Tobin‘s Q (TQ) refers to a market measure of firm performance for its ability to reflect the effect of ICT on firm performance (Zhang et al., 2012; Lin, 2007, Shin, 2006). As such, Shin (2006) argued that the TQ has the ability to explain further the effect of ICT on firm performance in terms of its intangible value, such as improved market orientation, higher product quality, better customer service, as well as support for re-engineering efforts. Since accounting-based measures have the tendency to ignore ICT effect on intangible value, the TQ is deemed appropriate to measure the effect of ICT investment on firm performance (Lin, 2007). However, in another study, the TQ reflected firm performance in terms of both tangible and intangible benefits (Zhang et al., 2012). Even though various types of TQ measurements have been proposed; the results obtained from various approaches do not differ much (Zhang et al., 2012; Chung & Pruitt, 1994). Hence, the measurement of this study is in agreement with Zhang et al., (2012) and Lin‘s (2007), which defined TQ as (MV + PS + DEBT)/TA, whereby MV refers to the market value of firm, PS is the liquidating value of preferred stock, TA denotes the total assets, and the DEBT value is derived from the following; (Current Liabilities – Current Assets) + Inventory+ Long-term Debt, as proposed by Zhang et al., (2012).

Moreover, the inclusion of an inventory element in this measurement by considering that the proper ICT management is either in the form of tangible (e.g., hardware) or intangible (e.g., software) would be advantageous to companies. Besides, the use of ICT is not only to generate greater networking, but also to help companies to reduce their inventory costs (Zhang et al., 2012; Strassman, 1997), besides raising the company‘s productivity with higher product quality control and accurate data analysis of sales marketing, which suggest more flexibility and efficiency in terms of production and labour control processes. In precise, proper ICT management allows companies to move rapidly in response to economic change (Strassman, 1997). In addition, all financial data related to the measurements of ROA and ROE proposed by Marshall et al., (2014), as well as TQ (Zhang et al., 2012; Lin, 2007), had been gathered from annual reports published by firms within the Malaysian technology-based sector during the period of 2010 to 2014.

4.5.2 Independent Variables

4.5.2.1 ICT Spending

This study examined the effect of ICT investment on the performance of companies in the Malaysian technology-based sector. Therefore, a measure of ICT had been definitely necessary. In selecting the ICT investment measurement, several measurements from the literature had been weighed in. This study only focused on ICT spending (Ugwuanyi & Ugwuanyi, 2013; Ekata, 2011; Liang et al., 2010; Lim et al., 2004; Anderson et al., 2003; Byrd & Marshall, 1997) as a proxy of ICT investment, while other ICT investment proxies used in past studies, such as ICT training costs and ICT staff expenditures, were dismissed due to shortcomings in data source. The measurement of ICT spending (ICTSPE) was constructed as ICTSPE, which is equivalent to the logarithm for the amount of Net Cash for IT Investing Activities (1ogNCITIA) (Mohd Noor & Apadore, 2014). The data of logNCITIA was derived from the details provided at the Notes to the Financial Statements in the annual reports. Besides, the NCITIA consists of investments in tangible ICT assets (e.g. hardware) (Mohd Noor & Apadore, 2014; Safari & Zhen Yu, 2014; Spyros & Euripidis, 2014; Romdhane, 2013; Ekata, 2011; Beccalli, 2007) and ICT intangible assets (e.g., software and R&D costs) (Mohd Noor & Apadore, 2014; Safari & Zhen Yu, 2014; Spyros & Euripidis, 2014; Romdhane, 2013; Ekata, 2011; Beccalli, 2007).

Based on the preceding discussion, the element of time-lagged effect of ICT spending is also seen as an important aspect in determining firm performance, by considering that ICT investment does not have an immediate impact on firm performance. Hence, instead of measuring ICT spending incurred in year *t*, this study measured ICT spending incurred in *t-1*, *t-2*, and *t-3*. ICT spending incurred in year *t* refers to $ICTSPE_t$, $ICTSPE_{t-1}$ refers to ICT spending incurred in year *t-1*, $ICTSPE_{t-2}$ refers to ICT spending incurred in year *t-2*, and $ICTSPE_{t-3}$ refers to ICT spending incurred in year *t-3*. Moreover, the literature suggests that ICT has been interpreted under the concept of intellectual capital (IC) (Kavida & Sivakoumar, 2011; Sundac & Krmpotic, 2009; OECD, 2008; Davenport & Prusak, 1998; IFAC, 1998; Sveiby, 1997). While in Malaysia, no accounting standard is available to disclose IC in annual reports (Rahim, Atan, & Kamaluddin, 2011). Although ICT is part of IC, there is still no mandatory accounting standard that requires Malaysian companies to disclose their ICT investment activities in their financial reporting. Thus, the aspects of ICT spending data, such as tangible asset (e.g. ICT equipment) and intangible assets (e.g. ICT software) were derived from the table of plant, property, and equipment, as well as intangible assets, respectively[22].

4.5.2.2 The Adoption of ICT Governance Standards (Processes)

ICT governance standards and frameworks, such as COBIT, ITIL, and other ISO standards for ICT, are categorized under IT governance processes, which are also referred to the formalization and institutionalization of strategic IT decision-making or IT monitoring procedures (De Haes & Van Grembergen, 2004; Van Grembergen et al., 2004; Peterson, 2003). In fact, these standards are designed to offer directions and ways of managing ICT within an organization with established engagement between governing bodies and their senior executives. The adoption of ICT governance standards and frameworks (ADICTG) in a company means the company practises ICT

[22] By considering the IFRS adoption in Malaysia implemented on or after 1st January 2006.

governance. Thus, in order to measure the adoption of ICT governance standards among Malaysian technology companies, this study employed the construct of IT governance processes, as carried out by Lazic et al., (2011b).

The ADICTG, in addition, was analysed with the availability of ICT governance standards gathered from annual reports, including portfolio management, ICT governance frameworks (e.g. COBIT and ITIL), ICT governance standards (e.g. ISO standards for ICT), ICT budget management, as well as ICT budget control and reporting. To date, no mandatory compliance has been imposed for ICT disclosure in companies‘ financial reporting. However, voluntary ICT disclosure is mostly practised by companies due to mandatory compliance of their Information System Security Management (ISMS) to be certified by ISO/IEC 27001, which has been imposed by the Malaysian government in 2010 (KPMG, 2015; JPM, 2010). Therefore, the analysis process included any word that expressed the features of ICT standards (e.g. ISMS or ISO/IEC 27001) in the annual reports. Moreover, dummy variables were applied in this study. If ICT governance standards and frameworks are made available in the annual reports, they were coded as 1, while 0 for nil description.

4.5.2.3 The Presence of ICT Governance Committee Structure

Based on the construct variables used in past studies; questionnaire, web-survey, and interview had been the most used methods. However, this study employed dummy variables during the process of collecting data in relation to hypotheses 3(a) and 3(b). In answering hypothesis 3(a), the presence of ICT governance committee structure (ICTGCOM) was analysed by identifying words that described the features of ICTGCOM in companies‘ annual reports. The features of ICTGCOM were determined based on the words that expressed the presence of either the ICT Strategy Committee (Ali et al., 2009; Boritz & Lim, 2008; Ali & Green, 2007; Ali & Green, 2005) or the ICT Audit Committee.

If ICTGCOM was identified from the annual reports, the variable of ICTGCOM was coded as 1, while 0 for absence of ICTGCOM. Meanwhile, as for hypothesis 3(b), the presence of ICT senior management (ICTSM) was specifically investigated based on the words that expressed the presence of ICT Steering Committee, which also referred to the management level that composed of either a Chief Information Officer (CIO), ICT Project Steering Committee (IPSC), ICT Security Committee (ICTSC) or Architecture Steering Committee (ASC), as proposed by De Haes and Van Grembergen (2015). As such, since this study employed dummy variable, coding 1 was awarded for the presence of CIO, IPSC, ICTSC, and ASC, as stated in the company‘s annual report, whilst 0 for absence of the stated committees. After that, the outcome of ICTSM was tested to confirm the effect of their presence upon firm performance.

4.5.2.4 Boards with ICT Education Background

Taking example from prior studies that examined the effect of board‘s education background on firm performance, only Gîrbină et al., (2012) focused on examining the effect of boards‘ education background (financial area) on firm performance[23]. Thus, in coding data for boards with ICT education background (BICTEDU), this study adhered to the suggestion proposed by Gîrbină et al., (2012) by constructing the variable in the form of BICTEDU proportion, which was determined by dividing the

[23] Most previous studies have measured the boards‘ education background by using the indicator of boards‘ education level, which defeats the purpose of this study.

number of BICTEDU (dummy) with the total number of board members (BSIZE). The number of BICTEDU determined using dummy variable was awarded with 1 for those with ICT education background, whereas 0 for those who do not. Moreover, the BICTEDU was measured at all levels of their ICT education background, regardless of the level of degree and study duration.

4.5.2.5 Boards with ICT Professional Qualification

The variable of boards with ICT professional qualification (BICTPRO) in this study was measured as the total number of BICTPRO (dummy), divided by the total number of board members (BSIZE) in a company, adhering to the method suggested by Yunos (2011). Those with ICT professional qualifications were denoted as 1, while 0 for otherwise. Some instances of ICT professional qualifications, such as the Certified Information Systems Security Professional (CISSP), the Certification of Information Systems Auditor (CISA), the Certification of Information Security Manager (CISM), the Certification of Governance of Enterprise IT (CGEIT), the Certification of Control Objectives for Information and Related Technology (COBIT) 5, as well as the Certification of Risk and Information Systems Control (CRISC), or others related to ICT designations that could be assessed from the annual reports in measuring BICTPRO.

4.5.2.6 Boards with ICT Industrial Experiences

The variable of boards with ICT industrial experience employed in this study is known as BICTIE. According to Drobetz et al., (2014), as experience at a similar firm, by definition, also constitutes industry experiences; prior experience at the firm where the director sits on the board was distinguished from prior experience in the industry (i.e., at other firms in the focal industry). Hence, in measuring BICTIE, due to shortcoming of data, this study only considered prior ICT experience the boards gained from other firms in the focal industry (technology industry). Those with prior ICT experiences at other technology firms, regardless of their title and job designation, were denoted as 1, while 0 for otherwise. As such, the BICTIE was measured as the total number of BICTIE (dummy) and divided by the total number of board members in the company.

4.5.2.7 Boards with ICT-Related Training

The measurement of the effect of training on firm performance varies across many studies (Nguyen et al., 2010). In fact, many types of training measurements have been introduced in past studies, including ICT training expenditures, ICT budgets, establishment of training plan (Forth & Mason, 2004), and the number of employees involved in training investments (Patrignani & Conlon, 2012). For instance, Zulkifli and Duasa (2008) conducted a training measurement based on both qualitative and quantitative techniques. Various types of training proxy measurements were introduced in the quantitative techniques: (1) quantified days‘ training; (2) percentage of knowledge workers trained in the last 12 months; and (3) intensity of training, whilst qualitative techniques included: (1) training expenditures; (2) trainers‘ years of experience; and dummy variables used for training policy, informal training, induction training, as well as the adoption of multidimensional training evaluation measure.

Meanwhile, according to the Securities Commission Malaysia (SC) (2007), through the revised MCCG in 2007, the Malaysian public listed companies are required, in adhering to the Listing Requirements of *Bursa Malaysia*, to disclose details of relevant training attended by each board member in their annual reports. Therefore, this study included training programs, workshops, seminars, and conferences related to ICT attended by the board members as boards with ICT-related training (BICTTR). This BICTTR was treated as a dummy variable with 0 for nil BICTTR and 1 for the presence of BICTTR in each company.

4.5.2.8 Ownership Structures

In determining the effect of concentrated ownership (COWN), the COWN had been based on the proportion of shares owned by the five largest shareholders to the total shares outstanding in the company (Lee & Lee, 2014; Zakaria et al., 2014; Haniffa & Hudaib, 2006). Meanwhile, the variable of managerial ownership (MOWN) was measured as the proportion of shares held by the executive directors of the company to the total number of shares outstanding, by following the prior construct (Zakaria et al., 2014; Wahla et al., 2012; Kamardin & Haron, 2011; Haniffa & Hudaib, 2006). Next, other variable of government ownership (GOWN) was measured as the proportion of shares held by government-linked companies (GLCs) to the total shares outstanding of the firm (Kiruri, 2013), whilst foreign ownership (FOWN) was measured as the proportion of shares held by foreign shareholders to the total shares outstanding of the firm (Kiruri, 2013).

Table 4.2 The Operationalization of Variables

Operational Variables		
Variables	**Acronym**	**Operationalization**
Return on Assets	ROA	Earnings before interest expenses and taxes (EBITs) divided by firm‘s average total assets
Return on Equity	ROE	Earnings after interest expenses and taxes (EAITs) divided by the average of shareholders‘ equity
Tobin‘s Q	TQ	(Market Value + Liquidating value of preferred stock + Debt) divided by Total Assets
ICT spending	ICTSPE	logNet Cash for IT Investing Activities (logNCITIA)
The adoption of ICT governance standards and frameworks	ADICTG	1 if there is ADICTG; 0 otherwise
The presence of ICT governance committee structure	ICTGCOM	1 if there is ICTGCOM; 0 for non-presence of ICTGCOM
The presence of ICT senior management	ICTSM	1 if there is CIO, IPSC, ICTSC and ASC; 0 for non-presence of CIO, IPSC, ICTSC and ASC
Boards with ICT educational background	BICTEDU	The number of BICTEDU (dummy) is divided by the total number of board members (BSIZE)
Boards with ICT professional qualification	BICTPRO	The total number of BICTPRO (dummy) divided by the total number of board members (BSIZE)
Boards with ICT industrial experience	BICTIE	The total number of BICTIE (dummy) divided by the total number of board members (BSIZE)
Boards with ICT-related trainings	BICTTR	1 if there is BICTTR; 0 for no BICTTR
Concentrated ownership	COWN	The proportion of shares owned by the ten largest shareholders
Managerial ownership	MOWN	The proportion of shares held by the executive directors
Government ownership	GOWN	The proportion of shares held by government-linked companies (GLCs)
Foreign ownership	FOWN	The proportion of shares held foreign shareholders
Board Independence	BINDP	The percentage of the number of independent executive directors (INEDs) divided by BSIZE
Board Size	BSIZE	Number of directors on the board
Leverage	LEV	The ratio of total debt to total assets
Firm Size	FSIZE	Firm size is the logarithm of total assets

4.5.3 Control Variables

The variable of board independence (BINDP) was measured as the percentage of the number of independent directors (NEDs) and divided by the total number of board members in a firm (Kamardin & Haron, 2011; Haniffa & Hudaib, 2006). The NEDs are to perform monitoring and have an oversight role on the management in protecting the interest of shareholders. As such, this study believes that the larger the proportion of NEDs on the board, the higher their monitoring level is in safeguarding the interest of shareholders, especially in making better decisions (Fama & Jensen, 1983).

Other than that, board size (BSIZE) was measured as the number of directors on the board (Kamardin, 2014; Kamardin & Haron, 2011). Nonetheless, it has been argued that BSIZE had been positively related to firm performance (Haider et al., 2015; Al-Matari et al., 2014; Qasim, 2014; Ibrahim & Abdul Samad, 2011; Haniffa & Hudaib, 2006).. Hence, it is predicted that a larger BSIZE would positively affect firm performance (Said, Crowther, & Amran, 2014). Meanwhile, leverage (LEV) was measured by the ratio of the total debt to the total assets (Kamardin, 2014; Liu, Tian, & Wang, 2011; Boritz & Lim, 2008), whereas firm size (FSIZE) was based on the logarithm of total assets (Kamardin, 2014; Kamardin & Haron, 2011; Ho, Wu, & Xu, 2011).

4.6 Panel Data

Panel data analysis was carried out to examine the effect of ICT investment, as well as other corporate governance variables, on firm performance. Moreover, panel data was selected mainly because it considers variables that cannot be observed or measured or variables that change over time and those that do not across entities, besides identifying the sources of possibly mingled effects. The use of panel data offers several benefits (Baltagi, 2005). Apart from its ability to control individual heterogeneity that can lead to misleading and biased results, it also can reduce multicollinearity problems as well as provides more reliable data information due to pooling individual and time dimension. Additionally, panel data also provides more efficient data, variability and captures a better dynamic adjustment (Jager, 2008).

In fact, a panel data set maybe either balanced or unbalanced. A balanced data set contains all data observed in all timeframes, while unbalanced data refer to a set of data from certain years and unobserved. The issue of balanced data set involves economic and financial data, which are often unavailable in balanced form because some individuals might have dropped out from a multiyear survey (Baum, 2006). Nonetheless, in studying the effect of ICT investment and other corporate governance variables on firm performance within the Malaysian context, it is unnecessary to have balanced panel data for no mandatory requirement is needed for ICT disclosure imposed by the Malaysian regulatory body on Malaysian companies‘ annual report. Nonetheless, in studying the effect of ICT investment and other corporate governance variables on firm performance within the Malaysian context, it is unnecessary to have balanced panel data for no mandatory requirement is needed for ICT disclosure imposed by the Malaysian regulatory body on Malaysian companies‘ annual report.

Regarding the implementation of IFRS in Malaysia on or after 1st January 2006, some companies have begun to voluntarily expose their ICT disclosure in an effort to improve their financial reporting disclosure. Being in a transitional period of improving their financial reporting (ICT disclosure), unbalanced panel data had been considered in this study. However, this study employed the balanced panel data set (cross-sectional and time series data) after weighing in the following issues; the effective date of IFRS implementation on 1st January 2006, the initiatives taken by the Malaysian government in the 9th and 10th Malaysia Plan, as well as the mandatory compliance of ISO/IEC 27001 imposed by the Malaysian government on the Government, including financial and ICT sectors in 2010. Besides, this study also excluded some companies after noting several reasons: It is (1) either the company did the ICT investment (ICTI) activities, but the amount related to ICTI is unrecorded in the annual report, or; (2) the company did the ICTI activities, but the amount related to ICTI is not properly recorded in the annual report (e.g. PPE and Intangible Assets did not separate amounts for ICT and office equipment spending).

4.7 Model Specification

According to Beccalli (2007), no single standard form is available to predict the effect of ICT investment on firm financial performance. Despite of large investments made in ICT, the IT paradox still occurs. One of the factors that contribute to the IT paradox is time-lag effect of ICT investment (Devaraj & Kohli, 2002; Brynjolfsson, 1993). Most prior studies have ignored the element of lagged effect of ICT investment in their research model, especially within the context of its effect on firm performance. Due to the absence of model in examining the effect of lagged variables of ICT investment on firm performance in empirical studies, similar treatments of the effect of lagged ICT investment variables in the context of other areas were also embedded in this study. For instance, Brynjolfsson et al., (1994) looked into the effects of IT investment variable (IT) incurred in year *t* and four-year lag of IT investment (e.g., IT_{t-1}, IT_{t-2}, IT_{t-3}, and IT_{t-4}) on firm size, which found that the decline in firm size was greater after a lag of 1 to 2 years following IT investments. Thus, a similar treatment of the effect of ICT investment with lagged variables developed by Brynjolfsson et al., (1994) was adopted in this study.

Past studies have proven that investments do exhibit positive effects on firm performance after a lag of one to two years (Hung et al., 2012; Brynjolfsson et al., 1989), a lag of two years (Francalanci & Galal, 1998), and a lag of two to three years (Brynjolfsson & Hitt, 2003; Brynjolfsson, Malone, Gurbaxani, & Kambil, 1994; Brynjolfsson & Hitt, 1993). Besides, Anderson et al., (2003) asserted that ICT spending incurred in year *t* is incrementally informative about firm performance in the subsequent year if the amount spent offers information about future performance, but not conveyed by the time series of firm performance in preceding years ($Y_{j,\ t-1}$). As such, this study estimated a positive coefficient on ICT spending that should reflect higher firm performance in subsequent years compared to preceding years[24] after considering a delayed impact of ICT spending on firm performance.

Meanwhile, pertaining to the payoff period of ICT investment on firm performance, several factors in accordance with the Malaysian practice were included in this study. According to the Malaysian Ministry of Finance (2014), the Accelerated Capital Allowance (ACA) on computers and IT assets are written off within a period of two years, whereas the useful life of ICT assets for three years has become a common practice for Malaysian Tax Income purposes. The inclusion of several lagged variables of ICTSPE by three time periods ($ICTSPE_{j,\ t-1}$, $ICTSPE_{j,\ t-2}$, and $ICTSPE_{j,\ t-3}$) was essential as the value of ICT spending does not immediately affect firm performance, but several years before gaining benefit.

[24] Consistent with Anderson et al. (2003), a positive coefficient on the IT spending variable would mean that firm performance in year t + i was higher relative to performance in years t and t-1 for firms that spent more on IT in year t.

In addition, to the best of the researcher's knowledge, no empirical model has tapped into the effect of ICT investment, along with some elements of corporate governance factors that consist of ICT governance mechanisms (ADICTG, ICTGCOM, and ICTSM), boards with diverse ICT expertise (BICTEDU, BICTPRO, BICTIE, and BICTTR), ownership structures (COWN, MOWN, GOWN, and FOWN), as well as four control variables (BINDP, BSIZE, LEV, and FSIZE), to establish their effects upon firm performance. Therefore, the empirical model specification was developed due to the integration of multiple independent variables, especially to further examine the effect of ICT investment, ICT governance mechanisms, boards with diverse ICT expertise, and ownership structures on firm performance in the Malaysian technology-based sector. The developed regression model is given in the following:

$$Y_{j,t} = \alpha + (\beta_1 \text{ ICTSPE}_{j,t}) + (\beta_2 \text{ ICTSPE}_{j,t-1}) + (\beta_3 \text{ ICTSPE}_{j,t-2}) + (\beta_4 \text{ ICTSPE}_{j,t-3}) + (\beta_5 \text{ ADICTG}_{j,t}) + (\beta_6 \text{ ICTGCOM}_{j,t}) + (\beta_7 \text{ ICTSM}_{j,t}) + (\beta_8 \text{ BICTEDU}_{j,t}) + (\beta_9 \text{ BICTPRO}_{j,t}) + (\beta_{10} \text{ BICTIE}_{j,t}) + (\beta_{11} \text{ BICTTR}_{j,t}) + (\beta_{12} \text{ COWN}_{j,t}) + (\beta_{13} \text{ MOWN}_{j,t}) + (\beta_{14} \text{ GOWN}_{j,t}) + (\beta_{15} \text{ FOWN}_{j,t}) + (\beta_{16} \text{ BINDP}_{j,t}) + (\beta_{17} \text{ BSIZE}_{j,t}) + (\beta_{18} \text{ LEV}_{j,t}) + (\beta_{19} \text{ FSIZE}_{j,t}) + \eta_j + \varepsilon_{j,t} \quad \text{Equation (1)}$$

$$\varepsilon_{j,t} = v_j + u_{j,t} \quad \text{Equation (2)}$$

where the description of each variable is as follows:

$Y_{j,t}$ represents either annual accounting performance ratios (ROA and ROE) or market ratio (TQ) of the Malaysian technology firms *j* at time *t*.

$\text{ICTSPE}_{j,t}$ represents the logarithm of ICT spending firms *j* at time *t*.

$\text{ICTSPE}_{j,t-1}$ represents the logarithm of ICT spending firms *j* at time *t - 1*.

$ICTSPE_{j,\ t-2}$ represents the logarithm of ICT spending firms *j* at time *t - 2*.

$ICTSPE_{j,\ t-3}$ represents the logarithm of ICT spending firms *j* at time *t - 3*.

$ADICTG_{j,t}$ represents the adoption of ICT governance standards or frameworks at firms *j* at time *t*.

$ICTGCOM_{j,t}$ represents the presence of ICT governance committee at firms *j* at time *t*.

$ICTSM_{j,t}$ represents the presence of ICT senior management at firms *j* at time *t*.

$BICTEDU_{j,t}$ represents boards with ICT education background at firms *j* at time *t*.

$BICTPRO_{j,\ t}$ represents boards with ICT professional qualification at firms *j* at time *t*.

$BICTIE_{j,\ t}$ represents boards with ICT industrial experience at firms *j* at time *t*.

$BICTTR_{j,\ t}$ represents boards with with ICT-related training at firms *j* at time *t*.

$COWN_{j,\ t}$ represents concentrated ownership at firms *j* at time *t*.

$MOWN_{j,\ t}$ represents managerial ownership at firms *j* at time *t*.

$GOWN_{j,\ t}$ represents government ownership at firms *j* at time *t*.

$FOWN_{j,\ t}$ represents foreign ownership at firms *j* at time *t*.

$BINDP_{j,\ t}$ represents board independence at firms *j* at time *t*.

$BSIZE_{j,\ t}$ represents board size at firms *j* at time *t*.

$LEV_{j,\ t}$ represents financial leverage at firms *j* at time *t*.

$FSIZE_{j,t}$ represents firm size at firms j at time t.

η_j represents unobserved firm fixed-effect.

$\varepsilon_{j,t}$ represents as an error term that includes time invariant effect v_j and random error term $u_{j,t}$.

Theoretically, Equation (1) is based on the static regression model. In fact, many past studies have relied on the static approach to measure the effect of ICT investment on firm performance (Arabyat, 2014; Makinde, 2014; Ugwuanyi & Ugwuanyi, 2013; Hung et al., 2012; Chari et al., 2008; Beccalli, 2007; Shin, 2006; Kim, 2004). However, only a few studies in the related area have applied the dynamic approach, which incorporates lagged values of dependent variable on the right side of the equation of their research model (Kooshki & Ismail, 2011; Jun, 2008; Anderson et al., 2003). Besides, the inclusion of lagged dependent variables as previous year financial performance in the model is indeed useful in estimating the financial performance for the following year(s) (Anderson et al., 2003; Abarbanell & Bushee 1997; Brown 1993; Shroff 1999; Mozes, 1992).

Equation (1), basically, examined the effect of ICT investment, ICT governance mechanisms, boards with diverse ICT expertise, and ownership structures on firm performance. Additionally, a fixed effect model is often used to control unobserved heterogeneity in panel data (Baltagi, 2005), which cannot be employed for endogenous variable in the model (De Minguel, Pindado, & De la Torre, 2003). Hence, the instrumental variable estimation could be applied to alleviate the endogeneity problem caused by the independent variable. Nonetheless, some researchers argued that it is indeed challenging to identify the most appropriate instrumental variables (Guo, 2015; Nakano & Nguyen, 2010) in order to cater to the needs of a valid instrumental variable, including no correlation with error term and correlation with endogenous variable (Baser, 2009). Moreover, firm performance might be treated as dynamic in nature (Mishra, 2014), thus suggesting a potential for the fixed effect approach to produce biased and inconsistent estimation (Wooldridge, 2013).

The time invariant effect of v_i is eliminated by the within transformation of fixed effect approach, but the transformed lagged dependent variable[25] is correlated with the transformed error term ($u_{j,t}$ - $\bar{u}_j$), while $Y_{j,\ t-1}$ is correlated with $u_{j,\ t-1}$ (Baltagi, 2005); leading to inconsistent estimate of the within transformation estimation method (Bond, 2002). Hence, in order to hinder endogeneity problems, the Generalized Method of Moments (GMM) was applied for the dynamic panel data model (DPM) in this study. Upon including lagged dependent variable of firm financial performance as independent variable (regressor), the develop model is given in the following:

$$\begin{aligned} Y_{j,\,t} = {} & \alpha + (\beta_1\ ICTSPE_{j,\,t}) + (\beta_2\ ICTSPE_{j,\,t-1}) + (\beta_3\ ICTSPE_{j,\,t-2}) + (\beta_4\ ICTSPE_{j,\,t-3}) + \\ & (\beta_5\ ADICTG_{j,\,t}) + (\beta_6\ ICTGCOM_{j,\,t}) + (\beta_7\ ICTSM_{j,\,t}) + (\beta_8\ BICTEDU_{j,\,t}) + \\ & (\beta_9\ BICTPRO_{j,\,t}) + (\beta_{10}\ BICTIE_{j,\,t}) + (\beta_{11}\ BICTTR_{j,\,t}) + (\beta_{12}\ COWN_{j,\,t}) + \\ & (\beta_{13}\ MOWN_{j,t}) + (\beta_{14}\ GOWN_{j,\,t}) + (\beta_{15}\ FOWN_{j,\,t}) + (\beta_{16}\ BINDP_{j,\,t}) + (\beta_{17}\ BSIZE_{j,\,t}) \\ & + (\beta_{18}\ LEV_{j,\,t}) + (\beta_{19}\ FSIZE_{j,\,t}) + (\beta_{20}\ Y_{j,\,t-1}) + \varepsilon_{j,\,t} \quad \text{......Equation (3)} \end{aligned}$$

$$\varepsilon_{j,t} = v_i + u_{j,t} \quad \text{......Equation (4)}$$

$$E(v_i) = E(u_{j,t}) = E(v_i\ u_{j,t}) = 0 \quad \text{...... Equation (5)}$$

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25 $(y_{j,t-1} - \bar{y}_{j,-1})$ where $\bar{y}_{j,-1} = \sum_{t=2}^{T} \frac{y_{j,t-1}}{T-1}$

where additional variables like $Y_{j,\ t-1}$ refers to financial performance of firm *j* at time *t-1*, while $\varepsilon_{j,t}$ refers to error term that includes the time invariant effect v_i and random error term $u_{j,t}$.

In examining the dynamic model of firm performance, this study adhered to several dynamic approaches from past studies (Nayan, Kadir, Ahmad, & Abdullah, 2013; Jun, 2008). As such, Jun (2008) examined the effect of ICT investment in the context of Korean security firms. Some elements of lagged dependent variables (e.g., ROA, ROE, and profits) were applied to the dynamic model as regressors, hence displayed significantly positive coefficient estimates for all tested models. The researcher claimed that the lagged values of returns displayed significant explanatory power for returns. Besides, as mentioned before, the Generalized Method of Moments (GMM) is an appropriate estimation method for this study. According to Roodman (2009), the GMM is useful for the following reasons: (1) the panel data have large individual observations (large N) and smaller time periods (small T); (2) the model is dynamic which contains lagged dependent variable; (3) the explanatory variables are not required to be strictly exogenous; and (4) it controls heteroscedasticity and autocorrelation. Besides, unobserved heterogeneity that appears in the fixed effect model is also controlled by the GMM dynamic panel model that allows for a dynamic relation of the dependent variable and may not require external instruments (Wintoki, Linck, & Netter, 2012).

Other than that, Anderson and Hsio (1982) proposed first differences as the methods of Ordinary Least Square (OLS) and Fixed Effect (FE) or Random Effect (RE) are inappropriate for dynamic panel data (Wooldridge, 2013). Under the first differences estimation, the time invariant effect of individuals was excluded and substituted with instrumental variable estimation. The instrumental variables for the lagged dependent variable were developed from the second and third lags of the dependent variable ($y_{j,t-2}$ and $y_{j,t-3}$ or $\Delta y_{j,t-2}$ and $\Delta y_{j,t-3}$). Although these instrumental variables are highly correlated with lagged dependent variable, they do not correlate with error disturbance (Roodman, 2009). Besides, even though the estimation method proposed by Anderson and Hsio (1982) is consistent, other experts argued that the method dismissed potential orthogonality conditions (Arellano & Bond, 1991).

Meanwhile, Arellano and Bond (1991) suggested a more efficient estimation procedure known as difference GMM estimator to deal with dynamic panel data. This difference GMM (DGMM) model is defined as a system of equation and uses lagged values of endogenous and exogenous variables as its instrumental variables. While DGMM corrects endogeneity bias, the method suffers from efficiency loss by omitting informative moment conditions. Hence, it was argued that the DGMM has a weakness where the lagged levels, sometimes, become poor instruments for the first differenced variables, which could be biased for finite sample usually associated with a highly persistent pattern of the dependent variable (Blundell, Bond, & Windmeijer, 2000). Moreover, subjected to the short time period of the panel data set used in this study (T = 5 years), the finite-sample might lead to downward bias, while weak instruments might invalidate the estimations (Bond et al., 2001; Blundell & Bond, 1998). Thus, these DGMM weaknesses suggest the inclusion of more moment conditions to increase the efficiency of estimations.

After that, the system GMM (SGMM) was then developed by Arellano and Bover (1995) and Blundell and Bond (1998), where this method is considered to be more superior than DGMM (Roodman, 2009). Furthermore, Bond, Hoeffler, and Temple

(2001) asserted that this method has the ability to correct unobserved heterogeneity, besides omitting variable bias, measurement error, and potential endogeneity that frequently affect estimation. In fact, SGMM amalgamates a system of two equations, including a level equation and differencing transform equation to generate a more efficient estimation. In fact, SGMM amalgamates a system of two equations, including a level equation and differencing transform equation to generate a more efficient estimation (Blundell & Bond, 1998; Arellano & Bover, 1995). This method, nevertheless, requires the assumption that first differences of instrumental variables for level variables are not correlated with unobserved individual effects, which means that the difference of predetermined variables can be used as instruments for level equations.

As for the SGMM estimation method, several rules of thumb regarding sample size in the dynamic approach were considered in this study. According to Bhattarai (2011), a large sample size (the number of observations over individuals and time) generates more accurate estimations and asymptotically consistent in dynamic approach. Besides, Soto (2009) claimed that a small sample size[26] would not permit a researcher to limit the number of instruments used for estimation. Hence, small sample size with unlimited number of instruments may cause an increase in the number of instruments[27], which could also lead to inconsistent and weak results for dynamic diagnostic tests (Mileva, 2007). In addition, the number of instruments must not exceed the number of groups (e.g., the companies selected in this case of study) (Roodman, 2009; Mileva, 2007). If the number of instruments does exceed the

[26] In the dynamic approach, sample sizes (N) of 100, 50, and 35 (Soto, 2009), as well as sample sizes at around 50 to 75 (Tauchen, 1986), are considered small.

[27] The general rule of thumb for dynamic GMM estimation method is to keep the number of instruments less than or equivalent to the number of individual sample size (Roodman, 2009; Mileva, 2007), or else, one- and two-step estimators of GMM cannot be computed (Soto, 2009).

number of groups, the value can still be considered under GMM estimation. Hence, in order to make estimation possible, Soto (2009) asserted that only the most relevant instruments should be used in each period[28].

4.7.1 Model Estimation Methods

This study applied the $Y_{j,\ t-1}$ variable, which refers to a dynamic element that represents the previous financial performance measures (e.g. ROA, ROE, and TQ) among companies in the Malaysian technology-based sector. First, the inclusion of lagged firm performance measures would suggest a prediction on future firm performance (Anderson et al., 2003; Abarbanell & Bushee 1997; Brown 1993; Shroff 1999; Mozes, 1992). For instance, the dynamic effect of $Y_{j,\ t-1}$ (previous year financial performance) used in this study had been examined to determine its impact on $Y_{j,\ t}$ (financial performance for the current year). Second, the formulation of lagged dependent financial measures was employed as a tool to correct endogeneity bias in the model (Kooshki & Ismail, 2011; Jun, 2008; Ho & Mallick 2006).

A natural starting point for estimating Equation (1) is pooled OLS, but one shortcoming posed by this conventional OLS is that the inclusion of the lagged dependent variable, $Y_{j,\ t-1}$, on the right makes the exogeneity assumption volatile (Wooldridge, 2002). $Y_{j,\ t-1}$ raises the dynamic panel bias (Nickell, 1981) as it ignores the joint endogeneity of the explanatory variables. Furthermore, Bond (2002) and Roodman (2006) indicated that although OLS and FE estimations for dynamic panel are biased, both researchers proved the validity of GMM estimation by providing both upper and lower bound, respectively. Moreover, according to Hsio (1986), the OLS

[28] The relevant instruments here refer to the only levels of lagged two periods used for the equation in differences, which is extended from the differences lagged for one period used in the first level of equation (Soto, 2009).

overestimated the coefficient of the lagged dependent variable because it positively correlated with errors, whereas Nickell (1981) argued that the FE estimation underestimated the coefficient in the short panel. Hence, in addition to the static version of the OLS and fixed effects model, this study also estimated a dynamic specification, thus abandoning the assumption that ε_i is not serially correlated for the present level of firm performance ($Y_{j,\ t}$) may rely on the previous firm performance levels ($Y_{j,\ t-1}$). With that, this study incorporates a lagged dependent variable on the right side; highlighting preference for dynamic panel estimation. Thus, this study estimated the parameters of the following equation:

$y_{jt} = y_{jt} - 1\gamma + x_{jt}\beta + u_j$ ……………………………………...…….Equation (6)

For $j = (1,\ldots..,N)$ and $t = (1,\ldots\ldots,T)$, and data sets with large n and small t were used. Upon construction, y_{jt-1} is correlated with the unobserved individual-level effects, u_j. Removing u_j by the within transformation (removing the panel-level means) produces inconsistent and biased estimator with T fixed.

With that, the difference of the Generalized Method Moments (DGMM) proposed by Arellano and Bond (1991) appears as an option to deal with endogeneity bias. However, it is argued that the lagged levels of the regressors are poor instruments for the first-differenced regressors (Mileva, 2007; Blundell & Bond, 1998), which could be biased for finite sample properties when the series are persistent because these instruments turn into weak predictors upon changes in endogenous (Blundell & Bond, 1998). After that, the system GMM (SGMM) was proposed by combining moment conditions of both difference and level equations (Blundell & Bond, 1998; Arellano & Bover, 1995) to generate better estimation of GMM (Roodman, 2009). Therefore, the

SGMM was employed in this study to determine the effect of ICT investment, ICT governance mechanisms, boards with diverse ICT expertise, and ownership structures on firm performance.

Basically, the regression model employed in this study is based on the dynamic panel model (DPM) (*refer* to Equation 3) that embeds the element of ‗dynamic' effects, including lagged dependent variables ($Y_{j,t-1}$) as an independent variable on the right equation of the model. In fact, the DPM is applied to examine the effect of ICT investment, ICT governance mechanisms, boards with diverse ICT expertise, and ownership structures on firm performance within the context of Malaysian technology-based sector from 2010 until 2014. Nonetheless, the System Generalized Method of Moments (SGMM) estimation method, which has been considered as more efficient than the Difference Generalized Method of Moments (DGMM), was applied in this study to solve bias and inefficient results in the Pooled OLS and Fixed effect model.

As for the small sample size used in this study, the small number of companies (33 companies for this study), as highlighted in prior studies, did not seem to have any significant effect on the estimation of System GMM (Santos & Barrios, 2011; Soto, 2009). Moreover, when time series are moderately or highly persistent, the SGMM estimator presents the lowest bias and the highest precision[29]. Furthermore, Soto (2009) also argued that the SGMM emerged as the best estimator or a powerful econometric tool for small sample bias and precision. Meanwhile, for additional robustness check, as far as the results are concerned, apart from the SGMM estimation

[29] For instance, Santos and Barrios used small time dimensions (T) from T=3 to T=50 with a number of individuals (N) from N=10 to N=50 in their intensive simulations to investigate both small and large samples of the dynamic panel data estimators, namely the within-groups and first-difference generalized method of moments. The results were of satisfactory under the estimations of the smallest sample size, i.e., N=10 and T=3, while the extreme sample size was N=50 and T=3.

method used for Equation (3); DGMM, Pooled Ordinary Least Square (OLS), and panel fixed effect (FE) estimation methods were also applied in this study.

4.8 Data Analysis Procedures

OLS estimator has been frequently used in many multiple regression cases to examine the relationship between a single dependent variable and several independent variables (predictors). Since this study also relies on the estimation of OLS and FE model; several diagnostic tests were performed for verification so that assumptions of multiple regressions are met, as well as to avoid misleading results (Gujarati, 2003; Hair et al., 2010). These tests began with normality, linearity, multicollinearity, homoscedasticity, and autocorrelation tests. In fact, each of these diagnostic tests was tested by using various statistical analyses and the details for each test are described in the following sub-sections.

4.8.1 Normality

An important assumption related to OLS regression is that the residuals can be identical and independently distributed with nil assumption or requirement that the predictor variables are normally distributed (Chen, Ender, Mitchell, & Wells, 2003). Following the example of checking normality of residuals by statistical experts (Park, 2008; Chen et al., 2003), as demonstrated in Stata Web Books, several methods, including graphical and numerical tests[30], were carried out in this study to test normality and to detect the presence of outliers. Some commonly used graphical methods for normality test include Kernel density estimate, P-P plot (probability-

[30] Numerical test is the test that expressed in or counted by numbers.

probability plot), and Q-Q plot (quantile-quantile plot); whilst for numerical test, statistical tests like Shapiro-Wilk test (swilk test), skewness and kurtosis test (sketest), as well as Inter-quartile range test (Iqr test), can be employed to verify assumptions. With that, the Swilk test had been selected for it has been acknowledged as the most powerful normality test available due to its ability in detecting a small departure from normality (Chen et al., 2003; Thode, 2002).

The histogram that plots the observed values against their frequency offers visual judgment if the distribution of data is bell-shaped, as well as insights about gaps in the data and outliers outlying values (Peat & Barton, 2005). Hence, histogram can be a poor method to determine the shape of data distribution because it is strongly affected by the number of bins used (Kabacoff, 2014). As such, the Kernel density plots have been suggested to be more effective to view the distribution of a variable (Kabacoff, 2014). Consistent with Chen et al., (2003), the Kernel density estimate was employed in this study.

According to Field (2009), the P-P plot plots the cumulative probability of a variable against the cumulative probability of a particular distribution (e.g., normal distribution). After data are sorted, the corresponding z-score is calculated and the score value is expected to reflect normal distribution. The score, then, is converted to the actual z-score, which is later plotted against the expected z-score. The result of the plot would reflect a straight diagonal line if the data are normally distributed. Besides, the Q-Q plot plots the quantiles (values that split a dataset into equal portions) of the dataset instead of every individual score in the data. Moreover, the Q-Q plots are easier to interpret in the case of large sample data (Field, 2009).

Moreover, based on past studies, graphical tests that were used to visualize data distribution may be useful to assess normality, while the assumption of data that are presented visually can be interpreted by researchers using their own judgment (Altman & Bland, 1996), although some claimed that the methods are usually unreliable and do not guarantee the normality of data distribution (Field, 2009; Oztuna, Elhan, & Tucar, 2006; Altman & Bland, 1995). On top of that, several numerical normality tests have been conducted as supplementary to the graphical methods, hence, used to assess the normality of data (Elliott & Woodward, 2007), such as skewness and kurtosis (sktest), Shapiro-Wilk test (swilk test), and Inter-quartile range test (Iqr test). These numerical tests compare the scores in the sample to a normally distributed set of scores with similar mean and standard deviation values; where the null hypothesis suggests ―data is normally distributed". If the test results in significant p-value, it means that the data do not fit the normal distribution.

4.8.2 Linearity

The assumption of linearity reveals if the correlation between the dependent variable and the predictors is a straight line or linear (Hair et al., 2006). In the case of multiple regressions, checking for linearity assumption is not a straightforward process[31]. In this study, an augmented partial residual plot graph against each independent variable in the regression model was applied to determine if a linear pattern exists between the variables.

[31] The straightforward process to determine the linearity assumption can be done by plotting the standardized residuals against each of the predictor variable in the regression model. The existence of nonlinear pattern indicates a problem of nonlinearity (Chen et al., 2003).

4.8.3 Multicollinearity

An important assumption underlying multiple regression analysis is that no collinearity should exist between two independent variables, which is referred as multicollinearity (Cheng, Hossain, & Law, 2001). High multicollinearity causes the estimated regression coefficient to be unreliable and unstable, because it might change drastically if small changes occur in the sample or model (Hamilton, 2003). As such, this problem may affect the result of the model tested for it is difficult to accurately estimate the coefficient of the true model (Cheng et al., 2001). Hence, the data gathered must be checked for any possible existence of multicollinearity and further cause the researcher to obtain wrong signs for regression coefficient, insight t-ratios, and high R-squared, but a few insignificant t-ratios and high pair-wise correlation among the regressors (Green, 2003; Gujarati, 2003; Cheng et al., 2001).

Furthermore, the existence of many independent variables could cause multicollinearity problem. In fact, two ways are available to test multicollinearity. Out of the two, the simplest way is by employing the Pearson[32] or Spearman correlation matrix[33] (r) for a bivariate analysis between the independent variables. The issue of multicollinearity arises when the correlation value of independent variables exceeds the cut off level of 0.9 (Tabachnick & Fidell, 2007; Hair et al., 2006). Meanwhile, the Variance Inflation Factor (VIF) test indicates how the variance of an estimator is inflated by the presence of multicollinearity. In fact, Hamilton (2009) asserted that it can also be used to show how the variance of coefficients and standard errors of other variables increase due to the inclusion of the variable (Hamilton, 2009). As a rule of

[32] The Pearson correlation matrix is a parametric test that measures the strength of the linear relationship between normally distributed variables.
[33] The Spearman correlation matrix is a non-parametric test that measures the variables that are not normally distributed.

thumb, a variable with greater VIF value or exceeding 10 is said to be highly correlated (Hair et al., 2006; Ho, 2006; Gujarati, 2003). Hence, this study weighs in the fact that if the correlation coefficient between two variables exceeds 0.90 and 10 for VIF; then multicollinearity could be a critical issue.

4.8.4 Homoscedasticity

Homoscedasticity refers to the assumption that a dependent variable has an equal level of variance across a range of independent variables. This is desirable mainly because the variance of the dependent variable should not be concentrated within a limited range of the independent values. The presence of an unequal variance of the residual can be said to have heteroscedasticity, which refers to the common violations in multivariate analysis (Hair et al., 2006). In fact, heteroscedasticity occurs when the variance of errors is not constant over the sample observation; making the coefficient estimate to be underestimated, and sometimes, making insignificant variables appear statistically significant (Hair et al., 2006).

This may also result in higher t and F values, which indicate that the null hypotheses may be rejected when they should not be rejected (Cheng et al., 2001). The presence of outliers and skewness in the distribution of one or more regressors included in the model is a source of heteroscedasticity. However, this heteroscedasticity issue could be detected by using scatter plots, White General Heteroscedasticity Test, and Breuch-Pagan Godfrey Test, as recommended by experts (Baum, 2006; Chen et al., 2003; Green, 2003). Null hypothesis, in which the variance of the residual is homogenous, was tested in this study, where p-value greater than 0.05 indicates that the hypothesis cannot be rejected and indicates that there is no problem of heteroscedasticity.

4.8.5 Autocorrelation

Another important OLS assumption is that error terms are independent and uncorrelated, while the size and the direction of a term have no bearing on the size and direction of the other. This condition is known as autocorrelation (serial correlation), where correlation between error terms of dataset of one period (*t*) and previous period (*t-1*) exists. In this situation, the error terms are not independent and hence, could offer incorrect *t* values and confidence intervals in regression. Besides, autocorrelation can be associated with the cross-sectional data, which is also known as spatial autocorrelation, which has been commonly associated with time series data. Time series data is, by definition, ordered in time and usually notes the difference by indexing by *t*. The past is the best predictor of the future. Thus, it is claimed that what occurs in time *t* is the best predictor of what will occur in the subsequent time (*t+1*).

As a result, observations are usually dependent. As for the error term, this means that the differences between the predicted and the actual error in one time period are probably related (positively) to the error in the next. Hence, if a series is ‗mean-reverting', then the errors may be negatively correlated. Moreover, the problem of autocorrelation may also be due to model misspecification and data manipulation. Therefore, a time series is generated by aggregating the data and introducing a certain amount of smoothing by creating a quarterly data set by summing or by averaging over months (or months from days, or quarters to years). Hence, some of the randomness of disaggregated data is lost, thus leading to systematic patterns in the error terms that could cause a case of autocorrelation to occur.

This study applied several tests to determine the presence of autocorrelation in the model, including Durbin-Watson (*D-W*) and Prais-Winsten tests. As a rule of thumb, if the value for Durbin-Watson, *d* statistic, approaches 0, positive autocorrelation occurs that implies no autocorrelation among the error terms, while *d* closer to 4 means negative autocorrelation. Besides, confirming how close to 0 or 4 is sufficient to determine if the model has either positive or negative autocorrelation, based on upper (*dU*) and lower (*dL*) critical values for *d*, which rely on the number of observations (*N*) and the number of explanatory variables (*k*). As for accuracy, the exact acceptable values of *dU* and *dL* are derived from the Durbin and Watson‘s (1951) original paper. Moreover, as a very conservative rule of thumb, Field (2009) suggested that values less than 1 or greater than 3 are definitely a cause for concern. If the problem of autocorrelation still exists, the Prais-Winsten transformation is used in this study.

In addition to the dynamic model, which is introduced in this study, several dynamic diagnostic tests were conducted to assure the validity of the GMM estimation methods. Furthermore, as the presence of dynamic element of lagged dependent variable is correlated with the error term, the estimators would be biased. In order to deal with this problem, this study employed instrumental variables and estimated the equation by using the GMM, by adhering to the suggestion given by Arellano and Bond (1991). With GMM, the variables to be instrumented must be strongly corrected with the related independent variables and the instrument must be valid in the sense that they are uncorrelated with the error term or the variable is exogenous. The validity of the difference of GMM estimations hinges on two types of specification tests: (i) Testing the validity of surplus instruments, and (ii) Testing the presence of serial correlation in the differenced residuals.

The validity test of the surplus or over identifying instrument can be tested via Sargan test. The Sargan test is a statistical test performed to check for over identifying restrictions in a statistical model. This test is also known as the Hansen test or the J-Test for over identified restrictions. The Sargan test is based on the observation that the residuals should be uncorrelated with the set of exogenous variables if the instruments are truly exogenous. Additionally, the Sargan test statistics can be calculated as TR^2, which refers to the number of observations and multiplied by the coefficient of determination from the OLS regression of the residuals (from the instrumental variable estimation) onto the set of exogenous variables.

This statistics is asymptotically chi-squared with m – k (where *m* is the number of instruments, while *k* is the number of endogenous variables) degrees of freedom under null hypothesis, where the instruments are valid because they are not correlated with the errors in the first differenced equation. Besides, the null hypothesis under this test assumes that instruments are exogenous, which means that there is no correlation between instruments and the error term. If the Sargan test rejects the null of no correlation, the IV (instrument variable) estimator is deemed as inconsistent and biased.

However, if there are priori reasons to expect autoregressive error in a panel regression model, or if the dynamics of the model are incorrectly specified, there is a strong possibility for autocorrelation to exist in the residuals. Technically, the Arellano-Bond test for autocorrelation has a null hypothesis of no autocorrelation and is applied to the differenced residuals. The test for the first-order serial correlation, which is also known as AR(1) process in the first differences, usually rejects the null hypothesis. Meanwhile, the test of the second-order serial correlation, also known as

AR(2) in first differences is more important, because it will detect autocorrelation in levels. On top of that, the use of panel data in this research is supported by the econometric software called Stata.

4.9 Summary of the Chapter

This chapter is consistent with the aim of this study to determine the effect of ICT investment, ICT governance mechanisms, boards with diverse ICT expertise, and ownership structures on the performance of firms within the Malaysian technology-based sector. Besides, this chapter highlights several significant elements, including the research framework developed in this study, hypotheses development, collection of data sample, measurements used for each variable, discussion on panel data, model specification, and data analyses procedures.

CHAPTER FIVE

RESULTS AND DISCUSSIONS

5.1 Introduction

The objective of this chapter is to report and discuss the findings retrieved from this study. Specifically, this chapter is divided into several sections. Section 5.2 discusses the pre-test for data variables that involved the initial dataset of 185 observations[34], which was conducted in the initial process to determine the normality and the linearity assumptions of data, as discussed in sub-sections 5.2.1 and 5.2.2, respectively. Besides, any potential outliers identified in the initial dataset and the results of outliers are further discussed in sub-section 5.2.3. Next, Section 5.3 presents the post-test for the data variables[35] and two assumption tests, which were again tested with normality and linearity tests, as discussed in sub-sections 5.3.1 and 5.3.2, respectively.

Section 5.4 explains the descriptive statistics for all data variables. This is later followed by the univariate analyses of T-Tests and correlation matrix discussed in Section 5.5. In ascertaining the credibility of the initial analysis, the results of several additional diagnostic tests for panel data are presented to determine the sensitivity and the robustness of the regression analysis in Section 5.6. Meanwhile, Section 5.7 reports the results obtained from the regression analyses for all models and lastly, the chapter ends with a summary of the overall findings of the study, as given in Section 5.8.

[34] The initial dataset of 185 observations (also referred as the original data) contains data that have not undergone the tests of normality, linearity, and outlier.
[35] Data variables that have undergone the process of post-test refer to the new dataset without outliers.

5.2 Pre-Test for Data Variables

Basically, the initial sample of this study was comprised of 37 (185 observations for five years) companies in the Malaysian technology-based sector. Besides, this study employed the balanced panel data as it is a more sensitive measurement of the changes that could have taken place between points in time (Cavana, Delahaye, & Sekaran, 2001). Furthermore, the results produced have been more robust, consistent, and stable to make generalization to the population so as to be more representative and meaningful. The Statistical software of STATA version 13 was applied to run the statistical analysis, especially to measure the effects exerted by the independent variables upon those dependent. Before discussing the findings of this study, it is beneficial to undertake normality, linearity, and outlier tests to explain the quality of the initial data variables. The following sub-sections present all the tests in detail.

5.2.1 Test of Normality

First, the raw data were screened by examining the basic statistics for the descriptive data, including mean, standard deviation, minimum, and maximum values of the variables primarily to detect any mistake or missing values in the data entry before the normality test was performed. In fact, several normality tests were conducted to determine the data normality before identifying potential outliers in the data set, which incorporated some graphical methods like Kernel density, probability-probability (P-P) plot, and quantile-quantile (Q-Q) plot. Besides, some numerical methods, for instance, test of Inter-quartile range (Iqr), was applied to assure the distribution of data normality, while the Shapiro-Wilk (Swilk test) was performed to confirm the existence of potential outliers in the data sample. Furthermore, in determining data normality, results of the graphical tests for each model (e.g., ROA, ROE, and TQ), such as the Kernel density estimate, the P-P plot, and the Q-Q plot, are illustrated in Figure 5.1. As for the Kernel density estimate test, the normal density line should be overlaid on the kernel plot as an indication of data normality. As shown in the Figure 5.1, the Kernel density test, P-P and Q-Q plots showed that the TQ model adhered to a normal distribution, while ROA and ROE models did not. The results also showed a serious deviation from normal distribution and indicated that the residuals in both ROA and ROE models were not normally distributed.

Table 5.1 The Inter-quartile Range (IQR) Test

Variables	IQR Results
ROA	mean= -1.4e-09 std.dev.= .7148 (n= 185) median= .0608 pseudo std.dev.= .3074 (IQR= .4147) 10 trim= .0614 low high -------------------- inner fences -.7808 .8781 # mild outliers 7 5 % mild outliers 3.78% 2.70% outer fences -1.403 1.5 # severe outliers 2 0 % severe outliers 1.08% 0.00%
ROE	mean= -6.9e-10 std.dev.= 1.041 (n= 185) median= .0929 pseudo std.dev.= .4479 (IQR= .6042) 10 trim= .0833 low high -------------------- inner fences -1.117 1.3 # mild outliers 3 3 % mild outliers 1.62% 1.62% outer fences -2.023 2.206 # severe outliers 2 0 % severe outliers 1.08% 0.00%
TQ	mean= 3.8e-10 std.dev.= .228 (n= 185) median= .003 pseudo std.dev.= .1815 (IQR= .2449) 10 trim= -.0012 low high ------------------- inner fences -.4878 .4918 # mild outliers 2 2 % mild outliers 1.08% 1.08% outer fences -.8552 .8592 # severe outliers 0 1 % severe outliers 0.00% 0.54%

The first numerical test involved the Inter-quartile range (IQR) test used to determine the normality of data in this study. In fact, severe outliers that consisted of those points were either 3 inter-quartile ranges below the first quartile or 3 inter-quartile ranges above the third quartile. Hence, the presence of any severe outliers should be sufficient evidence to reject the normality of data at a 5% significance level. Moreover, the results of IQR presented in Table 5.1 exhibit that the data set of this study contained severe outliers from ROA, ROE, and TQ models, and thus, the assumption of data normality was not fulfilled. Meanwhile, in the second numerical test, the Shapiro-Wilk test had been performed to test the normality of data, besides proving the existence of outliers. This test has been recommended as the best numerical test to determine the normality of data due to its ability to detect if a sample comes from a non-normal distribution (Bruin, 2006; Thode, 2002). This test is based on the correlation between the data and the corresponding normal scores (Peat & Barton, 2005).

Table 5.2 Shapiro-Wilk Test of Pre-Dataset

Variables	Obs	w	V	z	Prob>z
ROA	185	0.55032	62.693	9.484	0.00000
ROE	185	0.50460	69.066	9.706	0.00000
TQ	185	0.96807	4.452	3.422	0.00031

Moreover, the null hypothesis of the Swilk test assumes that the residuals are normally distributed. If the p-value is significant, then the null hypothesis would be rejected, suggesting non-independently distributed residuals. The results retrieved from the Shapiro-Wilk test for the pre-dataset, as presented in Table 5.2, show that the normality of residuals for ROA, ROE, and TQ were not fulfilled as the p-values were significant at .05. Hence, the residual values of ROA, ROE, and TQ were not normally distributed in the initial sample of study.

5.2.2 Test of Linearity

The graphs of augmented partial residual plot (acprplot) were generated for several independent variables, such as $ICTSPE_t$, BICTEDU, COWN, as well as one control variable, BINDP. Basically, the acprplot graph was used to verify the linearity assumption against the predicted value of some examples from the independent variables[36], simply to eyeball the model developed in this study. The acprplot graphs for $ICTSPE_t$, BICTEDU, COWN, and BINDP are presented in Figure 5.2. The acprplot graphs of $ICTSPE_t$, BICTEDU, COWN and BINDP for ROA and ROE column showed that the smooth line was almost close to the ordinary regression line, while the entire pattern for each independent variable tested displayed good uniform although each plot was interrupted by some potential influential points.

Nonetheless, the acprplot graphs under the TQ column showed that the data points for $ICTSPE_t$, BICTEDU, COWN, and BINDP were asymmetrically scattered from the ordinary regression line in the plot with critical outliers. Furthermore, the entire pattern of the graphs was not uniform, thus confirmed the non-linear relationship between these variables. As such, this study suggests that the assumption of a linear relationship between response variables and predictors as unfulfilled.

[36] Several variables, such as ADICTG, ICTGCOM, ICTSM, and BICTTR, were identified as no longer significant predictors since the predictors were collineared to each other after the entry error was corrected.

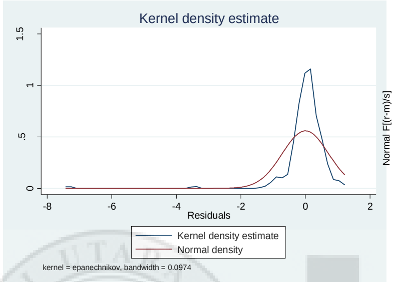
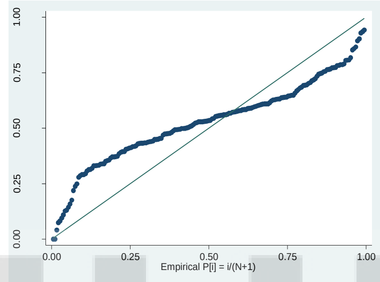
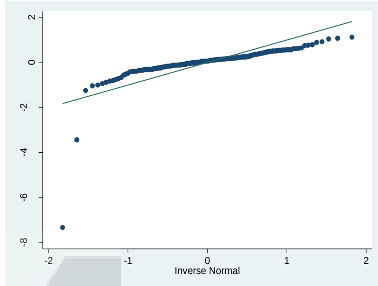
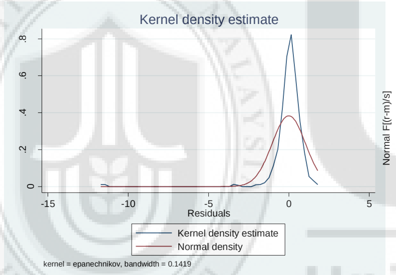
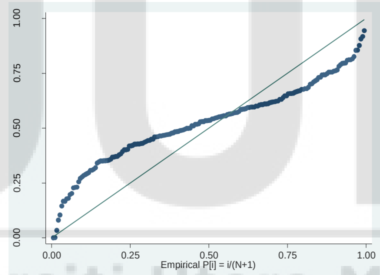
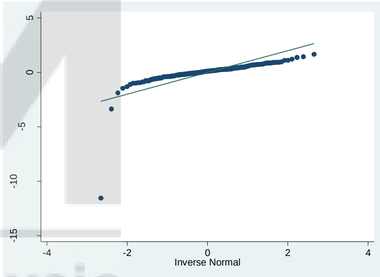
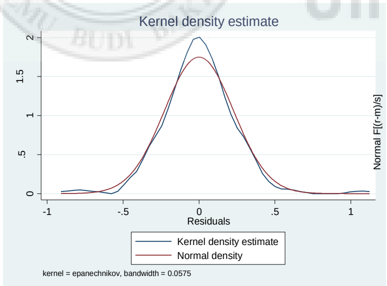
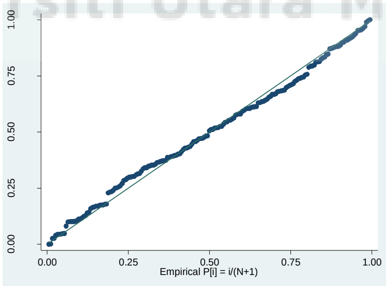
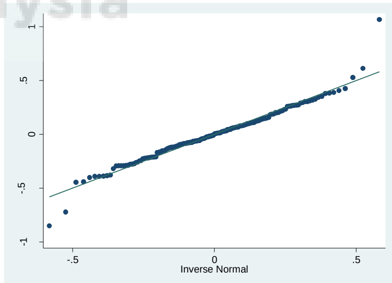
Dependent Variables/ Plots	Kernel Density-Plot	P-Plot	Q-Plot
ROA			
ROE			
TQ			

Figure 5.1: Pre-Test Graphs of Kernel Density, P-Plot and Q-Plot for ROA, ROE and TQ models.

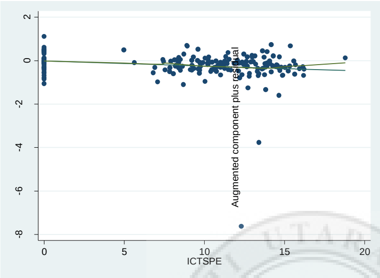
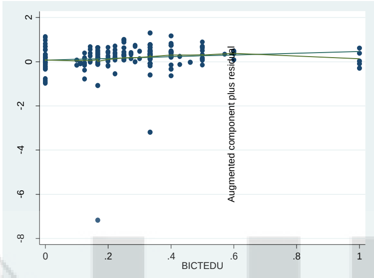
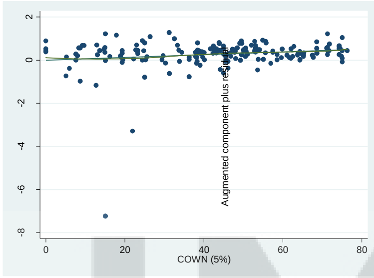
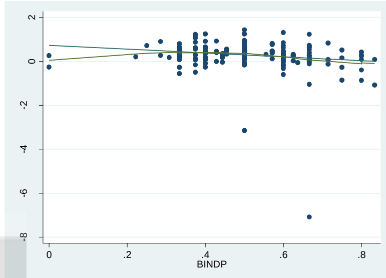
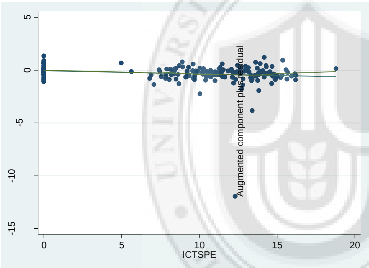
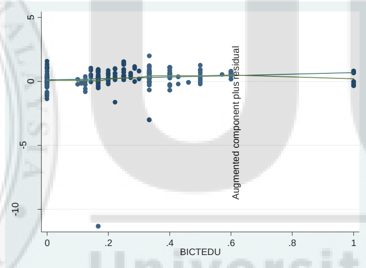
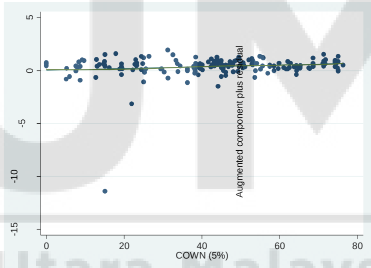
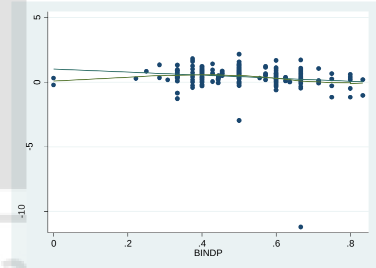
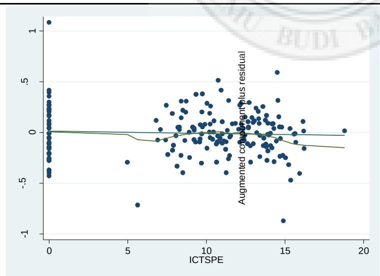
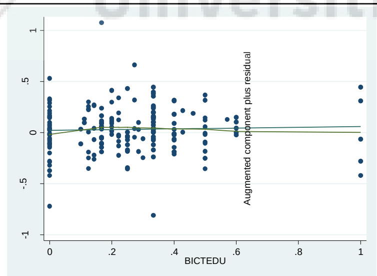
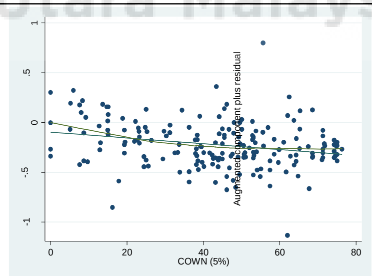
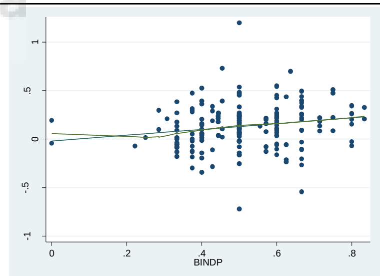
Dependent Variables/ Plots	ICTSPEt	BICTEDU	COWN	BINDP
ROA Augmented component plus residual				
ROE Augmented component plus residual				
TQ Augmented component plus residual				

Figure 5.2: Augmented Partial Residual Plot for Independent Variables

Note: $ICTSPE_t$ is ICT spending at time t; BICTEDU is boards' ICT educational background; COWN is concentrated ownership and BINDP is board independence.

5.2.3 Dealing with Outliers

It was noticed that outliers did exist in the data set and were identified through the pre-test of data variables. In dealing with potential outliers that exist in the model, several outlier treatment techniques were performed for further inspection. A careful analysis of the potential outliers that might exist in the inspection process is important to minimize the effect of extreme case scores, which could have a significant effect on the results; either too high or too low (Hair et al., 2010). Besides, the outlier treatments were based on high studentized residual, Cook‘s Distance (Cook‘s D), and high leverage, which were performed in this study using the STATA software.

Basically, observations with high standardized residual, normally above +3 or -3, could reflect influential outliers (Chen et al., 2003). Next, observation with Cook‘s D was applied to the dataset of this study. In fact, the higher the Cook‘s D; the more influential is the observation. According to the rule of thumb, observations with the value of Cook‘s D that exceeding a cut-off point of 4/*n*, where *n* refers to the number of observations, are indeed relevant (Chen et al., 2003; Hamilton, 2003). Lastly, observations with high leverage value greater than (2k+2)/*n* was conducted. Here, *k* refers to the number of predictors, while *n* is the number of observations (Chen et al., 2003).

During the initial process of outlier treatment, five extreme outliers were detected that represented four different companies. Hence, unbalanced panel dataset would be generated if the removal process of outliers from each group is only based on the number of extreme outliers. Nevertheless, this study decided to retain the balanced panel by dropping all companies with potential outliers[37]. The initial dataset was 185 observations (37 companies), but, a new dataset was generated after the deduction of 20 observations (four outlier companies) found during the outlier tests. Thus, the final dataset was comprised of 165 observations (33 companies). The details of the sample analysis are presented in Table 5.3.

Table 5.3 Analysis of the Sample

Particulars	Main Market	ACE Market	Total
A) The MPLCs with complete annual reports from the financial year end 2010 to 2014	700	77	777
B) Total companies in the Malaysian technology-based sector from the financial year end 2010 to 2014	35	68	103
C) Total companies in the Malaysian technology-based sector with **incomplete annual reports** from the financial year end 2010 to 2014	8	21	29
D) Total companies in the Malaysian technology-based sector with **complete annual reports** from the financial year end 2010 to 2014 (5 periods)	27	47	74
E) Total annual reports to be analysed in the initial process (E=D* 5 periods)	135	235	370
F) Total companies in the Malaysian technology-based sector with proper ICT records from the financial year end 2010 to 2014	14	23	37
G) Total companies' annual reports (G=F* 5 periods)	70	115	185
H) Total companies discarded (outliers)	1	3	4
I) Total observations discarded (I=H* 5 periods)	5	15	20
J) Final sample of companies in the Malaysian technology-based sector (J = F - H)	**13**	**20**	**33**
K) Final observations **(New dataset)** (K=J* 5 periods)	**65**	**100**	**165**

[37] The purpose of remaining a balanced panel dataset is to provide more reliable and stable dataset due to pooling individual and time dimension as well as to better capture the dynamic adjustment (Jager, 2008).

5.3 Post-Test for New Dataset

5.3.1 Test of Normality

In this section, several graphical tests of normality, such as Kernel density, P-P plot, and Q-Q plot, were again performed to determine the new dataset for normality. In addition, the numerical test of Shapiro-Wilk was also carried out to confirm data normality. As such, Figure 5.3 presents the post-test normality graphs of the new dataset. The purpose of conducting the normality test for the new dataset was to verify if the new dataset was normally distributed, so as to ensure that the requirements for using the statistical procedures, such as correlation, t-test, and regression, were met (Ghasemi & Zahediasl, 2012; Field, 2009; Pallant, 2007).

As a result, the kernel density graph, especially the post-test graphs, displayed that the data of ROA and ROE had normal distributions, while the graph of TQ showed that the data distribution was biased towards the left, in comparison to the data of pre-test, which had been normally distributed. In the same table, the post-test of P-P plots exhibited that data distribution of ROA and ROE did not differ much, when compared to the pre-test data. However, both data appeared to deviate less from the fitted line than the pre-test of P-P plots for ROA and ROE. The post-test P-P plot for TQ, on the other hand, seemed to deviate more from the fitted line than that for pre-test P-P plot, which still followed normal distribution.

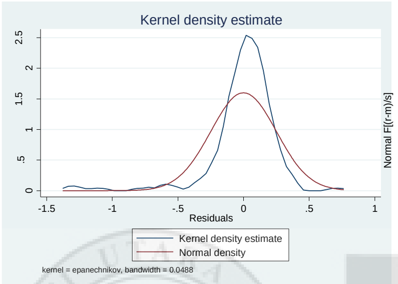
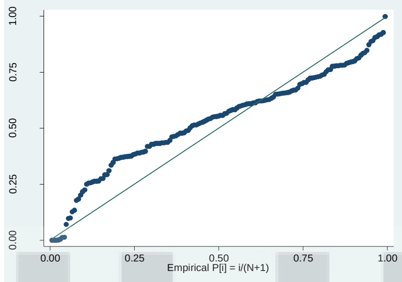
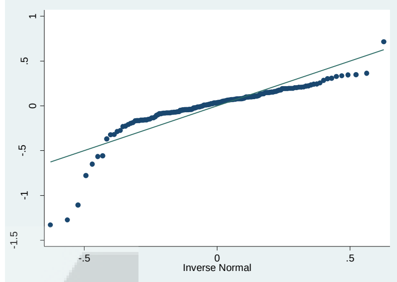
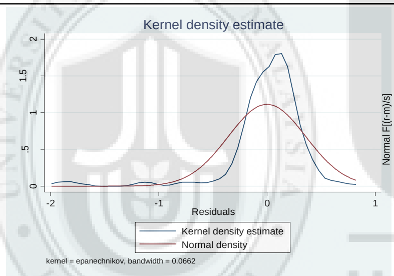
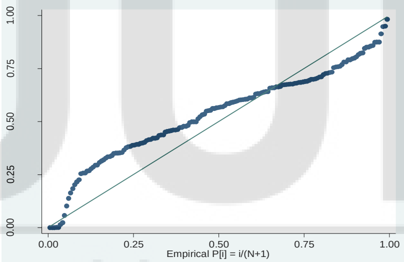
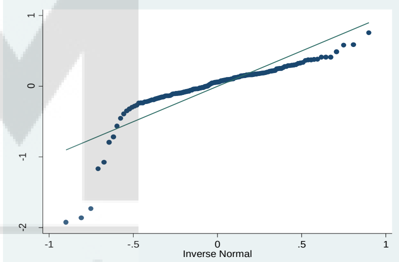
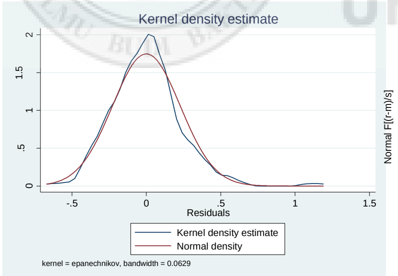
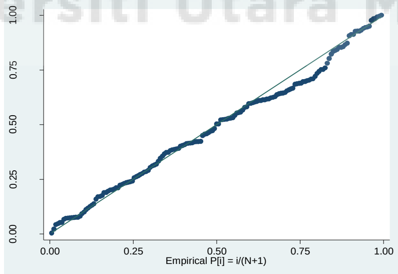
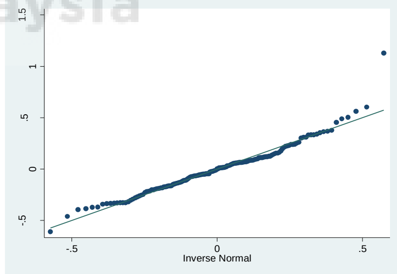
Dependent Variables/ Plots	Kernel Density-Plot	P-Plot	Q-Plot
ROA			
ROE			
TQ			

Figure 5.3: Post-Test Graphs of Kernel Density, P-Plot and Q-Plot for ROA, ROE and TQ models.

Meanwhile, the Q-Q plots for both ROA and ROE showed that both data points deviated more from the normal plot, indicating that both data points were not normally distributed either during the pre- or post-test of dataset. Additionally, the TQ plot showed that the data point was normally distributed during the pre-test of dataset, but no normal distribution for the post-test of dataset. Besides, the result of Shapiro-Wilk test for the post-dataset, as shown in Table 6.4, confirmed the non-normality of data distribution. The result showed that the normality of residuals for all models was not fulfilled since all the p-values were less than the chosen significance level of .05.

Table 6.4 Shapiro-Wilk Test of Post-Dataset

Variables	Obs	w	V	z	Prob>z
ROA	165	0.78301	27.402	7.543	0.00000
ROE	165	0.74810	31.811	7.883	0.00000
TQ	165	0.96020	5.027	3.679	0.00012

Note: ROA is return on assets; ROE is return on equities; TQ is Tobin's Q; post- dataset refers to the new dataset after the exclusion of outliers.

The normality tests for the post-test of dataset, nevertheless, do confirm the non-normality of data distribution; but violation of the normality assumption should not emerge as a major cause for dismissing the parametric procedures. Having a large sample size of more than 30 or 40 tends to lead the data to normal distribution, regardless of the data shape (Field, 2009; Elliot, 2007), while the distribution of the data can be ignored when a sample reaches hundreds of observations (Altman, 1995). Consistent with past researchers, the existence of non-normal data distribution in this study had been ignored, but the parametric procedures were conducted for the purpose of next statistical tests[38].

[38] The statistical tests here refer to t-test, correlation test and regression.

5.4 Descriptive Statistics

Table 5.5 Descriptive Statistics of Variables

Variables	Obs	Mean	Median	Standard Deviation	Minimum	Maximum
ROA	165	-0.0482	-0.0078	0.2876	-1.6158	0.8784
ROE	165	-0.0805	-0.0078	0.4140	-2.7251	0.9188
TQ	165	-0.2334	-0.2628	0.3848	-0.9220	1.4314
ROA_{t-1}	165	-0.0349	0.0000	0.2679	-1.6158	0.8784
ROE_{t-1}	165	-0.0588	0.0000	0.3846	-2.7251	0.9188
TQ_{t-1}	165	-0.1869	-0.1810	0.3499	-0.7379	1.4314
$ICTSPE_{t}$	165	9.1659	10.634	5.1696	0.0000	16.226
$ICTSPE_{t-1}$	165	7.4102	9.5764	5.8628	0.0000	16.226
$ICTSPE_{t-2}$	165	5.5548	0.0000	6.0826	0.0000	16.226
$ICTSPE_{t-3}$	165	3.8162	0.0000	5.6268	0.0000	15.639
ADICTG	165	0.8606	1.0000	0.3474	0.0000	1.0000
ICTGCOM	165	0.8364	1.0000	0.3711	0.0000	1.0000
ICTSM	165	0.9030	1.0000	0.2968	0.0000	1.0000
BICTEDU	165	0.2551	0.2500	0.2121	0.0000	1.0000
BICTPRO	165	0.1113	0.0000	0.1514	0.0000	0.6000
BICTIE	165	0.4942	0.5000	0.2326	0.0000	1.0000
BICTTR	165	0.3333	0.0000	0.4728	0.0000	1.0000
COWN	165	44.202	46.176	18.491	0.0000	76.358
MOWN	165	23.801	20.181	18.551	0.0000	70.509
GOWN	165	3.3334	0.0000	12.996	0.0000	68.705
FOWN	165	9.0324	1.7125	14.237	0.0000	73.440
BINDP	165	0.5135	0.5000	0.1485	0.2222	0.8333
BSIZE	165	6.7636	6.0000	1.7492	4.0000	13.000
LEV	165	0.1968	0.1134	0.2604	0.0021	1.4509
FSIZE	165	17.537	17.578	0.9706	15.296	20.236

Note: ROA is return on assets; ROE is return on equity; TQ is Tobin's Q; ROA_{t-1} is return on assets at time t-1; ROE_{t-1} is return on equity at time t-1; TQ_{t-1} is Tobin's Q at time t-1; ICTSPE is logarithm ICT spending at time t; $ICTSPE_{t-1}$ is ICT spending at time t-1; $ICTSPE_{t-2}$ is ICT spending at time t-2; $ICTSPE_{t-3}$ is ICT spending at time t-3; ADICTG is the adoption of ICT governance standards and frameworks; ICTGCOM is the presence of ICT governance committee; ICTSM is the presence of ICT senior management; BICTEDU is boards' ICT educational background; BICTPRO is boards' ICT professional qualification; BICTIE is boards' ICT industrial experience; BICTTR is boards' ICT-related trainings; COWN is concentrated ownership; MOWN is managerial ownership; GOWN is government ownership; FOWN is foreign ownership; BINDP is board independence; BSIZE is board size; LEV is leverage and FSIZE is firm size.

Table 5.5 presents the descriptive results of all related variables employed to examine the effect of ICT investment, ICT governance mechanisms, boards with diverse ICT expertise, and ownership structures on firm performance over the period of 2010 to 2014 within the context of Malaysian technology-based sector. Descriptive statistics describes the basic feature of the data employed in a study. The purpose of providing descriptive information is to offer a clear picture about the dependent and independent variables, specifically within the Malaysian technology-based sector. The statistics merely summarizes the dataset, instead for testing hypotheses. The descriptive table, therefore, consists of mean, median, standard deviation, maximum and minimum values; as well as skewness and kurtosis of dependent, independent, and control variables.

The first sub-section (Section 5.4.1) of this part of analysis describes the statistics of dependent variables that consists of ROA, ROE, and TQ, whereas the descriptive statistics in sub-section 5.4.2 focuses on all the independent variables of ICT investment (e.g., $ICTSPE_t$, $ICTSPE_{t-1}$, $ICTSPE_{t-2}$, and $ICTSPE_{t-3}$), ICT governance mechanisms (e.g., ADICTG, ICTGCOM, and ICTSM), boards with diverse ICT expertise (e.g., BICTEDU, BICTPRO, BICTIE, and BICTTR), ownership structures (e.g., COWN, MOWN, GOWN, and FOWN), as well as control variables (e.g., BINDP, BSIZE, LEV, and FSIZE), which are described in detail in sub-section 5.4.3.

5.4.1 Dependent Variables

It was noted that the mean values of ROA, -0.0482, and the median of -0.0078 ranged between the minimum value of -1.6158 and maximum at 0.8784, which implied that the sampled companies from the technology sector did not generate profits from their assets utilization. The mean and median values for ROE were -0.0805 and -0.0078 respectively; between the minimum -2.7251 and the maximum 0.9188. Similar to ROA, the descriptive results of ROE showed that the companies‘ shareholder equities had been in negative for over the five years under review.

Besides, the interval value of TQ ranged from -0.9220 to 1.4314 with a mean value of -0.2334 and the median of -0.2628. Meanwhile, the negative mean value indicates that the stock market for the companies was undervalued from 2010 to 2014. In precise, this study included the elements of one year lagged dependent variables on the right equation of the regression model as independent variables, namely one year lagged of ROA (ROA_{t-1}), one year lagged of ROE (ROE_{t-1}), and one year lagged of Tobin‘s Q (TQ_{t-1}). The mean value of ROA_{t-1} was -0.0349, which is between the minimum -1.6158 and the maximum 0.8784. Other than that, the interval values for ROE_{t-1} were between -2.7251 as minimum value and the maximum of 0.9188, with mean and median values of -0.0588 and 0.0000, respectively. Besides, the mean value of TQ_{t-1} was -0.1869 and ranged between -0.7379 and 1.4314.

In addition, since ROA, ROE, and TQ have negative mean and median values, there might be a reason of global financial crisis that took place from 2007 to 2009. During the analysis, it was obviously seen that companies within the Malaysian technology sector were still in a transitional period to adapt the then significant business environment challenges due to the significant impact of the crisis. Although the growth momentum was negative, the performance of yearly average value for all financial measures showed that the Malaysian technology sector had improved over the period of 2010 to 2014. In addition, Figure 5.4 portrays a clear picture of firm performance trends for yearly average value for all dependent variables from 2010 to

2014 in the Malaysian technology-based sector. From the observed average value, the trends of ROA showed an improvement in 2011, but a significant drop was noted in 2012 and 2013. After facing significant decrease in profits for two years, a little increase in ROA in 2014 showed that the technology companies were getting back on track by improving their assets utilization.

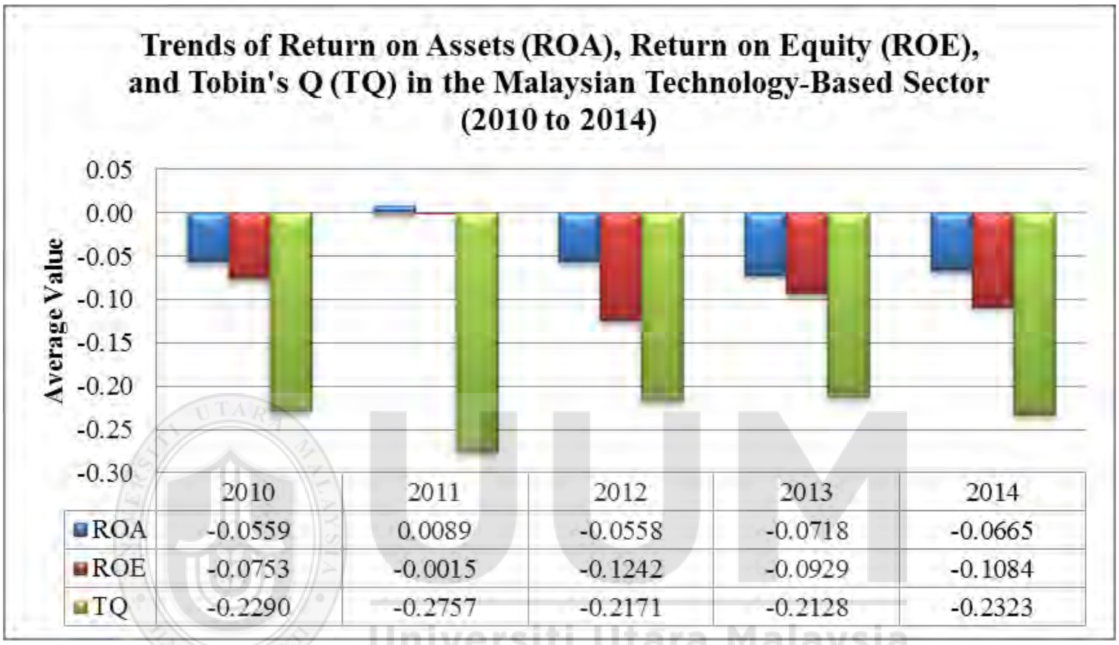


Figure 5.4: Trends of ROA, ROE and TQ in the Malaysian Technology-Based Sector (2010 to 2014).

In contrast, the trend of ROE fluctuated over the five years. Increment in ROA in 2011 showed that the companies had been effective in enhancing the value of their companies, which led the shareholders to gain benefits from the amount that they had invested in the companies. Besides, the percentage of ROE dropped significantly in 2012, followed by a slight increase in 2013 and again, a little drop in 2014. Basically, a steadily increase in ROE, due to improved profitability and efficiency, is desirable, but this cannot endure forever due to varied reasons like slow and fluctuating trends of ROE. Moreover, faced with significant business challenges due to financial crisis demand, companies are more careful in planning their strategies in conducting business, especially to reduce financial crisis effects upon profits, as well as to preserve confidence among shareholders towards the companies. Regarding TQ performance, it was clear that during the first two periods, there was a slight decline of stock market from -0.2290 to -0.2757. Although a slight decrease was noted in the Malaysian technology sector in its stock markets from 2010 until 2011, the performance of TQ displayed some continuity signs of growth from -0.2171 in 2012 to -0.2128 in 2013. The stock market, however, dropped to -0.2323 in 2014. The negative average value of TQ implied that the stock market for the technology companies had been, unfortunately, undervalued.

5.4.2 Independent Variables

5.4.2.1 ICT Investment

The descriptive statistics of ICT investment variables, as tabulated in Table 5.3, did not only focus on the variable of ICT spending incurred in year *t* ($ICTSPE_t$), but also included several lagged variables of ICT spending by three periods, namely ICT spending incurred in year *t-1* ($ICTSPE_{t-1}$), ICT spending incurred in year *t-2* ($ICTSPE_{t-2}$), and ICT spending incurred in year *t-3* ($ICTSPE_{t-3}$). As such, it was observed that the mean value for ICT spending spent in year *t* was 9.1659 with a median value of 10.634, which ranged between the minimum 0.0000 and the maximum 16.226, followed by ICT spending incurred in year *t-1* (7.4102), 5.5548 incurred in year *t-2*, and 3.8162 in year *t-3*. The minimum value of zero for ICT spending meant nil amount invested for ICT by the companies, whilst the maximum value of 16.226 indicated the highest amount of ICT investment made by the companies for the period of 2010 to 2014.

In order to precisely conclude the ICT investment trends in the Malaysian technology-based sector, an additional bar chart of the trend is illustrated in Figure 5.5, which is based on yearly average value of ICT investment made by the companies for the period of 2010 to 2014. As open economy is highly integrated with international markets in terms of trade and investment (Mei, 2010); many countries, including Malaysia, had been hit hard by the global economic downturn that took place from 2008 to 2009. Furthermore, the bar graph displays the trend of ICT spending that fluctuated over the periods of 2010 to 2014. This trend, however, proves that companies in the Malaysian technology-based sector have not stopped revolutionizing, but kept developing their technology capacity to consistently benefit in all areas for their short term sustainability achievement (Contreras & Tormo, 2009), besides reducing the impacts caused by financial crisis.

Figure 5.5: Trends of ICT Investment in the Malaysian Technology-Based Sector (2010 to 2014).
Note: ICTSPE refers to ICT spending, a proxy of ICT Investment.

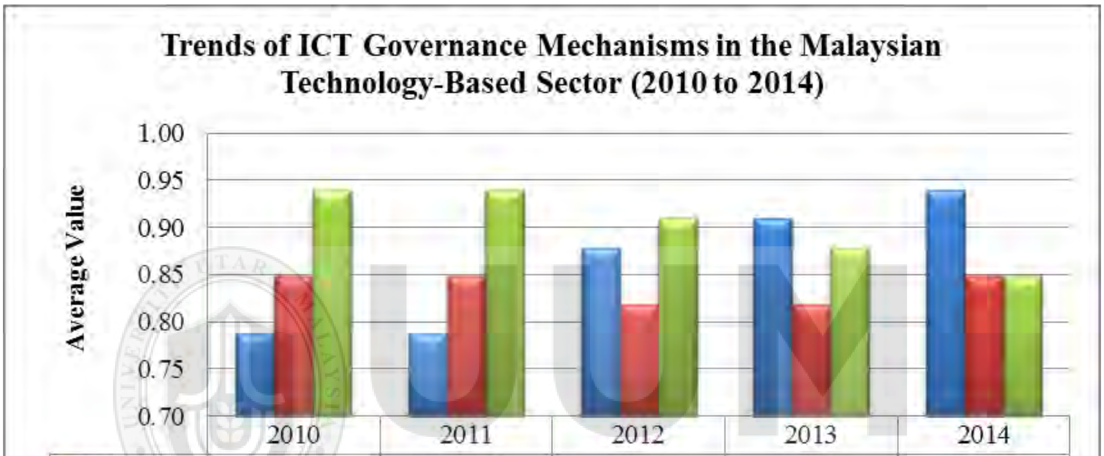
5.4.2.2 ICT Governance Mechanisms

The element of ICT governance is comprised of two mechanisms; ICT governance processes measured by ADICTG, and ICT governance structures measured by ICTGCOM and ICTSM[39]. The findings revealed that 86.1 per cent of the sampled companies did adopt the ICT governance standards or frameworks (ADICTG). On the other hand, the minimum value of ‗0' indicates that some companies did not adopt any ICT standard or framework in their business operation, whereas the maximum value of 1 denotes the adoption of ICT standards or frameworks by companies. Additionally, the results also exhibited that the presence of ICT governance committee (ICTGCOM) and ICT senior management (ICTSM) had been 83.64 per cent and 90.3 per cent, respectively. The results indicated that the number of ICTSM was higher than the number of ICTGCOM in the Malaysian technology-based sector. Moreover, the minimum value of ‗0' indicated the absence of ICTGCOM and ICTSM at a certain period of time, while the maximum value of ‗1' denoted otherwise.

In overall, this study concludes that more than 50 per cent of the ICT governance standards or frameworks had been adopted as guideline and basic structures of ICT implementation, as well as supported with the presence of ICTGCOM and ICTSM which has also exceeded 50 per cent in the Malaysian technology-based sector from 2010 until 2014. In addition, Figure 5.6 illustrates the trends of yearly average percentage value for ADICTG, ICTGCOM, and ICTSM in the Malaysian technology-based sector from 2010 until 2014. As for the adoption of ICT governance standards or frameworks (ADICTG), the bar graph shows that this aspect remained unchanged for its percentage appeared between 2010 and 2011. This could be due to the fact that

[39] ADICTG refers to the adoption of ICT governance standards or frameworks; ICTGCOM refers to the presence of ICT governance committee; and ICTSM refers to the presence of ICT senior management.

many companies were still in the initial process of adopting the mandatory compliance of ICT governance standards imposed by the Malaysian government in 2010. Furthermore, the percentage of adoption displayed an increase to 87.9 per cent in 2012, and continued to exhibit good progressive number of adoption to 93.94 per cent in 2014. Thus, the mandatory compliance of ICT governance standards in 2010 is viewed as an essential mechanism in assisting the technology sector to improve the quality of their ICT management after suffering from the 2008-2009 financial crises.



	2010	2011	2012	2013	2014
ADICTG	0.7879	0.7879	0.8788	0.9091	0.9394
ICTGCOM	0.8485	0.8485	0.8182	0.8182	0.8485
ICTSM	0.9394	0.9394	0.9091	0.8788	0.8485

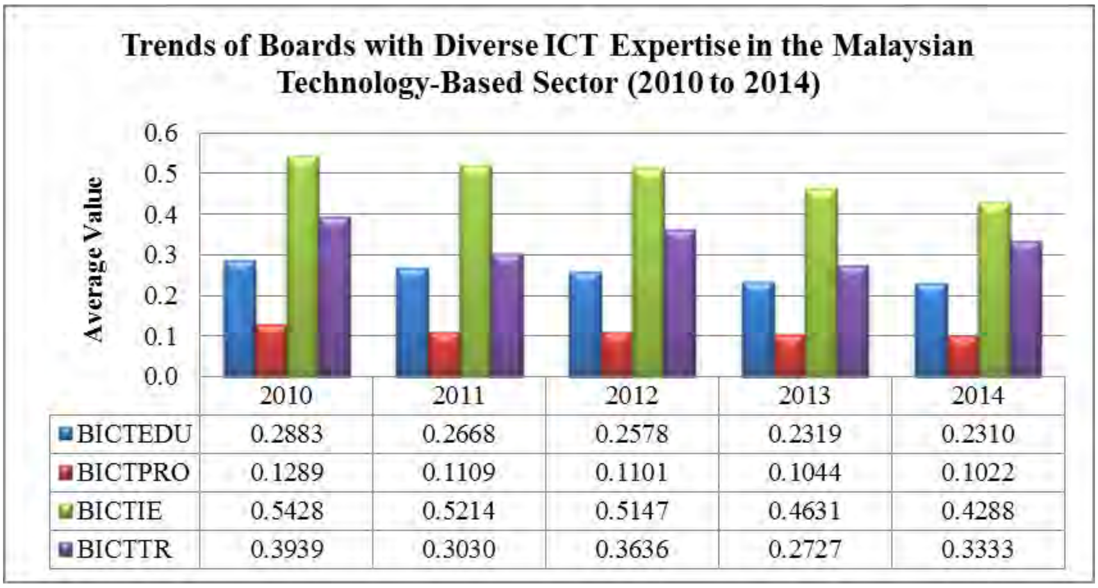
Figure 5.6: Trends of ICT Governance Mechanisms in the Malaysian Technology-Based Sector (2010 to 2014).

Furthermore, the percentage of the ICTGCOM presence remained unchanged between 2010 and 2011, but declined to 81.8 per cent in 2012, and again, the percentage retained until 2013. However, ICTGCOM displayed an increment up to 84.9 per cent in 2014. As for ICTSM, its percentages remained unchanged for 2010 and 2011. Nonetheless, the percentage of ICTSM began to decline from 90.9 per cent in 2012 to 84.9 per cent in 2014. However, it is remarkable that although the presence of ICTSM was inconsistent, this study found that the percentage of ICTSM exceeded that of ICTGCOM annually.

5.4.2.3 Boards with Diverse ICT Expertise

From the descriptive statistics of boards with diverse ICT expertise in the Malaysian technology-based sector from 2010 until 2014, boards with ICT industrial experiences (BICTIE) held the highest percentage of 49.42, in comparison to boards with ICT-related training (BICTTR) at 33.33 per cent, followed by the third highest; boards with ICT education background (BICTEDU) at 25.51 per cent, and the least at 11.13 per cent for boards with ICT professional qualifications (BICTPRO). The results indicated that the aspect of expertise in ICT industrial experiences was indeed possessed by most of the board members in the Malaysian technology sector from 2010 until 2014. From the findings, this study concludes that the levels of all types of ICT expertise possessed by the board of directors had been low as the percentage of boards with ICT expertise had been less than 50 per cent within the firms from the Malaysian technology sector. In fact, the overall minimum value of zero for each variable proved that a number of firms still did not rely on the capabilities of the board members with diverse ICT expertise, especially in carrying out their business operation.

Meanwhile, Figure 5.7 illustrates a clear trend of boards with diverse ICT expertise, such as BICTIE, BICTEDU, BICTTR, and BICTPRO in the Malaysian technology-based sector from 2010 until 2014, which had been based on yearly average percentage value for each variable. As described earlier, ICT industrial experiences have been indicated as the largest ICT expertise possessed by the majority of directors within the Malaysian technology-based sector. Although the bar graph of the BICTIE exhibited a downward trend from 2010 to 2014; the flow remained stable due to low decrease in the percentage value.



	2010	2011	2012	2013	2014
BICTEDU	0.2883	0.2668	0.2578	0.2319	0.2310
BICTPRO	0.1289	0.1109	0.1101	0.1044	0.1022
BICTIE	0.5428	0.5214	0.5147	0.4631	0.4288
BICTTR	0.3939	0.3030	0.3636	0.2727	0.3333

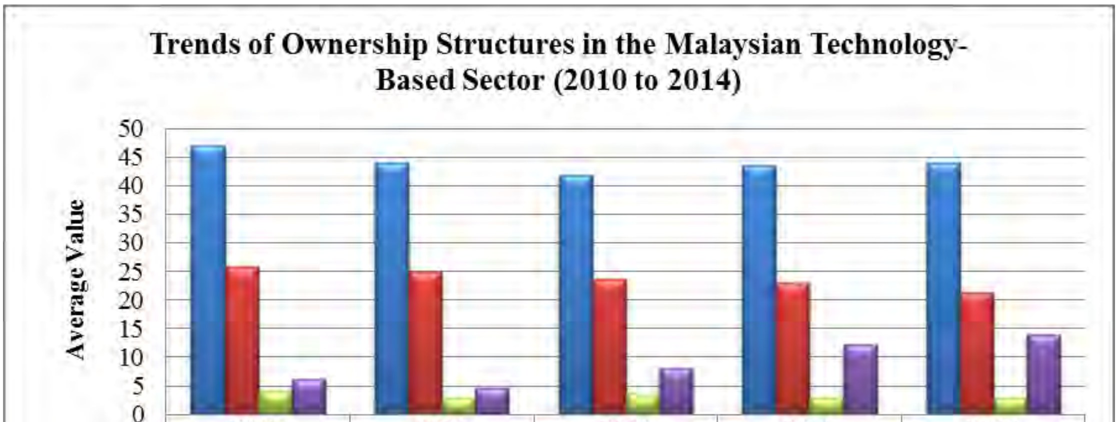
Figure 5.7: Trends of Boards with Diverse ICT Expertise in the Malaysian Technology-Based Sector (2010 to 2014).

Likewise, the percentage of BICTEDU also displayed a gradual decline by varying degrees over the five years. Moreover, regarding the performance of boards with ICT-related training (BICTTR) in the Malaysian technology-based sector, this study suggests that the bar graph had been unstable from 2010 until 2014. From the previous discussion, boards with ICT professional qualifications (BICTPRO) had been identified as the lowest ICT expertise held by the boards of directors in the Malaysian technology-based sector for the period of 2010 to 2014. In fact, the bar graph of BICTPRO showed that the percentage had steadily fluctuated with a slight change in the percentage along the periods under observation.

5.4.2.4 Ownership Structures

The descriptive statistics of ownership structures in the Malaysian technology-based sector from 2010 until 2014 is presented in Table 5.5. The table shows that the largest ownership structure in the Malaysian technology-based sector was dominated by the concentrated ownership (COWN) that held about 44.2 per cent of companies‘ shares for the period of 2010 to 2014. Next, the second largest was managerial ownership

(MOWN) that held 23.8 per cent of companies' shares, and followed by 9.03 per cent of foreign ownership (FOWN), while only 3.33 per cent by the government (GOWN).



	2010	2011	2012	2013	2014
COWN	47.161	44.120	41.977	43.708	44.047
MOWN	25.821	24.963	23.689	23.139	21.392
GOWN	4.2374	2.9014	3.4912	3.0260	3.0112
FOWN	6.2988	4.5701	8.0586	12.211	14.023

Figure 5.8: Trends of Ownership Structures in the Malaysian Technology-Based Sector (2010 to 2014).

Furthermore, based on the yearly average value of ownership structures presented in Figure 5.8; the trend of COWN in the Malaysian technology sector displayed a decline in its percentage from 47.2 per cent in 2010 to 41.9 per cent in 2012. However, the percentage improved in 2013 and continued to grow until 2014 with 43.7 per cent and 44.05 per cent, respectively. On the other hand, the percentage of MOWN showed a steady decline from 2010 to 2014. Meanwhile, foreign investors began to show much interest in investing in the Malaysian technology sector in 2012. As such, the figure shows the FOWN graph moved up from 4.57 per cent in 2011 to 14.02 per cent in 2014. However, the percentage of GOWN remained steady, although a slight decrease was noted in its percentage for 2013 and 2014.

5.4.3 Control Variables

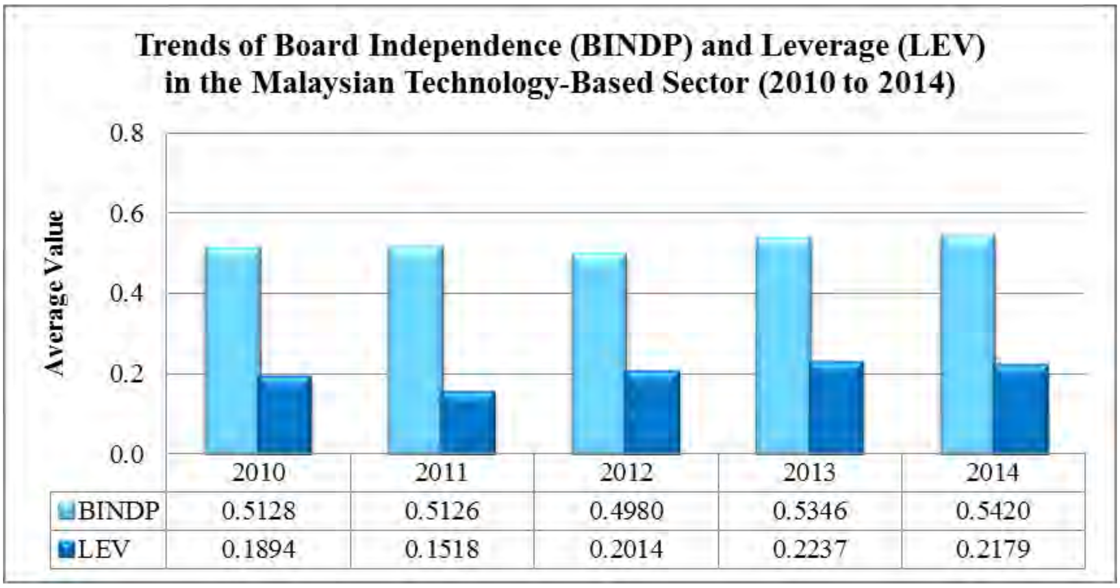


Figure 5.9: Trends of Board Independence (BINDP) and Leverage (LEV) in the Malaysian Technology-Based Sector (2010 to 2014).

Table 5.5 presents the descriptive statistics for control variables, such as board independence (BINDP), board size (BSIZE), leverage (LEV), and firm size (FSIZE) for the period of 2010 to 2014 in the Malaysian technology-based sector. This study found that the percentage value of 51.4 per cent for BINDP showed that the companies in the Malaysian technology sector did implement good corporate practice as this percentage value exceeded the 33.3 per cent cut-off point of the minimum level of board independence, as suggested by the Malaysian Code on Corporate Governance. Turning to BSIZE, the result showed that the companies had 6.76 board members on average with a median value of 6 that ranged from the minimum 4 to the maximum 13 board members. Besides, the mean and median values for financial leverage (LEV) were 0.1968 and 0.1134, respectively, which ranged between the minimum value of 0.0021 and the maximum 1.4509. This study also examined the variable of firm size, which was measured using the logarithm of companies‘ total assets. The mean value of firm size, as a result, for those in the Malaysian technology-based sector was 17.54, while its median of 17.58 ranged between the minimum of 15.29 and the maximum of 20.24.

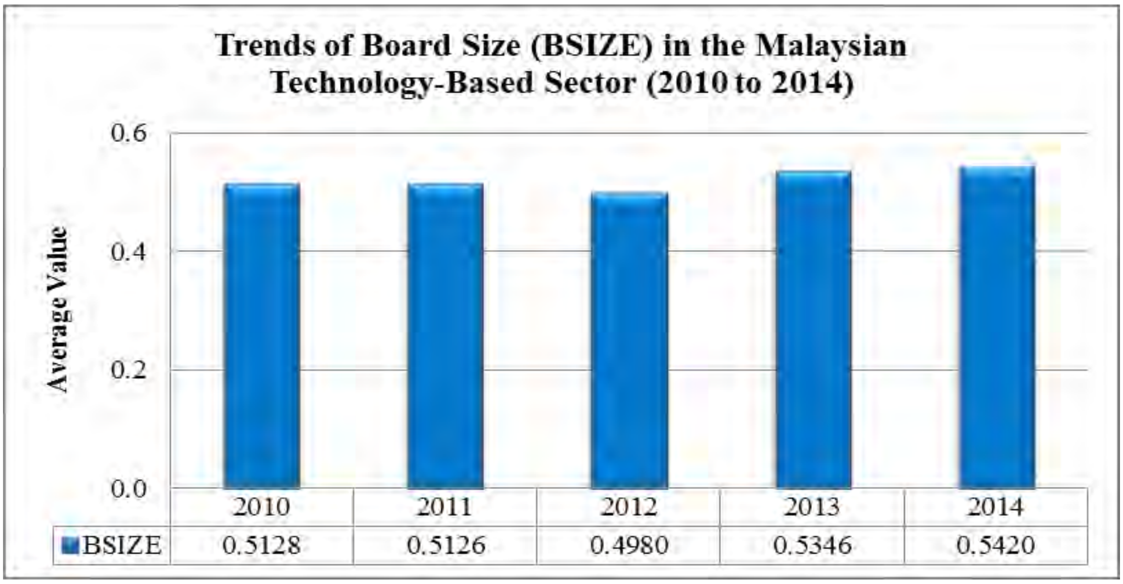


Figure 5.10: Trends of Board Size (BSIZE) in the Malaysian Technology-Based Sector (2010 to 2014).

Figure 5.9, in addition, depicts a clear trend of yearly average values for board independence (BINDP) and leverage (LEV) in the Malaysian technology-based sector for the period of 2010 to 2014. The bar graph of BINDP showed that the percentage had a slight decrease from 51.3 per cent in 2010 to 49.8 per cent in 2013, while the number of independent boards showed continuous increment from 2013 with 53.5 per cent to 54.2 per cent in 2014. In the overall view of financial leverage (LEV), the bar graph shows that the LEV rose in 2011 with the leverage at 15.2 per cent to 22.4 per cent in 2013, while a slight decrease was noted in 2014 with 21.8 per cent. Meanwhile, the trends of board size (BSIZE) in the Malaysian technology sectors as illustrated in figure 5.10, shows that the size of board members did not significantly change and it remained stable from 2010 to 2014. As for firm size (FSIZE), Figure 5.11 depicts the trend of FSIZE in the Malaysian technology-based sector for the period of 2010 to 2014. The figure shows that the bar graph was relatively stable through the observed periods with slight increase that started from 2010 until 2011.

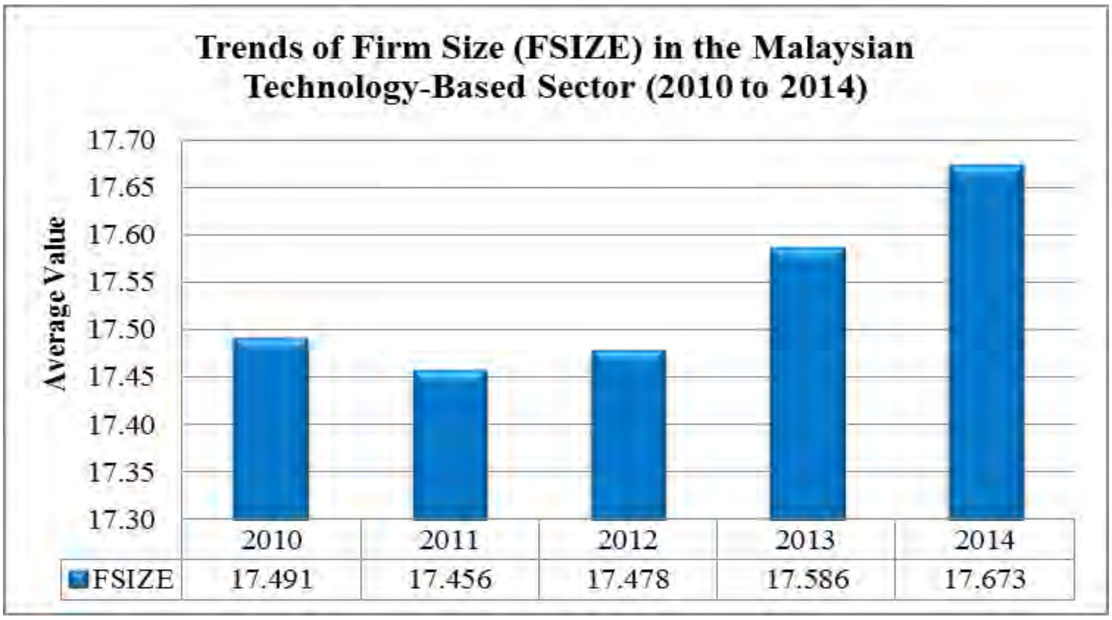


Figure 5.11: Trends of Firm Size (FSIZE) in the Malaysian Technology-Based Sector (2010 to 2014).

5.5 Univariate Analysis

In this study the t-test and Pairwise correlation matrix were conducted for all sampled companies in the Malaysian technology-based sector to test the key variables.

5.5.1 T-test for All Sampled Companies in the Malaysian Technology Sector

The first objective outlined in this study is to examine the extent of ICT investment among firms in the Malaysian technology-based sector. As such, inferential statistics was performed using t-test to examine the extent of ICT investment in the Malaysian technology-based sector. With that, this section provides several inter-temporal comparisons of ICT investment, which was measured by ICT spending (ICTSPE) mean value using the Independent Sample Test for Equality of Means. This Independent Sample Test for Equality of Means was employed in this inter-temporal analysis to examine the difference in the mean values of ICT spending (ICTSPE) between group populations, such as (1) inter-ICT components[40]; (2) inter-Bursa markets[41]; (3) inter-ICT governance mechanisms; (4) inter-board characteristics; (5) inter-ownership structures; and (6) inter-company characteristics. Hence, Table 5.6 to Table 5.12 illustrate the findings retrieved from results of t-test for all compared variables measured using dichotomous and continuous values, as well as coded using dummy (1, 0).

5.5.1.1 Inter-ICT Components

Three group categories that were represented by their own indicators had been established in order to examine if the difference in the mean value of ICT investment existed between the compared indicators. As for the first group, the t-test was carried out to verify the difference in the means of ICT investment between the frequencies of companies that did invest in ICT and the frequencies of companies that did not do so. Hence, for this purpose of examination, ICT spending (ICTSPE) was used to measure ICT investment. Table 5.6 presents the analysis findings of inter-ICT component group statistics and t-test. The results in the group statistics showed that 131 (79 per cent) total frequencies of companies made ICT investment, in comparison to 34 (21 per cent) total frequencies of companies that did not invest in ICT.

From the total frequencies (131) of investment made in ICT, approximately 76 frequencies of ICT investment were made by companies from the ACE Market. However, the frequencies of ICT investment made by companies from the Main Market were only recorded at 55, which is lower than those of ACE Market. Other

[40] Inter-ICT components refer to the comparison between ICT tangible assets (e.g., hardware) and ICT intangible assets (e.g., software, R&D, copyrights, pattern, etc.).
[41] Inter-Bursa Markets refer to the comparison between Main Market (MM) and ACE Market (ACE).

than that, the mean value was also found higher which was at 11.6 in the frequencies of companies that did invest in ICT compared to the mean value of 0 6 in the frequencies of companies that did not invest in ICT. Furthermore, the t-test results exemplified a statistically significant difference between the frequencies of companies that did invest and those that did not invest in ICT investment at a significant level of 1 per cent. In precise, most companies in the Malaysian technology sector were significantly involved in making ICT investment over the period of 2010 to 2014.

Table 5.6 Inter-ICT Components: Analysis of Group Statistics and T-Test

Group Statistics **Test Variable: ICTSPE**							**t-test**	
Variables	**Dummy Codes**	**MM (Fq.)**	**ACE (Fq.)**	**TFq**	**%**	**Mean**	***t***	***p***
Invested in ICTSPE and not invested	1 Invested	55	76	131	79	11.6	51.8	0.000 ***
	0 Not invested	10	24	34	21	0.00		
	Total	**65**	**85**	**165**	**100**			
Invested in ICTTA and not invested	1 Invested	48	70	118	72	10.6	56.5	0.000 ***
	0 Not invested	17	30	47	28	0.00		
	Total	**65**	**85**	**165**	**100**			
Invested in ICTTN and not invested	1 Invested	30	37	67	41	12.4	40.1	0.000 ***
	0 Not invested	35	63	98	59	0.00		
	Total	**65**	**85**	**165**	**100**			

Note: ICTSPE refers to ICT spending which is the measurement of ICT investment; ICTTA refers to ICT tangible assets; ICTTN refers to ICT intangible assets; MM refers to Main Market; ACE refers to the ACE Market; Fq. refers to the frequencies; and TFq. refers to the total frequencies. *, ** and *** represent significance at 10%, 5% and 1% levels respectively.

Next, in order to examine the extent the companies in the Malaysian technology sector had been involved in ICT investment, two group categories were established, namely ICT tangible assets (ICTTA) and ICT intangible assets (ICTTN). The comparison for ICTTA was performed using two indicators; (1) the frequencies of companies that did invest in ICTTA were recorded as 1; while (2) the value _0‘ denoted the frequencies of companies that did not invest in ICTTA. Likewise, the ICTTN was compared between two indicators; (1) the frequencies of companies that did invest in ICTTN were recorded as 1; while (2) the value _0‘ was meant for frequencies of companies that did not invest in ICTTN.

The results in the group statistics showed that 118 (72 per cent) total frequencies of companies did invest in ICTTA, whereas only 47 (28 per cent) frequencies of companies did not invest in ICTTA. From the total frequencies (118) of making investment in ICTTA, approximately 70 frequencies of companies in the ACE Market invested in ICTTA. The frequencies of companies from the Main Market did invest in ICTTA, but only 48 were recorded; which is lower than the frequencies of ACE Market. Besides, the statistics results revealed that the total frequencies of companies in ICTTN investment had been 67 (41 per cent). Unfortunately, the results disclosed that 98 (59 per cent) total frequencies of companies in the Malaysian technology sector did not invest in ICTTN for the period of 2010 to 2014. From the total frequencies (67) of making investment in ICTTN, only 37 frequencies of companies from the ACE Market invested in ICTTN, which recorded a higher number when compared to those from the Main Market, which were only 30. Both t-test results of ICTTA and ICTTN, as presented in Table 5.6, exhibited statistically significant differences at a significant level of 1 per cent between the indicators.

Since it had been confirmed that the companies in the technology sector were indeed significantly involved in ICT investment, Table 5.7 offers the answer to the question of _which did the Malaysian technology sector spent most in ICT investment; either ICT tangible assets (ICTTA) or ICT intangible assets (ICTTN)?‘. The total investment for ICTTA was about RM 31,513,060 (28 per cent), which is lower than the total investment for ICTTN; RM 79,744,531 (72 per cent). The overall total ICT investment made by companies in the Malaysian technology-based sector from 2010 until 2014 was RM 111,257,591, where companies from the Main Market (RM 71,757,392) emerged as the main contributor to the total ICT investment, when compared to those from the ACE Market (RM 39,500,199). Besides, from the overall total of ICT investment, it was found that the sector had invested mostly in ICTTN (72 per cent), instead of only 28 per cent in ICTTA.

Table 5.7 Total of ICT Investment in the Malaysian Technology-based Sector (2010 to 2014)

Types of ICT Investment	**MM (RM)**	**Total (%)**	**ACE (RM)**	**Total (%)**	**Total of ICT investment in the Bursa Markets (RM)**	**Total (%)**
• Investment amount of ICTTA	21,647,259	30	9,865,801	25	31,513,060	28
• Investment amount of ICTTN	50,110,133	70	29,634,398	75	79,744,531	72
Total Amount of ICT Investment	71,757,392	100	39,500,199	100	111,257,591	100

Note: ICTTA refers to ICT tangible assets; ICTTN refers to ICT intangible assets; MM refers to Main Market; and ACE refers to the ACE Market.

5.5.1.2 Inter-Bursa Markets

Basically, two types of Bursa Markets exist in the Malaysian technology-based sector, namely Main Market and ACE Market. The Inter-Bursa Markets comparison was performed to determine the extent of ICT investment (ICTSPE) in the Malaysian technology-based sector. For that purpose, ICT investment was compared between the Main Market and the ACE Market. The initial prediction of this comparison was that differences may appear between the Main Market and the ACE Market in terms of their ICT investments in the Malaysian technology-based sector from 2010 to 2014, since the Main Market is comprised of more established companies that held strong financial records[42] compared to the ACE Market, which is characterized by emerging companies.

Table 5.8 Inter-Bursa Markets: Analysis of Group Statistics and T-Test

Group Statistics Test Variable: ICTSPE					t-test	
Grouping Variable	**Dummy Codes**	**TFq**	**%**	**Mean**	***t***	***p***
MKTYPE	1 MM	65	39	9.98	1.67	0.097*
	0 ACE	100	61	8.63		
	Total	**165**	**100**			

Note: MKTYPE refers to Market Type; MM refers to Main Market; ACE refers to the ACE Market; and TFq. refers to the total frequencies. *, ** and *** represent significance at 10%, 5% and 1% levels respectively.

Additionally, Table 5.8 demonstrates the difference of ICT investment had been relatively small between the Main Market and the ACE Market. Besides, the mean value of ICT investment was higher among companies from the Main Market, when compared to those from the ACE Market, which were 9.98 and 8.63, respectively. Hence, the null hypothesis is rejected at a 10 per cent significant level. Although the results displayed slight difference for ICT investment between these two Bursa Markets, the stronger financial wealth derived from the Main Market has aided the market to spend more in ICT investment, in comparison to the ACE Market.

5.5.1.3 Inter-ICT Governance Mechanisms

The three criteria of ICT governance mechanisms were established to examine the difference, if any, in the mean values of ICT investment between: (1) companies with and without ICT governance standards or frameworks (ADICTG); (2) companies with the presence and absence of ICT governance committee (ICTGCOM); as well as (3) companies with the presence and absence of ICT senior management (ICTSM). The

[42] Having strong financial record helps the company to invest in ICT as ICT investment itself requires a huge amount of funds.

results of group statistics and t-test for inter-ICT governance mechanisms, as given in Table 5.9, portray insignificant difference between ADICTG, ICTGCOM, and ICTSM, as this study failed to reject the null hypotheses at any significant levels; indicating nil difference in the means of ICT investment between companies with and without ADICTG, as well as between companies with the presence and absence of ICTGCOM and ICTSM.

Table 5.9 Inter-ICT Governance Mechanisms: Analysis of Group Statistics and T-Test

Group Statistics Test Variable: ICTSPE							**t-test**	
Grouping Variables	**Dummy Codes**	**MM (Fq.)**	**ACE (Fq.)**	**TFq**	**%**	**Mean**	***t***	***p***
ADICTG	1 with	63	79	142	86	9.24	0.44	0.664
	0 without	2	21	23	14	8.73		
	Total	**65**	**100**	**165**	**100**			
ICTGCOM	1 presence	59	79	138	84	9.35	1.02	0.311
	0 absence	6	21	27	16	8.24		
	Total	**65**	**100**	**165**	**100**			
ICTSM	1 presence	59	90	149	90	9.19	0.18	0.856
	0 absence	6	10	16	10	8.94		
	Total	**65**	**100**	**165**	**100**			

Note: ADICTG is the adoption of ICT governance standards and frameworks; ICTGCOM is the presence of ICT governance committee; ICTSM is the presence of ICT senior management; MM refers to Main Market; ACE refers to the ACE Market; Fq. refers to the frequencies; and TFq. refers to the total frequencies. *, ** and *** represent significance at 10%, 5% and 1% levels respectively.

5.5.1.4 Inter-Board Characteristics

The inter-board characteristics were also formulated to examine the extent of ICT investment in the Malaysian technology-based sector by assessing each criterion of board characteristic indicator variables, which were coded using dummy variables in this study. Table 5.10 presents the results of group statistics and t-test for inter-board characteristics. As for the variable of boards with ICT education background

(BICTEDU), both criteria of dichotomous and continuous values were applied to verify the difference, if any, between the mean values of two populations on ICT investment; between presence and absence of BICTEDU, by using dichotomous values. Besides, a comparison of ICT investment was also performed to examine the existence of difference between mean values for companies with frequencies more than the median value of BICTEDU, which was 0.25, by using continuous values.

From the group statistics, the total frequencies of the presence of BICTEDU had been 129, while absence of BICTEDU was 36. The mean value of ICT investment was higher at 9.57 for those with BICTEDU, as compared to the mean value of those without BICTEDU, which was at 7.73. Meanwhile, the t-test results displayed a significant difference between the presence and the absence of BICTEDU in ICT investment. As such, the null hypothesis is rejected at a 10 per cent significance level. This indicated that the presence of BICTEDU aided in fostering companies‘ ICT development that led them to invest in ICT. However, the findings showed insignificant difference for the mean values of ICT investment between companies‘ frequencies with more and less than the median value of BICTEDU as this study has failed to reject the null hypothesis at any significant level.

As for boards with ICT professional qualifications (BICTPRO), a comparison was performed to ascertain if a difference existed between the presence and the absence of BICTPRO in fostering companies‘ ICT investment[43]. As depicted in the table, a significant difference in the mean values of ICT investment between the presence and

[43] However, the comparison to examine the difference, if any, between mean values of ICT investment for companies‘ frequencies exceeding the median value of BICTPRO could not be conducted in this study as the median value for BICTPRO was found 0 from the descriptive table, and the outcome of this treatment turned out exactly similar to the ones tested (the comparison between presence and absence of BICTPRO).

absence of BICTPRO had been discovered as the mean value of ICT investment was found higher for those with BICTPRO at 9.94, compared to 8.47 for those without BICTPRO. Thus, this study rejects the null hypothesis at 10 per cent significance level.

Table 5.10 Inter-Board Characteristics: Analysis of Group Statistics and T-Test

Group Statistics Test Variable: ICTSPE							t-test	
Grouping Variables	**Dummy Codes**	**MM (Fq.)**	**ACE (Fq.)**	**TFq**	**%**	**Mean**	***t***	***p***
BICTEDU	1 presence	57	72	129	78	9.57	1.90	0.06
	0 absence	8	28	36	22	7.73		*
	Total	**65**	**100**	**165**	**100**			
	1 > median of BICTEDU	29	54	83	50	9.71	1.36	0.18
	0 < median of BICTEDU	36	46	82	50	8.62		
	Total	**65**	**100**	**165**	**100**			
BICTPRO	1 presence	43	35	78	47	9.94	1.84	0.07
	0 absence	22	65	87	53	8.47		*
	Total	**65**	**100**	**165**	**100**			
BICTIE	1 presence	63	99	162	98	9.23	1.19	0.24
	0 absence	2	1	3	2	5.67		
	Total	**65**	**100**	**165**	**100**			
	1 > median of BICTIE	36	55	91	55	9.85	1.90	0.06
	0 < median of BICTIE	29	45	74	45	8.32		*
	Total	**65**	**100**	**165**	**100**			
BICTTR	1 presence	28	27	55	33	10.3	2.03	0.04
	0 absence	37	73	110	67	8.59		**
	Total	**65**	**100**	**165**	**100**			
BINDP	1 ≥ 1/3 of INED	39	67	106	63	8.74	-1.41	0.16
	0 < 1/3 of INED	26	33	59	37	9.93		
	Total	**65**	**100**	**165**	**100**			
BSIZE	1 presence	48	82	130	79	9.24	0.34	0.74
	0 absence	17	18	35	21	8.90		
	Total	**65**	**100**	**165**	**100**			

Note: BICTEDU is boards' ICT educational background; BICTPRO is boards' ICT professional qualification; BICTIE is boards' ICT industrial experience; BICTTR is boards' ICT-related trainings; BINDP is board independence; BSIZE is board size; MM refers to Main Market; ACE refers to the ACE Market; Fq. refers to the frequencies; and TFq. refers to the total frequencies. *, ** and *** represent significance at 10%, 5% and 1% levels respectively.

Likewise, the ICT investment was also compared between the presence and absence of boards with ICT industrial experiences (BICTIE), as well as to examine the difference in the mean values of ICT investment between companies‘ frequencies with more and less than the median value of BICTIE (0.5[44]). In fact, the results of BICTIE exhibited insignificant difference between the presence and absence of BICTIE as the null hypothesis could not be rejected at any significant level. Meanwhile, the mean values of ICT investment differed significantly between companies‘ frequencies with more and less than the median value of BICTIE at a significance level of 5 per cent. The mean value of ICT investment was found higher at 9.85 for companies‘ frequencies with more than the median value of BICTIE, when compared to the mean value of those with less than the median value of BICTIE, which was at 8.32. The results indicated that ICT investment was better served with the presence of companies‘ frequencies with more than the median value of BICTIE, compared to those less.

In addition, ICT related-training has been deemed as essential for boards as a base to build new knowledge of cutting-edge changes in technological development, as well as to develop skills for innovation of future products and services. With t-test, the ICT investment was also compared between presence and absence of boards with ICT-related training (BICTTR). The results displayed a significant difference for the mean values of ICT investment for the comparison between the presence and absence of BICTTR. The mean value for those with BICTTR had been higher at 10.3, when compared to those without BICTTR; 8.59. Hence, the null hypothesis is rejected at 5 per cent significance level. The results further indicated that the presence of BICTTR helped to boost the companies‘ ICT investment during the period of 2010 to 2014.

[44] Refer to Table 5.5 Descriptive Statistics of Variables.

The comparison of ICT investment was also performed between two indicator variables of board independence (BINDP), namely (1) independent executive directors (INEDs), which is more than or equivalent to one third of the board size and recorded as _1'; as well as (2) INEDs with less than one third of the board size and recorded as _0'. The results of the t-test showed insignificant variance between the mean values of ICT investment with more than or equivalent to one third of INEDs and less than one third of INEDs among companies, as the null hypothesis could not be rejected at any significant level. Likewise, the results of the comparison for ICT investment between two indicator variables of board size (BSIZE) also exhibited insignificant difference between having more than 6 board members and less than 6 board members in the companies[45], since the null hypothesis could not be rejected at any significant level.

5.5.1.5 Inter-Ownership Structures

Inter-ownership structures were also formulated under t-test to examine the extent of ICT investment in the Malaysian technology sector. In fact, four main ownership structure variables were employed for this t-test investigation. First, comparisons of ICT investment from ownership variables, such as COWN, MOWN, and FOWN, were conducted to ascertain the difference, if any, between mean values of ICT investment for companies' frequencies with more or less than the median value from each ownership variable. Besides, the comparison of ICT investment was also performed between companies with and without government and foreign ownerships.

Table 5.11 presents the results of group statistics and t-test for the ownership structures. The results showed a significant difference at 5 per cent significant level for mean values of ICT investment between companies' frequencies with exceeding

[45] The determined number of 6 board members refers to the mean value of board size (BSIZE) found from the descriptive analysis in Table 5.5.

value than the median value of COWN, which was 46.176[46], in comparison to those with lower than the COWN median value. Likewise, a significant difference at 5 per cent significance level was revealed for mean values of ICT investment between companies' frequencies with more than the median value of FOWN, which was 1.7125[47], compared to those with lower than the FOWN median value. However, the results revealed insignificant difference for the means of ICT investment between companies' frequencies with more and less than the median value of MOWN as the null hypothesis could not be rejected at any significance level.

Table 5.11 Inter-Ownership Structures: Analysis of Group Statistics and T-Test

Group Statistics Test Variable: ICTSPE							**t-test**	
Grouping Variables	**Dummy Codes**	**MM (Fq.)**	**ACE (Fq.)**	**TFq**	**%**	**Mean**	***t***	***p***
COWN	1 > median of 46.176	41	43	84	51	10.07	2.32	0.02 **
	0 < median of 46.176	24	57	81	49	8.23		
	Total	**65**	**100**	**165**	**100**			
MOWN	1 > median of 20.181	37	46	83	50	8.57	-1.49	0.14
	0 < median of 20.181	28	54	82	50	9.77		
	Total	**65**	**100**	**165**	**100**			
GOWN	1 with	16	4	20	12	11.26	2.49	0.02 **
	0 without	49	96	145	88	8.88		
	Total	**65**	**100**	**165**	**100**			
FOWN	1 with	48	65	113	68	9.63	1.70	0.09 *
	0 without	17	35	52	32	8.16		
	Total	**65**	**100**	**165**	**100**			
	1 > median of 1.7125	33	51	84	51	9.94	1.97	0.05 **
	0 < median of 1.7125	32	49	81	49	8.36		
	Total	**65**	**100**	**165**	**100**			

Note: COWN is concentrated ownership; MOWN is managerial ownership; GOWN is government ownership; FOWN is foreign ownership; MM refers to Main Market; ACE refers to the ACE Market; Fq. refers to the frequencies; and TFq. refers to the total frequencies. *, ** and *** represent significance at 10%, 5% and 1% levels respectively.

[46] Refer to Table 5.5 Descriptive Statistics of Variables.
[47] Refer to Table 5.5 Descriptive Statistics of Variables.

Besides, the dichotomous values used to differentiate the mean value of ICT investment between companies with and without GOWN and FOWN also demonstrates significant results as the null hypothesis could be rejected at 5 per cent and 10 per cent significant levels, respectively. Hence, the findings indicated a significant difference for the mean values of ICT investment, which was found higher for companies‘ frequencies with GOWN (11.26), compared to the mean value for companies‘ frequencies without GOWN, which was at 8.88. Other than that, a significant difference was also found higher for companies with FOWN at 9.63, when compared to those without FOWN at 8.16. Hence, it is concluded that the companies in the Malaysian technology sector were better served with GOWN and FOWN, as well as companies‘ frequencies with more than the median value of COWN, in boosting ICT investment for the period of 2010 to 2014.

5.5.1.6 Inter-Company Characteristics

Inter-company characteristics were also examined to examine the extent of ICT investment in the Malaysian technology-based sector by assessing two criteria of company characteristics: leverage (LEV) and firm size (FSIZE). Meanwhile, the results of group statistics and t-test for company characteristics are shown in Table 5.12. The two indicator variables used to differentiate leverage (LEV) in the t-test are: (1) frequencies of companies with more than the median value of leverage, which was 0.1134[48]; and (2) frequencies of companies with less than the median value of leverage. The t-test was conducted to examine a difference between the mean values of ICT investment among companies‘ frequencies with more than the median value of leverage and those with less than the median value of leverage.

[48] Refer to Table 5.5 Descriptive Statistics of Variables.

Table 5.12 Inter-Company Characteristics: Analysis of Group Statistics and T-Test

Group Statistics Test Variable: ICTSPE							**t-test**	
Grouping Variables	**Dummy Codes**	**MM (Fq.)**	**ACE (Fq.)**	**TFq**	**%**	**Mean**	***t***	***p***
LEV	1 > median of 0.1134	35	46	81	49	9.40	0.58	0.56
	0 < median of 0.1134	30	54	84	51	8.94		
	Total	**65**	**100**	**165**	**100**			
FSIZE	1 > median of 17.578	48	35	83	50	10.23	2.71	0.01 **
	0 < median of 17.578	17	65	82	50	8.09		
	Total	**65**	**100**	**165**	**100**			

Note: LEV is leverage; FSIZE is firm size; MM refers to Main Market; ACE refers to the ACE Market; Fq. refers to the frequencies; and TFq. refers to the total frequencies. *, ** and *** represent significance at 10%, 5% and 1% levels respectively.

The results showed insignificant difference between the frequencies of companies with more than the median value of leverage and the frequencies of companies with less than the median value of leverage, since the null hypothesis could not be rejected at any significant level. Besides, the comparison of ICT investment was also conducted between two indicators of firm size (FSIZE), namely (1) the frequencies of companies with total assets more than the median value of FSIZE (17.578[49]), which was recorded as ‗1‘; and those with total assets less than the median value of FSIZE, which was recorded as ‗0‘. The results displayed a significant difference at 5 per cent significance level for the mean value of ICT investment between these two indicators, as the mean value of the first criteria exhibited higher value than that of the second criteria.

[49] Refer to Table 5.5 Descriptive Statistics of Variables.

5.5.2 Pairwise Correlation Matrix

The Pairwise Pearson's correlation matrix was employed to examine the existence of multicollinearity among the independent variables. Table 5.13 shows that the correlation coefficients absolute values between the variables were lower than the 0.9 threshold value for potential multicollinearity (Tabachnick & Fidell, 2007; Hair et al., 2006); therefore all variables were included in the regression estimation. In the case of inconsistent findings, the result of multicollinearity is solved by using the panel data analysis method.

5.6 Testing for Panel Data

Basically, some elements of lagged dependent variables were applied to the equation model used in this study (refer to *Equation (3)*). In order to offer the robustness check for the validity of SGMM estimation method, the estimation results of DGMM, Pooled OLS, and panel fixed effect (FE) were also considered in this study. In addition, several common diagnostic tests like tests of multicollinearity, heteroscedasticity, autocorrelation, and F-test, were performed to examine if the data violate the underlying statistical assumptions. Besides, the results of two dynamic diagnostic tests; Sargan test[50] and Arellano-Bond test[51], were also applied to confirm the validity of GMM estimation methods. Next, regression analyses were used after the data met all diagnostic tests.

[50] The Sargan test was performed to determine if a correlation exists between the instruments and the error term in this study.
[51] Two tests were discovered under the Arellano-Bond (AR), namely first-order serial correlation test, AR(1); and second-order serial correlation test, AR(2). Under the rule of thumb of this assumption test, the test should reject the null of no first-order serial correlation, but it should not reject the null that there is no second-order serial correlation.

Table 5.13 Pairwise Correlation Matrix

Variables	**ROA**	**ROA$_{t-1}$**	**ROE**	**ROE$_{t-1}$**	**TQ**	**TQ$_{t-1}$**	**ICTSPE$_{t}$**	**ICTSPE$_{t-1}$**	**ICTSPE$_{t-2}$**	**ICTSPE$_{t-3}$**
ROA	1.0000									
ROA$_{t-1}$	0.1190	1.0000								
ROE			1.0000							
ROE$_{t-1}$			0.0824	1.0000						
TQ					1.0000					
TQ$_{t-1}$					0.6445***	1.0000				
ICTSPE$_{t}$	-0.0227	0.1045	-0.0452	0.1155	-0.0727	-0.1551**	1.0000			
ICTSPE$_{t-1}$	0.0478	-0.0575	0.0075	-0.0829	-0.0122	-0.2145***	0.4134***	1.0000		
ICTSPE$_{t-2}$	-0.0496	0.0105	-0.0542	-0.0254	0.0204	-0.1122	0.1931**	0.5754***	1.0000	
ICTSPE$_{t-3}$	-0.0505	-0.0921	-0.0233	-0.1161	0.0213	-0.0572	0.1219	0.3315***	0.6330***	1.0000
ADICTG	-0.0584	-0.0342	-0.0078	0.0187	-0.1997**	-0.1928**	0.0341	0.0941	0.1086	0.1052
ICTGCOM	-0.0297	0.1070	0.0156	0.1143	-0.2347**	-0.0825	0.0794	0.0316	0.0426	0.0663
ICTSM	0.1425*	0.0921	0.1118	0.0667	0.0925	0.0790	0.0143	-0.0493	-0.1440*	-0.1433*
BICTEDU	0.1415	0.0898	0.1351*	0.0795	-0.0718	-0.0384	0.0543	-0.0361	-0.0617	-0.0553
BICTPRO	0.1081	0.0422	0.1193	0.0541	-0.1618**	-0.1062	0.1371*	0.0251	-0.0197	-0.0260
BICTIE	0.0715	0.0320	0.0783	0.0273	-0.0807	-0.0296	0.2372***	0.1023	-0.0117	-0.0904
BICTTR	0.0275	0.0769	0.0286	0.0735	-0.0237	-0.0747	0.1567**	0.1006	0.0833	-0.0025
COWN	0.2665***	0.2226***	0.2041***	0.1765**	-0.0116	-0.0140	0.2180***	0.0744	0.0091	0.0043
MOWN	-0.0040	-0.0451	-0.0330	-0.0762	0.3144***	0.2217***	-0.0782	-0.1361*	-0.1952**	-0.1700**
GOWN	-0.0084	0.0054	0.0078	0.0172	0.0677	0.0684	0.0857	0.0424	0.0428	0.0246
FOWN	-0.1031	-0.1651**	-0.0767	-0.1559**	-0.1758**	-0.0851	0.0940	0.1756**	0.2653***	0.2355***
BINDP	-0.0804	0.0439	-0.0472	0.0820	-0.1223	-0.0933	-0.1239	-0.0209	0.0615	0.0941
BSIZE	0.0920	-0.0062	0.0691	-0.0405	0.2814***	0.2108***	0.1365*	0.1485*	0.1458*	0.1053
LEV	-0.2290***	-0.1257	-0.3191***	-0.2196***	0.5882***	0.4738***	-0.0220	-0.0092	0.0887	0.0721
FSIZE	0.2845***	0.2526***	0.2550***	0.2293***	0.1025	0.0534	0.1913**	0.1332*	0.0961	0.0865

Note: ROA is return on assets; ROE is return on equity; TQ is Tobin's Q; ROA$_{t-1}$ is return on assets at time t-1; ROE$_{t-1}$ is return on equity at time t-1; TQ$_{t-1}$ is Tobin's Q at time t-1; ICTSPE is ICT spending at time t; ICTSPE$_{t-1}$ is ICT spending at time t-1; ICTSPE$_{t-2}$ is ICT spending at time t-2; ICTSPE$_{t-3}$ is ICT spending at time t-3; ADICTG is the adoption of ICT governance standards and frameworks; ICTGCOM is the presence of ICT governance committee; ICTSM is the presence of ICT senior management; BICTEDU is boards' ICT educational background; BICTPRO is boards' ICT professional qualification; BICTIE is boards' ICT industrial experience; BICTTR is boards' ICT related trainings; COWN is concentrated ownership; MOWN is managerial ownership; GOWN is government ownership; FOWN is foreign ownership; BINDP is board independence; BSIZE is board size; LEV is leverage and FSIZE is firm size. *, ** and *** represent significance at 10%, 5% and 1% levels respectively.

Table 5.13 Pairwise Correlation Matrix (continued)

Variables	ADICTG	ICTGCOM	ICTSM	BICTEDU	BICTPRO	BICTIE	BICTTR	COWN	MOWN	GOWN	FOWN
ADICTG	1.0000										
ICTGCOM	0.0585	1.0000									
ICTSM	-0.1319*	0.0211	1.0000								
BICTEDU	-0.2517***	0.1950**	0.2767***	1.0000							
BICTPRO	-0.0019	0.2873***	0.2053***	0.4277***	1.0000						
BICTIE	-0.0933	0.4126***	0.4626***	0.4765***	0.4958***	1.0000					
BICTTR	0.0990	0.1390*	-0.0290	-0.2358***	0.0499	0.1057	1.0000				
COWN	-0.1362*	-0.1049	0.0969	-0.0490	-0.0472	-0.0481	0.1117	1.0000			
MOWN	-0.1904**	0.1004	0.0643	0.0979	0.0808	0.1969**	-0.0256	0.1503*	1.0000		
GOWN	0.1035	0.0732	-0.0214	-0.0720	0.1200	-0.0827	0.0972	0.2371***	-0.2685***	1.0000	
FOWN	0.0474	-0.0809	-0.0790	0.0262	-0.1049	-0.0129	-0.0703	0.0130	-0.2504***	-0.1562**	1.0000
BINDP	0.3220***	-0.1813*	-0.3630***	-0.2484***	-0.2322***	-0.3878***	-0.0264	-0.1581	-0.3045***	-0.0833	-0.0155
BSIZE	-0.2051***	0.0246	0.1670**	-0.0178	-0.1662**	0.0327	0.0147	0.3253***	0.0491	0.1793**	0.0512
LEV	-0.1926**	-0.2393***	-0.0666	-0.0983	-0.1018	-0.1438*	-0.0850	-0.0457	0.1466*	-0.0496	-0.0485
FSIZE	0.0541	0.0973	0.1934**	0.0681	0.1962**	0.0208	0.0769	0.4205***	0.0323	0.2454**	-0.1124

Note: ADICTG is the adoption of ICT governance standards and frameworks; ICTGCOM is the presence of ICT governance committee; ICTSM is the presence of ICT senior management; BICTEDU is boards' ICT educational background; BICTPRO is boards' ICT professional qualification; BICTIE is boards' ICT industrial experience; BICTTR is boards' ICT related trainings; COWN is concentrated ownership; MOWN is managerial ownership; GOWN is government ownership; FOWN is foreign ownership; BINDP is board independence; BSIZE is board size; LEV is leverage and FSIZE is firm size. *, ** and *** represent significance at 10%, 5% and 1% levels respectively.

Table 5.13 Pairwise Correlation Matrix (continued)

Variables	BINDP	BSIZE	LEV	FSIZE
BINDP	1.0000			
BSIZE	-0.4243***	1.0000		
LEV	-0.1325	0.1427	1.0000	
FSIZE	-0.0551	0.2545***	0.0420	1.0000

Note: BINDP is board independence; BSIZE is board size; LEV is leverage and FSIZE is firm size.
*, ** and *** represent significance at 10%, 5% and 1% levels respectively.

5.6.1 Results of Multicollinearity

Table 5.14 Results of Variance Inflation Factor (VIF)

Variables	ROA		ROE		TQ	
	VIF	1/VIF	VIF	1/VIF	VIF	1/VIF
ROA_{t-1}	1.28	0.781752				
ROE_{t-1}			1.29	0.773783		
TQ_{-1}					1.60	0.624819
$ICTSPE_{t}$	1.43	0.701008	1.44	0.695150	1.42	0.704125
$ICTSPE_{t-1}$	1.82	0.548832	1.84	0.544468	1.82	0.548798
$ICTSPE_{t-2}$	2.43	0.411206	2.42	0.413594	2.36	0.422994
$ICTSPE_{t-3}$	1.80	0.556758	1.80	0.555590	1.76	0.569482
ADICTG	1.33	0.749304	1.33	0.750241	1.35	0.742656
ICTGCOM	1.52	0.655933	1.52	0.659072	1.50	0.665749
ICTSM	1.68	0.596525	1.67	0.597426	1.69	0.592296
BICTEDU	1.72	0.582498	1.71	0.583917	1.71	0.586438
BICTPRO	1.77	0.566328	1.76	0.566988	1.77	0.564674
BICTIE	2.56	0.390658	2.56	0.390687	2.57	0.389213
BICTTR	1.21	0.823536	1.21	0.824043	1.21	0.824356
COWN	1.70	0.587067	1.67	0.598072	1.66	0.602615
MOWN	1.64	0.608996	1.64	0.609570	1.68	0.593771
GOWN	1.48	0.673980	1.48	0.677179	1.51	0.660069
FOWN	1.38	0.724525	1.37	0.728422	1.34	0.749045
BINDP	1.97	0.506535	1.97	0.506350	2.03	0.493154
BSIZE	1.67	0.598593	1.67	0.599579	1.72	0.581209
LEV	1.30	0.771274	1.33	0.751925	1.60	0.626610
FSIZE	1.65	0.606826	1.65	0.605551	1.61	0.622445
Mean VIF	**1.67**		**1.67**		**1.70**	

Note: ROA is return on assets; ROE is return on equity; TQ is Tobin‘s Q; ROA_{t-1} is return on assets at time t-1; ROE_{t-1} is return on equity at time t-1; TQ_{t-1} is Tobin‘s Q at time t-1; ICTSPE is ICT spending at time t; $ICTSPE_{t-1}$ is ICT spending at time t-1; $ICTSPE_{t-2}$ is ICT spending at time t-2; $ICTSPE_{t-3}$ is ICT spending at time t-3; ADICTG is the adoption of ICT governance standards and frameworks; ICTGCOM is the presence of ICT governance committee; ICTSM is the presence of ICT senior management; BICTEDU is boards‘ ICT educational background; BICTPRO is boards‘ ICT professional qualification; BICTIE is boards‘ ICT industrial experience; BICTTR is boards‘ ICT-related trainings; COWN is concentrated ownership; MOWN is managerial ownership; GOWN is government ownership; FOWN is foreign ownership; BINDP is board independence; BSIZE is board size; LEV is leverage and FSIZE is firm size.

The Variance Inflation Factors (VIFs) of the variables for all models were examined. Table 5.14 demonstrates that VIF for the ROA model ranged from 1.21 to 2.56. As for the ROE model, the VIF values also ranged from 1.21 to 2.56, while 1.21 to 2.57 for TQ model. Therefore, the VIF for all three models used in this study were found to be around 1.21 to 2.57, which are below than the threshold value 10 (Hair et al., 2006;

Ho, 2006; Gujarati, 2003). Therefore, multicollinearity is not likely to affect regression analysis, which allows for the standard interpretation of regression coefficients.

5.6.2 Selection of the Appropriate Model

Apart from the two dynamic models applied in this study, the most appropriate statistical model was also chosen to describe the effect of ICT investment, ICT governance mechanisms, boards with diverse ICT expertise, and ownership structures on firm performance. Moreover, due to the panel data used in this study, the models of the study were also subjected to other regression models (Fixed and Random Effects), in addition to Pooled OLS, because of the uncertainty in conjunction to the conformity with the OLS regression model assumptions, as indicated by the normality test, as discussed in sub-section 5.3. As such, several statistical tests were carried out and the results are demonstrated in Table 5.15.

Table 5.15 Results of Statistical Tests (Hausman, Lagrange Multiplier (LM) and F-Test)

Types of Tests	Statisitics	ROA	ROE	TQ
• Hausman Test	Chi^2 Prob > chi^2	9659.36 (0.0000)	8673.88 (0.0000)	4295.64 (0.0000)
• Breusch-Pagan Lagrange Multiplier (LM) Test	Chi^2 Prob > chi^2	0.00 (1.0000)	0.00 (1.0000)	0.00 (1.0000)
• F-Test	F-value Prob > F	3.86 (0.0000)	3.25 (0.0000)	2.28 (0.0011)

Note: ROA is return on assets; ROE is return on equity; and TQ is Tobin‘s Q.

The first test refers to the Hausman test, which compared the FE and RE models. Second, the Breusch-Pagan LM test was conducted to select the most suitable model between the RE and OLS models, and lastly, ended with the F-test. The Hausman specification test was conducted to examine if the individual effects were uncorrelated with other predictors in the model. Hence, it may result in inconsistency with the presence of such correlation. Moreover, the fixed effects (FE) model considers the presence of correlation between independent variables and error term, while the random effects (RE) model does not. The null hypothesis (H_0) assumes that unobserved effect is uncorrelated with explanatory variables, while the alternative hypothesis (H_1) determines that the unobserved effect is correlated with explanatory variables. Besides, the Hausman test determines the null hypothesis that the coefficients estimated by the efficient RE estimator are similar to the ones estimated by the consistent FE estimator.

If a significant *p* value is generated (prob>chi2 is smaller than the 5 per cent significance level), the null hypothesis is rejected, while the FE model is preferred than the RE model. If the result shows a non-significant *p* value (prob>chi2 is larger than the 5 per cent significance level); it is suggested that the RE is more appropriate than the FE model (Stock & Watson, 2007; Greene, 2003). As such, the Hausman test was performed for all financial performance models of ROA, ROE, and TQ. Moreover, as shown in Table 5.15, the Hausman test results showed that the *p* values of ROA, ROE, and TQ were significant since the null hypotheses could be rejected at the significance level of 5 per cent. The results indicated that the FE model was the most appropriate among all models. The next step involved the test of Breush-Pagan LM, in order to compare between OLS and RE models. This involved testing for the presence of time and individual effects based on the OLS residuals. The null hypothesis in the LM test is that there is no time or individual effects to indicate that the OLS estimator is consistent, thus suggesting that the OLS is the most appropriate method. Meanwhile, the null hypothesis is rejected if the test result hints the presence of time upon individual effects, hence suggesting that the RE is the most appropriate method to use.

Based on Table 5.15, the results of the LM test showed that the null hypothesis for ROA, ROE and TQ is rejected at the significance level of 5 per cent; indicating no time or individual effect in the models. Hence, the pooled OLS method is the most appropriate for use. The last step involved the restricted F-test to compare the pooled OLS and FE models since the OLS was found to be the most appropriate model in the second test (LM test). Moreover, the restricted F-test was conducted for pooled OLS and FE models because the primary distinction between them lies in the premise of the individual effects. The null hypothesis is rejected at the significance level of 5 per cent if the model contains individual heterogeneity associated with a single or more predictors. The rejection of null hypothesis indicates that the *p* value is significant, thus suggesting the FE estimator as more appropriate than the pooled OLS.

Other than that, Andale (2016) suggested two ways to make decision; whether to reject the null hypothesis of F-test, either through (1) the *p* value of F-test, where a significant *p* value (*p* value is smaller than 5 per cent significant level) can reject the null hypothesis, indicating that the FE is more appropriate than the OLS, while a non-significant *p* value (*p* value is larger than 5 per cent significant level) cannot reject the null hypothesis, thus indicating that the OLS is better than the FE model; or (2) comparing the F-value with the F-critical value, where if the F-critical value is smaller than the F-value, then the null hypothesis can be rejected at a 5 per cent significant level; depicting the better use of FE model than OLS model. If the F-critical value is larger than the F-value, thus the null hypothesis cannot be rejected at 5 per cent significant levels, suggesting that the OLS model is the best model compared to the FE model. Moreover, Table 5.15 displays the results from the F-test, which show that significant *p* values were generated from the models of ROA, ROE, and TQ, thus the null hypotheses are rejected at 5 per cent significant level. Besides, the FE was opted instead of the pooled OLS as the null of no individual effect is rejected. However, the pooled OLS results for all models are also presented for the purpose of comparison, as well as to determine the robustness of the results.

5.6.3 Results of Heteroscedasticity

Table 5.16 Results of Heteroscedasticity and Autocorrelation

Types of Tests	Statisitics	ROA	ROE	TQ
Heteroscedasticity Tests:				
• Breusch-Pagan/Cook-Weisberg Test	Chi^2 Prob > chi^2	51.21 (0.0000)	133.20 (0.0000)	6.95 (0.0084)
• White Test	Chi^2 Prob > chi^2	165.0 (0.4634)	165.0 (0.4634)	165.0 (0.4634)
Autocorrelation Tests:				
• Durbin-Watson (D-W) (original)	D-W value	1.939318	1.939592	2.020245
• Prais-Winston (P-W) (transformed)	D-W value	2.005764	2.000150	1.997077

Note: ROA is return on assets; ROE is return on equity; and TQ is Tobin's Q.

Table 5.16 shows the results of heteroscedasticity and autocorrelation tests. In fact, two heteroscedasticity tests were conducted in this study, namely the Breusch-Pagan/Cook-Weisberg Test and confirmed by the White Test. As for the Breusch-Pagan/Cook-Weisberg Test, the results of ROA, ROE, and TQ showed that all *p* values were less than the significant level of 5 per cent. Therefore, the null hypotheses of ROA, ROE, and TQ are rejected due to the existence of heteroscedasticity issue in each model. Both results showed that the variances were not constant and another test was required to rectify the identified heteroscedasticity problem. The results of the White Test, finally, confirmed the non-existence of heteroscedasticity issue among the three models of ROA, ROE, and TQ.

The results showed that the *p* values of ROA, ROE, and TQ were greater than the significant level of 5 per cent. Thus, all the null hypotheses are not rejected and free from any heteroscedasticity issue in each model. Both results showed that the variances were not constant and another test was needed to rectify the identified heteroscedasticity problem. The results of the White Test finally have confirmed the non-existence of heteroscedasticity problem in the three models of ROA, ROE TQ. The results showed that the *p* values of ROA, ROE and TQ were greater than the significance level of 5 per cent. Thus, all the null hypotheses were not rejected and indicated that there was no hetereoscedasticity problem in each model.

5.6.4 Results of Autocorrelation

First, the autocorrelation test was carried out to identify any first-order serial correlation in the disturbances when all the predictors had been strictly exogenous by using the Durbin-Watson (D-W) statistics test. The lower bound (dL) and the upper bound (dU) were identified at 1.462 and 1.896, respectively[52]. As presented in Table 5.16, the results of D-W original value of ROA (1.939318), ROE (1.939592), and TQ (2.020245) exemplified no serial correlation in the model. Later, the Prais-Winsten transformation was applied to confirm the autocorrelation problem in ROA, ROE, and TQ models. The autocorrelation results, as shown in Table 5.16, confirmed that there was no serial correlation in ROA, ROE, and TQ models as the transformed values of D-W for each model had been 2.005764, 2.000150, and 1.997077, respectively. In conclusion, the results of the transformed D-W showed that ROA, ROE, and TQ models were free from autocorrelation problem; indicating the absence of autocorrelation in the data.

[52] The values of dL and dU are derived from the chi-square table at the significant level of 1 per cent, whereas the sample size and the number of regressors used were 165 and 20, respectively.

5.7 Regression Analysis

This section unfolds the effect of ICT investment, ICT governance mechanisms, boards with diverse ICT expertise, and ownership structures on firm performance. Generally, this study employed a dynamic model, which was estimated by using the System Generalized Method of Moments (SGMM). The SGMM was selected because it has been acknowledged as the most superior estimation method for the dynamic model (Nayan et al., 2013; Roodman, 2009). Apart from the SGMM estimation result, the estimation results of Pooled OLS, fixed effect (FE) model, and Difference GMM were also applied in this study to generate more accurate and robust results, besides observing the changes in the results under varied estimation methods.

The OLS regression results were calculated with robust standard errors clustered by firm-specific effects. Meanwhile, the FE estimations were calculated with controlling for firm-specific effects, while the dynamic estimation methods presented the Difference GMM (DGMM) and System GMM (SGMM) estimation results by treating $Y_{j,t-1}$ as an endogenous variable. Moreover, one should note that the inclusion of lagged dependent variables is highly correlated with error term, thus leading to results in biased estimates for the regression parameters. As for the potential of endogeneity problem, several instrumental variables were used and estimated by means of the Generalized Method of Moments (GMM) (Arellano & Bond, 1991).

Besides, some validity checks were performed in order to ascertain that the variables to be instrumented are uncorrelated with the error term or the variable is exogenous. As such, several dynamic diagnostic tests like Sargan test and two tests of Arellano-Bond; the first-order serial correlation; AR(1), and the second-order serial correlation;

AR(2), had been conducted in this study. The findings retrieved from Sargan test and two tests of AR(1) and AR(2) are presented in Table 5.17.

Table 5.17 Results of Dynamic Diagnostic Tests

Types of Tests	Statistics	ROA	ROE	TQ
Difference Generalized Method of Moments (DGMM)				
• Sargan Test	Chi^2 Prob > chi^2	6.4916 (0.2613)	4.9512 (0.4219)	3.3865 (0.6406)
• AR(1) Test	z-value Prob > z	-2.6081 (0.0091)	-2.0852 (0.0370)	-2.0977 (0.0359)
• AR(2) Test	z-value Prob > z	-0.4660 (0.6412)	-0.5659 (0.5715)	0.3789 (0.7048)
System Generalized Method of Moments (SGMM)				
• Sargan Test	Chi^2 Prob > chi^2	7.0224 (0.5342)	6.2807 (0.6158)	8.4651 (0.3894)
• AR(1) Test	z-value Prob > z	-2.4788 (0.0132)	-2.3386 (0.0194)	-2.5142 (0.0119)
• AR(2) Test	z-value Prob > z	-0.6226 (0.5336)	-0.5993 (0.5490)	0.0969 (0.9227)

Note: ROA is return on assets; ROE is return on equity; TQ is Tobin‗s Q; AR(1) is the Arellano-Bond first-order serial correlation; and AR(2) is the Arellano-Bond second-order serial correlation.

The dynamic diagnostic tests were tested to both dynamic regression models; the Difference GMM (DGMM) and System GMM (SGMM), which were applied in this study. Basically, in the general rule of thumb for Sargan test, the null hypothesis is rejected at 5 per cent significant level, which indicates that instruments are exogenous if the *p* value is insignificant (*p* value is larger than the 5 per cent significant level). Meanwhile, the null hypothesis will not be rejected at the significant level of 5 per cent if the *p* value is significant (*p* value is smaller than the 5 per cent significant level); indicating that the instruments are not consistent and bias.

On the other hand, under the rule of thumb of Arellano-Bond tests; the AR(1) and AR(2), the differenced error term is probably serially correlated at the AR(1), but not at the AR(2). These two Arellano-Bond tests results for autocorrelation in the first difference of residuals at AR(1) and AR(2) are also illustrated in Table 5.17. The results indicated that the serial correlations in the Difference GMM (DGMM) and the System GMM (SGMM) were absent from ROA, ROE, and TQ models as the null hypotheses could not be rejected at the 5 per cent significant level. Thus, both Arellano-Bond tests were correctly specified under the ROA, ROE, and TQ models. The failure to reject the Sargan test confirmed the overall validity of the surplus instruments; hence, the additional instruments were indeed informative. Overall, this study concludes that the SGMM estimation has passed all the tests, suggesting that the estimation method was valid and the models were correctly specified.

Next, the analysis of the effect of ICT investment, ICT governance mechanisms, boards with diverse ICT expertise, and ownership structures on firm performance had been based on the benchmark specification; system GMM (SGMM). However, for the purpose of providing additional robustness check, as far as the results are concerned, apart from the SGMM results, the DGMM, the Pooled Ordinary Least Square (OLS), and the panel fixed effect (FE) results were also embedded in the table of regression results. Therefore, the regression results for OLS, FE, DGMM, and SGMM for the model of ROA are presented in Table 5.18, whilst Tables 5.19 and 5.20 for ROE and TQ models, respectively. The analyses were classified into five sub-sections: Sub-section 5.7.1 discusses the effects of ICT investment on firm performance ($H_{1(a)}$ to $H_{1(d)}$); sub-section 5.7.2 highlights the effects of ICT governance mechanisms on firm performance (H_2, $H_{3(a)}$ to $H_{3(b)}$); sub-section 5.7.3 explains the effects of boards with diverse ICT expertise on firm performance (H_4 to H_7); sub-section 5.7.4 focuses on the effects of ownership structures on firm performance (H_8 to H_{11}); and the effects of control variables, including board independence, financial leverage, board size, and firm size on firm performance reported in sub-section 5.7.5.

Table 5.18 Regression Results of ROA

Variables	**OLS**	**FE**	**DGMM**	**SGMM**
Constant	-1.2169*** 0.4441	-3.5994*** 0.9091	-4.5996*** 1.1899	-4.1922*** 0.8868
$ICTSPE_{t}$	-0.0089* 0.0048	-0.0134** 0.0055	-0.0091 0.0079	-0.0093 0.0062
$ICTSPE_{t-1}$	0.0048 0.0047	-0.0008 0.0041	-0.0071* 0.0042	-0.0064** 0.0030
$ICTSPE_{t-2}$	-0.0020 0.0053	-0.0029 0.0044	-0.0050 0.0039	-0.0031 0.0037
$ICTSPE_{t-3}$	-0.0002 0.0049	-0.0003 0.0044	-0.0049 0.0043	-0.0057 0.0043
ADICTG	-0.0293 0.0686	-0.0461 0.0833	-0.0621 0.0624	-0.0501 0.0481
ICTGCOM	-0.0968 0.0688	-0.1549* 0.0804	-0.2265*** 0.0827	-0.1757*** 0.0619
ICTSM	-0.0389 0.0901	-0.0661 0.1089	-0.0118 0.0947	-0.0083 0.0904
BICTEDU	0.1324 0.1288	0.2969 0.2704	0.4814 0.4134	0.3165 0.2870
BICTPRO	0.0937 0.1813	0.2534 0.4047	0.3432 0.5885	0.2844 0.5274
BICTIE	0.0599 0.1429	0.6942** 0.2694	0.8009*** 0.2571	0.6756*** 0.2415
BICTTR	0.0125 0.0485	-0.0169 0.0499	-0.0911 0.0565	-0.0746 0.0471
COWN	0.0035** 0.0015	-0.0042 0.0029	-0.0017 0.0024	-0.0021 0.0025
MOWN	-0.0022 0.0014	-0.0059*** 0.0021	-0.0032* 0.0019	-0.0043*** 0.0014
GOWN	-0.0041** 0.0019	0.0018 0.0039	0.0033** 0.0014	0.0034* 0.0017
FOWN	-0.0032* 0.0017	-0.0004 0.0021	0.0075 0.0049	0.0046* 0.0026
BINDP	-0.1319 0.1822	-0.1607 0.2104	-0.2008 0.1572	-0.1638 0.1165
BSIZE	0.0062 0.0152	0.0241 0.0239	-0.0042 0.0202	-0.0029 0.0214
LEV	-0.2818*** 0.0902	-0.4801*** 0.1234	-0.5487* 0.2849	-0.6528** 0.2739
FSIZE	0.0748*** 0.0273	0.2173*** 0.0522	0.2715*** 0.0685	0.2549*** 0.0559
ROA_{t-1}	-0.0335 0.0878	-0.4332*** 0.0845	-0.3169*** 0.0582	-0.2366*** 0.0597
No. of obs	165	165	99	132
R-Sq	0.2467	0.6276	N/A	N/A
Adj. R-Sq	0.1421	0.4547		
No. of groups	N/A	N/A	33	33
No. of instruments			26	29
Sargan test			0.2613	0.5342
AR(1)			0.0091	0.0132
AR(2)			0.6412	0.5336

Note: ROA is return on assets; ROA_{t-1} refers to ROA in year t-1; ICTSPE is ICT spending at time t; $ICTSPE_{t-1}$ is ICT spending at time t-1; $ICTSPE_{t-2}$ is ICT spending at time t-2; $ICTSPE_{t-3}$ is ICT spending at time t-3; ADICTG is the adoption of ICT governance standards and frameworks; ICTGCOM is the presence of ICT governance committee; ICTSM is the presence of ICT senior management; BICTEDU is boards' ICT educational background; BICTPRO is boards' ICT professional qualification; BICTIE is boards' ICT industrial experience; BICTTR is boards' ICT-related trainings; COWN is concentrated ownership; MOWN is managerial ownership; GOWN is government ownership; FOWN is foreign ownership; BINDP is board independence; BSIZE is board size; LEV is leverage; FSIZE is firm size; AR(1) is the Arellano-Bond first-order serial correlation; and AR(2) is the Arellano-Bond second-order serial correlation. Robust standard errors are in parentheses. *, ** and *** represent significance at 10%, 5% and 1% levels respectively.

Table 5.19 Regression Results of ROE

Variables	**OLS**	**FE**	**DGMM**	**SGMM**
Constant	-1.8103*** 0.6372	-4.6607*** 1.3659	-5.4685*** 1.5165	-5.0649*** 1.3253
$ICTSPE_{t}$	-0.0121* 0.0069	-0.0219*** 0.0083	-0.0144 0.01256	-0.0181* 0.0104
$ICTSPE_{t-1}$	0.0017 0.0069	-0.0067 0.0061	-0.0146** 0.0064	-0.0117** 0.0057
$ICTSPE_{t-2}$	-0.0027 0.0076	-0.0052 0.0066	-0.0062 0.0058	-0.0042 0.0055
$ICTSPE_{t-3}$	0.0022 0.0071	0.0033 0.0066	-0.0045 0.0073	-0.0038 0.0073
ADICTG	-0.0216 0.0983	-0.0592 0.1252	-0.0839 0.0914	-0.0726 0.0734
ICTGCOM	-0.1270 0.0985	-0.2269* 0.1199	-0.3008** 0.1173	-0.2553*** 0.0982
ICTSM	-0.0996 0.1293	-0.1506 0.1636	-0.0298 0.1372	0.0017 0.1297
BICTEDU	0.1597 0.1847	0.4304 0.4055	0.7535 0.5366	0.4192 0.4216
BICTPRO	0.1462 0.2601	0.2071 0.6083	0.2209 0.8321	0.2704 0.8165
BICTIE	0.1217 0.2051	0.9608** 0.4048	0.9588*** 0.3488	0.9169*** 0.3089
BICTTR	0.0153 0.0695	-0.0276 0.0749	-0.1298 0.0921	-0.0973 0.0813
COWN	0.0035* 0.0021	-0.0065 0.0043	-0.0008 0.0043	-0.0012 0.0041
MOWN	-0.0031 0.0021	-0.0071** 0.0032	-0.0029 0.0028	-0.0038 0.0023
GOWN	-0.0051* 0.0028	0.0004 0.0058	-0.0011 0.0020	-0.0002 0.0019
FOWN	-0.0039 0.0024	-0.0006 0.0031	0.0105 0.0073	0.0063 0.0050
BINDP	-0.1609 0.2616	-0.2952 0.3163	-0.4217* 0.2511	-0.3685 0.2246
BSIZE	0.0135 0.0217	0.0258 0.0359	-0.0131 0.0345	-0.0089 0.0346
LEV	-0.5736*** 0.1312	-0.8998*** 0.1871	-1.0916* 0.5730	-1.0998*** 0.3357
FSIZE	0.1139*** 0.0392	0.2975*** 0.0785	0.3368*** 0.0871	0.3179*** 0.0809
ROE_{t-1}	-0.0869 0.0882	-0.4004*** 0.0852	-0.2208*** 0.0587	-0.1697*** 0.0524
No. of obs	165	165	99	132
R-Sq	0.2510	0.5941	N/A	N/A
Adj. R-Sq	0.1469	0.4056		
No. of groups	N/A	N/A	33	33
No. of instruments			26	29
Sargan test			0.4219	0.6158
AR(1) AR(2)			0.0370 0.5715	0.0194 0.5490

Note: ROE is return on equity; ROE_{t-1} refers to ROE in year t-1; ICTSPE is ICT spending at time t; $ICTSPE_{t-1}$ is ICT spending at time t-1; $ICTSPE_{t-2}$ is ICT spending at time t-2; $ICTSPE_{t-3}$ is ICT spending at time t-3; ADICTG is the adoption of ICT governance standards and frameworks; ICTGCOM is the presence of ICT governance committee; ICTSM is the presence of ICT senior management; BICTEDU is boards' ICT educational background; BICTPRO is boards' ICT professional qualification; BICTIE is boards' ICT industrial experience; BICTTR is boards' ICT-related trainings; COWN is concentrated ownership; MOWN is managerial ownership; GOWN is government ownership; FOWN is foreign ownership; BINDP is board independence; BSIZE is board size; LEV is leverage; FSIZE is firm size; AR(1) is the Arellano-Bond first-order serial correlation; and AR(2) is the Arellano-Bond second-order serial correlation. Robust standard errors are in parentheses. *, ** and *** represent significance at 10%, 5% and 1% levels respectively.

Table 5.20 Regression Results of TQ

Variables	Pooled OLS (OLS)	Fixed Effect (FE)	Difference GMM (DGMM)	System GMM (SGMM)
Constant	-0.9159**	-2.2834**	-4.1611***	-3.7569***
	0.4061	0.9216	0.9900	0.7793
$ICTSPE_{t}$	-0.0002	0.0096*	0.0184***	0.0166***
	0.0044	0.0057	0.0059	0.0046
$ICTSPE_{t-1}$	0.0062	0.0066	0.0019	0.0070***
	0.0044	0.0042	0.0041	0.0026
$ICTSPE_{t-2}$	0.0008	0.0025	0.0061*	0.0033
	0.0048	0.0045	0.0036	0.0030
$ICTSPE_{t-3}$	0.0032	0.0020	0.0030	0.0068
	0.0045	0.0045	0.0057	0.0043
ADICTG	-0.0434	-0.1022	-0.1111	-0.0867
	0.0629	0.0858	0.0822	0.0611
ICTGCOM	-0.1912***	-0.1594*	-0.2082***	-0.2121***
	0.0624	0.0812	0.0595	0.0505
ICTSM	0.1375*	0.0357	0.1019	0.1486*
	0.0828	0.1117	0.1259	0.0885
BICTEDU	0.0706	-0.1738	-0.5187**	-0.2011
	0.1174	0.2759	0.2593	0.1618
BICTPRO	-0.2588	-0.8293**	-2.3955***	-1.3549***
	0.1660	0.4184	0.8489	0.4384
BICTIE	-0.0226	0.2239	0.7453***	0.5066**
	0.1309	0.2773	0.2404	0.2113
BICTTR	0.0561	0.0651	0.0277	-0.0099
	0.0443	0.0509	0.0582	0.0423
COWN	-0.0038***	0.0007	-0.0004	-0.0022
	0.0013	0.0029	0.0036	0.0027
MOWN	0.0061***	0.0047**	0.0042	0.0044**
	0.0013	0.0022	0.0026	0.0022
GOWN	0.0046**	-0.0005	-0.0007	0.0009
	0.0018	0.0039	0.0023	0.0021
FOWN	-0.0019	-0.0020	-0.0024	-0.0018
	0.0015	0.0021	0.0022	0.0016
BINDP	0.2319	0.0641	0.4326***	0.2933**
	0.1716	0.2162	0.1439	0.1277
BSIZE	0.0315**	0.0383	0.0558*	0.0619**
	0.0141	0.0245	0.0289	0.0248
LEV	0.4392***	0.5535***	0.5555**	0.6883***
	0.0916	0.1313	0.2733	0.2517
FSIZE	0.0219	0.0908*	0.1837***	0.1585***
	0.0246	0.0528	0.0474	0.0359
TQ_{t-1}	0.4136***	0.1772**	0.3499*	0.1527
	0.0699	0.0790	0.2070	0.1039
No. of obs	165	165	99	132
R-Sq	0.6479	0.7820	N/A	N/A
Adj. R-Sq	0.5990	0.6808		
No. of groups	N/A	N/A	33	33
No. of instruments			26	29
Sargan test			0.6406	0.3894
AR(1)			0.0359	0.0119
AR(2)			0.7048	0.9227

Note: TQ is Tobin's Q; TQ_{t-1} refers to TQ in year t-1; ICTSPE is ICT spending at time t; $ICTSPE_{t-1}$ is ICT spending at time t-1; $ICTSPE_{t-2}$ is ICT spending at time t-2; $ICTSPE_{t-3}$ is ICT spending at time t-3; ADICTG is the adoption of ICT governance standards and frameworks; ICTGCOM is the presence of ICT governance committee; ICTSM is the presence of ICT senior management; BICTEDU is boards' ICT educational background; BICTPRO is boards' ICT professional qualification; BICTIE is boards' ICT industrial experience; BICTTR is boards' ICT-related trainings; COWN is concentrated ownership; MOWN is managerial ownership; GOWN is government ownership; FOWN is foreign ownership; BINDP is board independence; BSIZE is board size; LEV is leverage; FSIZE is firm size; AR(1) is the Arellano-Bond first-order serial correlation; and AR(2) is the Arellano-Bond second-order serial correlation. Robust standard errors are in parentheses. *, ** and *** represent significance at 10%, 5% and 1% levels respectively.

5.7.1 The Effects of ICT Investment on Firm Performance (H_1, H_{1a} to H_{1d})

This sub-section explains the effects of ICT investment on firm performance in the Malaysian technology-based sector. Several hypotheses were developed in order to describe the significant effect of ICT investment on firm performance in the Malaysian technology-based sector (H_1) variables, namely ICT spending incurred in year *t* ($ICTSPE_t$) (H_{1a}), ICT spending incurred in year *t-1* ($ICTSPE_{t-1}$) (H_{1b}), ICT spending incurred in year *t-2* ($ICTSPE_{t-2}$) (H_{1c}), and ICT spending incurred in year *t-3* ($ICTSPE_{t-3}$) (H_{1d}) on firm performance, as measured by ROA, ROE, and TQ. Basically, results from H_{1a} to H_{1d} describe the results of H_1 in overall. The regression results are comprised of four estimation methods; Pooled OLS, fixed effect (FE), Difference GMM (DGMM), and System GMM (SGMM).

As for hypothesis 1(a), the $ICTSPE_t$ was expected to negatively affect firm performance. The results showed that ROA was significantly and negatively affected by $ICTSPE_t$ under the estimations of OLS and FE at the significant levels of 10 per cent and 5 per cent, respectively. However, the results revealed insignificant effect of $ICTSPE_t$ on ROA under the estimations of DGMM and SGMM. The $ICTSPE_t$ was also found to have significantly negative effect on ROE at the significant level of 10 per cent under the estimation of OLS, while the significant level was stronger at 1 per cent, as estimated by the FE method. Under the estimation method of dynamic models, the effect of $ICTSPE_t$ was significantly negative on ROE at 10 per cent significant level by the SGMM, but insignificant effect was found by the DGMM. Surprisingly, a significantly positive effect of $ICTSPE_t$ was found for TQ at the significant level of 10 per cent by the FE method, which had been strongly affected by DGMM and SGMM at 1 per cent significant level.

In respect of the SGMM results, the negative coefficient value of ROE (-0.0181) indicated that increase of a unit in $ICTSPE_t$ caused a 0.0181 decrease in ROE. This negative effect of $ICTSPE_t$ on firm performance (ROE) supports the hypothesis in this study. Generally, when a significant amount is invested for ICTs in the initial period, it takes time for companies to derive back the returns from the investment made to enable them to roll the returns to generate more profits for the shareholders. Furthermore, Figure 5.4 clearly illustrates the trend of yearly negative performance of ROA and ROE in the Malaysian technology sector that often fluctuated from 2010 to 2014. The technology sector was considered at high risk if investment in ICT was continued with significant amount during these periods as the returns on investment does not immediately reflect on firm performance. Meanwhile, the positive coefficient value of 0.0166 in the SGMM indicated that increase in a unit in $ICTSPE_t$ led to a 0.0166 unit increase in TQ. Moreover, the positive effect of $ICTSPE_t$ on TQ proved that the $ICTSPE_t$ has the ability to positively enhance the companies' stock markets. The finding supports Anderson's et al., (2003) that ICT investment in period *t* has a positive effect on firm performance.

Meanwhile, in the initial hypothesis, $ICTSPE_{t-1}$ (H_{1b}), $ICTSPE_{t-2}$ (H_{1c}), and $ICTSPE_{t-3}$ (H_{1d}) were expected to positively affect firm performance. As revealed by the OLS and FE results, insignificant effect of $ICTSPE_{t-1}$ on ROA, ROE, and TQ was found in this study. Meanwhile, the results showed that the ROA was significantly and negatively affected by the $ICTSPE_{t-1}$ under the estimations of DGMM and SGMM at 10 and 5 per cent significant levels, respectively. Likewise, the negative and significant effect of $ICTSPE_{t-1}$ was also found on ROE, estimated by DGMM and SGMM, both at the significant level of 5 per cent. Conversely, the results from SGMM revealed that the TQ was significantly and positively affected by the

$ICTSPE_{t-1}$ at the significant level of 1 per cent. In terms of $ICTSPE_{t-2}$ and $ICTSPE_{t-3}$, however, no estimation method displayed any significant effect on ROA and ROE. While there was also no significant effect of $ICTSPE_{t-3}$ on TQ for all estimation methods, a positive and significant effect of $ICTSPE_{t-2}$ on TQ was detected by the DGMM method at 10 per cent significant level, but insignificant effect from the SGMM result.

Based on the SGMM results, the negative coefficient value of ROA (-0.0064) and ROE (-0.0117) indicated that the increase in a unit in $ICTSPE_{t-1}$ caused a 0.0064 decrease in ROA, while 0.0117 decrease in ROE. Malaysia has emerged as a large exporter of high- and medium-technology equipment (Natasya, 2009). The continuous negative performance of ROA and ROE was due to the economic downturn occurred in 2009, which led to unstable growth in the performance of Malaysian technology sector, primarily due to the weakening demand for ICT products[53]. This imperfect market demand of ICT affects the way of many technology manufacturers in strategizing their business plans since the economy is still faced with a variety of significant challenges during these periods, hence too risky when their investment returns are unsure.

Moreover, economists have argued that the volatility of ICT investment spending is an important mechanism in explaining business cycles. As the demand for ICT products and services declined, the slow recovery from the 2009 financial crisis had destabilized ICT investment, which led to the decrease in firm performance. Besides, the trend of ICT investment in the Malaysian technology sector was declining since 2010 and became worse until 2014, as illustrated in Figure 5.5. Since the technology sector is often embedded with new ICT equipment, the slowdown of investment

[53] As reported by the IHS Global Insight World Industry Service (WIS).

activity in ICT reduced the adoption of new technology innovations; worsening firm performance.

Nevertheless, the significantly positive effect of $ICTSPE_{t-1}$ on TQ with coefficient value of 0.0070 implied that a unit increase in $ICTSPE_{t-1}$ led to a 0.0070 unit increase in TQ. Besides, the positive effect on TQ could be seen clearly in its trend that begun to increase in 2011 until 2013, but a slight slump in 2014. As demonstrated in Table 5.7, the amount of investment for ICT in the Malaysian technology sector was significantly invested in ICT intangible assets (ICTTN), compared to ICT tangible assets (ICTTA). The nature of ICT investment in the Malaysian technology sector, moreover, has changed over the periods due to the financial crisis in 2008 and 2009.

In order to keep pace with the latest technological development, innovation and creativity were needed to produce high quality products, although the companies were challenging conditions due to the crises. Experts argued that investment in ICT intangible assets recovered and grew after the recession period, compared to investment in ICT tangible assets (Goodridge, Wallis, & Haskel, 2014). For long term planning, investment in intangible assets is encouraged to help companies for their on-going development. For instance, Davenport (1998) revealed that investment in Enterprise Resource Planning software (ERP) constituted with proper implementation of software led to increase in company productivity. Since the initial investment costs in ICT intangible assets are huge and their implementation is time-consuming, it was not expected that the investment returns would immediately affect firm performance.

Some researchers suggested that market value-based (measured by Tobin's Q) is more appropriate to reflect the effect of ICT investment lag effects on firm performance. For instance, Zhang et al., (2012) found that investment in ICT was insignificant for

TQ after three years of ERP implementation, but surprisingly the result showed that the effect of ICT investment significantly increased after four years ERP was implemented. Back to the findings of this study, the effect of ICT investment was not only found to have significantly positive effect on TQ for ICT spending incurred in year *t-1*, but also for ICT spending incurred in year *t*. Although the effect of $ICTSPE_{t-2}$ on TQ was found insignificant by SGMM, a significantly positive effect of $ICTSPE_{t-2}$ on TQ was detected by DGMM. As such, based on the overall results of TQ, this study found that the TQ did not only significantly and positively affected by ICT investment incurred in years *t-1* and *t-2*, but also spending in ICT incurred in year *t*.

Based on the results of the SGMM estimation, this study concludes that the H_{1a} is supported since the result found significantly negative effect of $ICTSPE_t$ on ROE. Although the negative effect of $ICTSPE_t$ was expected in the initial hypothesis of H_{1a}, the result revealed that the effect of $ICTSPE_t$ was significantly positive on TQ. Other than that, the H_{1b} is supported by the TQ, but not by ROA and ROE as both measures had significantly negative effect by $ICTSPE_{t-1}$. Finally, the results showed that $ICTSPE_{t-2}$ and $ICTSPE_{t-3}$ were not supported since both variables had insignificant effects on ROA, ROE, and TQ. Therefore, the study concludes that the H_1 is supported by H_{1a} since the result revealed significantly negative effect of $ICTSPE_t$ on ROE, but significantly positive effect on TQ. Besides, H_1 is also supported by H_{1b} due to the significantly positive effect of $ICTSPE_{t-1}$ on TQ, whereas significantly negative effect on ROA and ROE. However, the H_1 is not supported under the effects of $ICTSPE_{t-2}$ and $ICTSPE_{t-3}$ on all financial performance measures.

5.7.2 The Effects of ICT Governance Mechanisms on Firm Performance (H_2, H_{3a}, and H_{3b})

In the preceding discussion, the role of ICT governance has been highlighted as an important mechanism that can help to improve the performance of companies via ICT investment. In terms of adoption of ICT governance standards or frameworks (ADICTG), unfortunately, the variable failed to display any significant effect on ROA, ROE, and TQ in all estimation methods. This insignificant result does not support prior studies that found a positive effect for the adoption of ICT governance standards and frameworks on firm performance (Neff et al., 2013; Flores et al., 2011; Lazic et al., 2011a; Lazic et al., 2011b; Simonsson et al., 2010). Hence, hypothesis H_2 is not supported in this study.

Successful governance of ICT needs both participation of management level and ICT governance committee (ICTGCOM). The results showed that the effect of ICTGCOM was statistically significant and negative on ROA, as estimated by the FE at 10 per cent significant level, while 1 per cent significant level by DGMM and SGMM. Likewise, the ROE was also significantly and negatively affected by ICTGCOM under the FE estimation at 10 per cent significant level, while 5 and 1 per cent by DGMM and SGMM, respectively. As for the TQ model, all the estimation methods showed significantly negative effect of ICTGCOM on the TQ at the significant level of 10 per cent by the FE method, while significant at 1 per cent by OLS, DGMM, and SGMM.

Based on the findings of SGMM, the negative coefficients of -0.1757, -0.2553, and -0.2121 indicated that increase in one unit for ICTGCOM caused 0.1757, 0.2553, and 0.2121 decreases in ROA, ROE, and TQ, respectively. Basically, the negative effect of ICTGCOM on firm performance might be due to the smaller number of ICTGCOM with expertise in ICT area. Table 5.21 presented the number of ICTGCOM with and without ICT expertise in the Malaysian technology-based sector from 2010 until 2014. As such, only 197 ICTGCOM with ICT expertise (37 per cent) were available in the Malaysian technology sector, compared to the 342 ICTGCOM without ICT expertise (63 per cent) for the period of 2010 to 2014. This smaller number of ICTGCOM with ICT expertise supports the finding obtained by Kaur et al., (2012), which indicated that the adoption of ICT governance structure is still low in the Malaysian practice. The result of this study, however, is inconsistent with the previous studies that found positive effect in the presence of ICT committee structure on firm performance (Boritz & Lim, 2008; Boritz & Lim, 2007).

Table 5.21 ICT Governance Committee With and Without ICT Expertise

Particular	**With ICT Expertise**	**%**	**Without ICT Expertise**	**%**	**Total**
Number of ICT Governance Committee (ICTGCOM)	197	37	342	63	539

The results also showed insignificant effect of ICTSM on ROA and ROE in all estimation methods. However, the ICTSM displayed a significantly positive effect on TQ at the significant level of 10 per cent in OLS method and SGMM, but insignificant effect of ICTSM on TQ via FE and DGMM methods. In respect of the SGMM result, the positive coefficient value of 0.1486 indicated that increase in one unit in ICTSM resulted in a 0.1486 unit increase in TQ. Thus, the result of the ICTSM found in this study supports the previous findings that found the positive effect of ICTSM presence on firm performance (Jamba et al., 2013; Kaur et al., 2012; Boritz & Lim, 2008; Boritz & Lim, 2007).

The overall results of ICT governance structure imply that companies in the Malaysian technology sector had positively performed under the presence of ICT senior managers rather than their ICT governance committee. From the initial assumption, it was expected that the ICT governance committee would positively affect firm performance through their effective ICT oversight duty. However, due to the existence of many ICTGCOM with no ICT expertise was most likely the reason for poor performance exerted by the committee potentially exposed to inappropriate ICT conduct in the companies. Although the presence of ICTSM has brought about positive value to firm performance, undue reliance of ICTGCOM upon ICTSM capabilities in conducting ICT could potentially lead to agency problem. Therefore, based on the findings of SGMM estimation method, this study concludes that, overall, H_2 and H_{3a} do not support the initial hypothesis since the results found insignificant effect of ADICTG and significantly negative effect of ICTGCOM on ROA, ROE, and TQ. Nonetheless, the H_{3b} is supported by TQ, but not supported by ROA and ROE as both measures exhibited insignificant effects on TQ.

5.7.3 The Effects of Boards with Diverse ICT Expertise on Firm Performance (H_4 to H_7)

This sub-section highlights the effects of several variables of boards with diverse ICT expertise; boards with ICT education background (BICTEDU, H_4), boards with ICT professional qualifications (BICTPRO, H_5), boards with ICT industrial experiences (BICTIE, H_6), and boards with ICT-related training (BICTTR, H_7). As for the BICTEDU, all the estimation methods did not find any significant effect of BICTEDU on ROA and ROE. However, the negative effect of BICTEDU on TQ was identified under the estimation of DGMM at the significant level of 5 per cent. Likewise, the effect of BICTPRO was also insignificant on ROA and ROE, while significantly negative on TQ was discovered by FE, DGMM, and SGMM. Moreover, the FE result revealed significantly positive effect of BICTIE on ROA and ROE, while both dynamic estimations (DGMM and SGMM), showed significantly positive effect of BICTIE on all firm performance measures. The BICTTR, however, appeared insignificant on ROA, ROE, and TQ through all the estimation methods.

As for the SGMM findings, the negative coefficient value of -1.3549 indicated that an increase in one unit in BICTPRO caused a 1.3549 decrease in TQ. Although the result revealed a negative effect of BICTPRO on TQ, the positive coefficient values of 0.6756, 0.9169, and 0.5066 indicated that increase in one unit of BICTIE led to 0.6756, 0.9169, and 0.5066 unit increments in ROA, ROE, and TQ, respectively. This study also found that the performance of Malaysian technology sector was positively affected by the boards with ICT industrial experiences (BICTIE). As digital transforms virtually at a rapid pace, technology companies have begun realising that without greater technology experiences among board of directors to guide business strategy and operations, these companies would probably face difficulties to improve firm performance.

Due to the nature of the industry sector itself, the ICT strategies adopted by all companies must be governed by boards with extensive experiences in handling ICT because they were the pioneers of ICT or technology tasks in the area of marketing, sales, product management, and technical roles before moving to top level position that dealt with more complicated ICT tasks and responsibilities. Besides, these experienced directors would be well-versed in dealing with not only cutting-edge technology development, but also on how to compete with contenders, how to restrategize their ICT strategies so as to ascertain effective succession planning of ICT in companies. Thus, this study concludes that H_4 and H_7 are not supported by all the performance measures because the effects of BICTEDU and BICTTR were insignificant. Likewise, H_5 is also not supported by the performance measures due to insignificant effect of BICTPRO on ROA and ROE, while significantly negative effect on TQ. However, H_6 is positively supported by ROA, ROE, and TQ.

5.7.4 The Effects of Ownership Structures on Firm Performance (H_8 to H_{11})

As for ownership structures, concentrated ownership (COWN) was found to have a positive effect on ROA and ROE, but negative on TQ, as revealed by the OLS. The managerial ownership (MOWN) displayed significantly negative effect on ROA, as discovered by the DGMM at the significant level of 10 per cent, while 1 per cent under FE and SGMM. Besides, the FE found that the ROE was negatively affected by MOWN at 5 per cent significant level. As expected, the MOWN exhibited a significantly positive effect on TQ, as estimated by the OLS, which is at 1 per cent significant level, while 5 per cent significant level with FE and SGMM.

Meanwhile, as for the government ownership (GOWN), the OLS exhibited a significantly negative effect on ROA. Surprisingly, both DGMM and SGMM revealed better result of positive effect of GOWN on ROA. Besides, the OLS result showed that the effect of GOWN was significantly negative on ROE at the significant level of 10 per cent, but significantly positive on TQ at 5 per cent of significant level. As for foreign ownership (FOWN), its effect was insignificant on ROE and TQ. Nevertheless, the negative effect of FOWN was found on ROA at the significant level of 10 per cent, as revealed by the OLS. Moreover, result from the SGMM discovered more efficient effect of FOWN on ROA, which was significantly positive at 10 per cent of significant level.

In respect of the SGMM findings, although the MOWN displayed a negative effect on ROA, the positive coefficient value of 0.0044 indicated that increase in one unit in MOWN led to 0.0044 increases in TQ. Meanwhile, the positive coefficient value of GOWN, which was 0.0034, and FOWN at 0.0046, indicated that increase in one unit in GOWN and FOWN led to 0.0034 and 0.0046 unit increase in ROA. Furthermore, as portrayed from the t-test result depicted in sub-section 5.5.1.5, ICT investment activities were better served by companies with government and foreign ownerships for the period of 2010 to 2014, compared to those without government and foreign involvement.

The positive effects of GOWN and FOWN indicated that the increment in shares held by government and the additional capital injection provided by foreign investors have enhanced the ability among companies in the technology sector, especially in controlling their scarce technological and financial resources. Besides, the Malaysian government has been actively promoting the inward foreign direct investment (FDI) by offering several financial incentives to hasten the growth of firm performance via technology spill over effects in the Malaysian technology companies (Solomon, Islam, & Bakar, 2015). Hence, in order to attract inward FDI, Malaysian government has provided several financial incentives to foreign investors, including exemption from company tax and duty on imported inputs, investment in tax credits, and accelerated depreciation allowance on investment (Solomon et al., 2015). Moreover, the inward FDI stocks have been considered as important due to numerous capabilities possessed by foreign investors in providing non-tangible productive assets, such as technological know-how, marketing and managing skills, export contacts, better coordination supplier, as well as customer relationship and reputation (Aitken & Harrison, 1999).

Moreover, it is not uncommon for major business ICT projects to be approved by the board, where the government and foreign shareholders often have representation. It seems that the decline in the percentage of MOWN involvement from 2010 to 2014, while increasing the percentage of GOWN and FOWN involvement after 2011, conveyed the message that the impact of external parties has led the managerial strategic decision to be more inclined towards the implementation of normal practices. In fact, the increase in ROA in 2014 was seen as a positive sign to the Malaysian technology sector that has re-spurred its economic growth through ICT development. A slight increase due to government support and continuance involvement of foreign investors in providing their capital resources were not only able to enhance the ICT development in the Malaysian technology sector, but also reduced the likelihood of expropriation of corporate assets by managers.

Meanwhile, the managerial ownership was recognized as the second highest in the Malaysian technology sector then. The positive effect of MOWN on TQ indicated that managers did reflect positively on profit that can be generated from the stock market. Besides, past researchers have argued that managers were entrenched when they held a sufficient amount of company shares (Beyer, Czarnitzki, & Kraft, 2012). In respect of their response towards generating profits from the stock market, Beyer et al., (2012) revealed an inverse U-shaped relationship between the degree of MOWN and investment in ICT intangible assets (e.g., R&D costs) since managers became entrenched to pursue their own interests. Moreover, as investment in ICT intangible assets can foster growth (Aghion & Howit, 2009), a significant amount invested in

R&D, for instance, might positively affect a manager's remuneration, power, and prestige (Beyer et al., 2012).

Besides, a common incentive, such as providing managers an option to buy stock at a fixed price as part of their compensation, can lead them to gain benefits directly from a higher stock price while making decisions to enhance the value of the company. Thus, based on the overall result of the effect of ownership structures on firm performance in respect of the findings of SGMM, this study concludes that H_8 (COWN) is not supported by all performance measures. Meanwhile, as for H_9 (MOWN), this study found positive support by TQ, but not by ROA and ROE. Other than that, H_{10} (GOWN) was positively supported by ROA, while insignificant and not supported by ROE and TQ. Finally, the SGMM result revealed that H_{11} (FOWN) also showed positive support by ROA, but not by ROE and TQ.

5.7.5 The Effects of Control Variables and Lagged Dependent Variable ($Y_{j,\ t-1}$) on Firm Performance

Next, this sub-section presents the results of the effects of several control variables; board independence (BINDP), board size (BSIZE), leverage (LEV), firm size (FSIZE), and lagged dependent variables ($Y_{j,\ t-1}$). The effect of each control variable is discussed in detail in sub-sections 5.7.5.1 to 5.7.5.5.

5.7.5.1 Board Independence (BINDP)

The finding for the effect of BINDP had been insignificant on ROA, as disclosed via all estimation methods. Through the estimation of DGMM, the result revealed a significantly negative effect of BINDP on ROE at the significant level of 10 per cent.

As expected, a statistically significant and positive effect of BINDP was found on TQ in DGMM and SGMM at the significant levels of 1 per cent and 5 per cent, respectively. In respect of the SGMM result, a positive coefficient value of BINDP in TQ was 0.2933, which indicated that the presence of independent executive directors (INEDs) with more than or equivalent to one-third of the total number of board members had significantly influenced the firm performance. It was also argued that companies that had performed well under the guidance and monitoring control by a large number of INEDs had been due to diversification of opinions effect that increased the tendency of making good decision (Sah & Stiglitz, 1991). During this recovery period, INEDs positively reflected the stock market, which gave more focus on re-strategizing the long term succession planning of a company.

5.7.5.2 Board Size (BSIZE)

As for board size (BSIZE), the effect of BSIZE was insignificant on ROA and ROE, as revealed by all estimation methods. However, the results showed that TQ was significantly and positively affected by BSIZE at the significant level of 5 per cent from the OLS and SGMM, while significant at 10 per cent from DGMM. Based on the SGMM result, a positive coefficient value of 0.0619 implied that increase in one unit in BSIZE led to increase of 0.0619 in TQ. Besides, Table 5.22 of the board size shows that 79 per cent of companies in the Malaysian technology sector had more board of directors than the median value of 6.

Table 5.22 Board Size

Particular	**With less than median value of BSIZE < 6**	**%**	**With equal or more than median value of BSIZE > 6**	**%**	**Total**
Number of Board Size (BSIZE)	35	21	130	79	165

The finding is consistent with that of past studies, where positive effect was found for larger board size on firm performance (Said et al., 2014) with varied expertise among its board members, including their experiences, information, and skills (Haynes & Hillman, 2010). Moreover, having a large number of board members would expose these companies to be more efficient, especially in dealing with high information-processing demands, better operation of complex and competitive ICT environment, as well as in developing more alternative solutions (Ruigrok, Peck, & Kell, 2006); thus improving the quality of ICT investment strategic decision, and ultimately, towards better firm performance.

5.7.5.3 Leverage (LEV)

The results showed that the effect of LEV was significantly negative on ROA and ROE for all estimation methods. In respect of the SGMM result, negative coefficient values of -0.6528 and -1.0998 indicated that increase in one unit in LEV caused 0.6528 and 1.0998 decrease in ROA and ROE, respectively. In fact, the results imply that companies in the Malaysian technology sector were likely be involved in making large amounts of investments or issue large amounts of debt to fund their product development, since the nature of these companies are highly associated to technology R&D, manufacturing electronics, building software, as well as selling computers and other ICT products. During these transitional periods, especially after the 2009 crisis, the trend of ICT investment in the Malaysian technology sector had been inconsistent from 2010 until 2014. This phenomenon might be due to the fact that most companies were confronted with financial constraints, especially ICT investment.

Hence, for the purpose of ICT investment, Jain (2015) argued that the leverage in the technology sector was high due to huge capital expenditure for investment in tangible and intangible ICT assets to grow the business. As such, financial leverage is usually employed to generate greater returns on their assets. However, past studies have suggested that the companies are commonly uninterested to presume large debts to finance, especially on ICT assets. This is because; debt, especially in the rapidly changing world of ICT, is closely associated with high risks as the rapid development of new ICT could make a product to become obsolete within a short time.

For instance, investment in ICT intangible assets is considered to be very challenging (Basu & Saha, 2011) as the assets could not serve as effective collateral to support high level of debt (Ou & Haynes, 2006). Therefore, generally, when companies take on debt; it becomes a liability on which the companies must pay interest. Increase in financial leverage occurs when companies' ROA does not exceed the interest on the loan, which also diminishes the companies' ROE and profitability. Thus, highly levered companies would not be able to deliver higher returns (Milano & Theriault, 2012), thus brings in a negative impact on firm performance (Ou & Haynes, 2006).

In contrast, both dynamic measures showed that the effect of LEV was statistically significant and positive on TQ, but its significant effect was more efficient at 1 per cent, as portrayed by the SGMM, when compared to the 5 per cent by the DGMM. From the perspective of SGMM, a positive coefficient value of 0.6883 indicated that increase in one unit in LEV led to 0.6883 unit increment in TQ. This finding, nonetheless, contradicts the findings retrieved from ROA and ROE. However, prior studies have suggested that technology companies were commonly uninterested to presume large debts to finance, especially on the investment of ICT intangibles (e.g., R&D, brand enhancement, copyright, patents, employee training, and system development) since its investment is highly associated with huge capital of expenditure.

Furthermore, managers often deal with the most difficult situations on how to generate returns to the shareholders at the best way, since a huge amount of capital is needed either for their present operational processes or investment in new R&D. Hence, for the purpose of investment, the company‘s management is more likely to use internal funds rather than resorting to external financing. This action could lead to information asymmetry between managers and other investors, who might assume that the company lacks the capital to finance investment effectively, which would eventually lead the company to retain their earnings rather than taking debt. This is likely to have a negative impact on the company‘s market performance (Nwaolisa & Chijindu, 2016).

Hence, it has been suggested that the usage of internal financing has been considered as the best tool, rather than debt for financing investment, as well as for the solution of the information asymmetries (Myers, 1984). Moreover, the growing capital injection by investors is seen as an opportunity for these companies to induce more investment, especially in ICT. Managers‘ commitment, especially through their contribution in effectively managing ICT[54], has been found to have a positive effect on generating company‘s profits. Managers who perform well through their competencies by balancing the interests of multiple stakeholders, and ignore the reality of their self-interest in maximizing shareholder‘s wealth increase the market value of the company.

[54] The sentence refers to the positive effect of ICT senior managers (ICTSM) on Tobin‘s Q.

5.7.5.4 Firm Size (FSIZE)

The results showed that ROA and ROE were strongly positive and significantly affected by the firm size (FSIZE) at 1 per cent significant level from all estimation methods. The effect of FSIZE was identified as insignificant on TQ, as revealed by the OLS, but significantly positive on TQ at 10 per cent significant level under the FE method, but more efficient at 1 per cent by DGMM and SGMM. In the SGMM, the positive coefficient of FSIZE on ROA was 0.2549, while 0.3179 and 0.1585 on ROE and TQ, respectively. The coefficient values indicated that increase in one unit in FSIZE would increase the ability of companies to improve 0.2549 units in ROA, as well as 0.3179 in ROE and 0.1585 in TQ. Furthermore, as presented in Table 5.12, large firm size[55] has invested more in ICT investment compared those smaller[56]. This implies that the better the firm size of companies, the better the companies access to ICT investment opportunities, and the more likely the companies to improve firm performance. In precise, larger firm size allowed companies to utilize their ICT investment assets in a more effective manner that would deliver better returns to the companies in the future.

5.7.5.5 Lagged Dependent Variable ($Y_{j,\, t-1}$)

As for the lagged variable of firm financial performance, the results of FE, DGMM, and SGMM showed that the effect of ROA_{t-1} on ROA was significantly negative at 1 per cent significant level with coefficient equivalent to -0.2366. Likewise, the effect of ROE_{t-1} was also found to have a significantly negative effect on ROE at 1 per cent significant level with coefficient value at -0.1697. Hence, a unit increase in ROA_{t-1} led

[55] Larger FSIZE is characterized by companies' total assets which is more than the median value of FSIZE.
[56] Smaller FSIZE is characterized by companies' total assets which is less than the median value of FSIZE.

to a decrease of 0.2366 unit in ROA, whilst increase in ROE_{t-1} led to a decrease of 0.1697 unit in ROE.

Besides, the negative coefficient results of ROA_{t-1} and ROE_{t-1} showed that the ability of the company to generate profit in past years would be on the contrary effect on the level of profitability in the present year. Meanwhile, the effect of TQ_{t-1} was found to have a significantly positive effect on TQ at 1 per cent significant level, as revealed by the OLS, 5 per cent significant level by FE, as well as 10 per cent significant level under the estimation of DGMM. However, the SGMM result showed insignificant effect of TQ_{t-1} on TQ.Nevertheless, the results of the negative effects of ROA_{t-1} on ROA and ROE_{t-1} on ROE are in accordance with prior studies, which have examined and discovered the negative effect of lagged dependent variable of firm performance to the firm performance in current year (Margaretha & Supartika, 2016; Yazdanfar, 2013; Salman & Yazdanfar, 2012), however, against the past findings in ICT-related studies that found significantly positive effect of lagged firm performance measures on current performance measures (Jun, 2008; Anderson et al., 2003).

Moreover, as illustrated in Figure 5.4, the trend of Malaysian technology sector performance of ROA and ROE was negatively unstable over the period of 2010 to 2014. The decrease in the performance might be due to the fact that the Malaysian technology sector was still managing their transition from crisis to recovery after the 2009 financial crisis. Although some improvements were noted in the financial performance measures, the performance remained low and negative, despite of a slight increase.

5.8 Summary of the Chapter

This chapter starts with the results of several assumption tests divided into two processes: pre-test and post-test for data variables. The pre-test employed the original data by determining the normality and linearity of the gathered data, besides identifying the existence of potential outliers in the dataset. The exclusion of outliers produced a new dataset, which was then retested to confirm data normality in the post-test. Next, descriptive statistics and results of univariate tests are presented, which is then followed by the discussion of diagnostic tests for panel data, including the results of multicollinearity and the appropriate model from among three models; pooled OLS, fixed-effect, and random effect.

On top of that, the discussion concerning diagnostic tests also covers the results of heteroscedasticity, as well as autocorrelation, for the dataset. In addition to the dynamic diagnostic tests, results of the Sargan and Arellano-Bond tests are also depicted in this chapter. This is followed by the discussion of the regression analysis of pooled OLS, fixed effect (FE), as well as the two dynamic estimation methods, known as the Difference Generalized Method of Moments (DGMM) and the System Generalized Method of Moments (SGMM). Moreover, all the tests were performed to test the findings for three dependent variables of financial performance measures, which are comprised of return on assets (ROA), return on equities (ROE), and Tobin's Q (TQ). Finally, the next chapter discusses the overall conclusion, implications, limitations, and recommendations for future research.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This chapter concludes the main findings from the results presented in the previous chapter, along with some recommendations for appropriate regulatory bodies, relevant agencies and industries, as well as those interested parties, all presented in six sections. Section 6.2 summarizes the findings of each hypothesis from the three financial performance measures (ROA, ROE, and TQ) based on the main equation; Equation (3), presented in sub-section 4.7. In addition, the implications of the study are highlighted in Section 6.3, while Section 6.4 reports the limitations of the study and several recommendations for future research. Lastly, Section 6.5 concludes the entire study of this thesis.

6.2 Summary of the Study

This study was motivated by several alarming issues since many ICT investments made have yet to prove success, but cases of ICT failure have been recorded in a number of prior studies. Besides, several issues related to corporate governance practices in dealing with the present ICT challenges have also been highlighted in this study as these issues have been identified as the main contributors to the failure of ICT investment, which may influence firm performance. Furthermore, due to lack of evidence found in past studies in relation to the effect of ICT investment and other corporate governance factors on firm performance, hence, apart from ICT investment, several important elements of corporate governance in ICT, such as ICT governance mechanisms and boards with diverse ICT expertise, as well as common issues of corporate governance practices related to ownership structures, are recommended in this study.

For instance, several sub-elements have been proposed to portray the ICT governance mechanisms in this study, which is comprised of adoption ICT governance standards or frameworks, the presence of ICT governance committee, and ICT senior management. Moreover, four types of boards with diverse ICT expertise have been introduced in this study, which are boards with ICT educational background, boards with ICT professional qualifications, boards with ICT industrial experiences, and boards with ICT-related training. Meanwhile, the elements of concentrated ownership, managerial ownership, government ownership, and foreign ownership have also been embedded in this study. In terms of ICT investment, the lagged effects of ICT investment was established as any ICT investment made would not immediately affect the performance of a firm.

Furthermore, this study has outlined some research objectives. The first objective is to examine the extent of ICT investments in the Malaysian technology-based sector. Hence, inter-temporal comparisons were made using t-test to determine any difference in ICT investment between inter-population groups, namely inter-ICT components, inter-Bursa markets, inter-board characteristics, inter-ICT governance mechanisms, inter-board characteristics, inter-ownership structures, and inter-company characteristics.

As a result, the t-test revealed a statistically significant difference in the means of ICT investment between companies that invested in ICT and those that did not. The mean values had been higher among firms that invested in ICT, hence indicating that the Malaysian technology sector has been actively involved in making ICT investment during the period of 2010 to 2014. Besides, it has been revealed that the Malaysian technology sector has spent more substantial amount in acquiring ICT intangible assets compared to ICT tangible assets. Besides, to further identify the extent the Malaysian technology sector has been investing in ICT tangible and intangible assets, extended t-test was performed by comparing two inter-population groups: (1) ICT tangible assets (ICTTA), and (2) ICT intangible assets (ICTTN).

The t-test results exhibited a statistically significant difference at 1 per cent significant level in the means of ICTTA between the frequencies of firms that invested in ICTTA, compared to the frequencies of firms that did not invest in ICTTA. Besides, a statistically significant difference has also been discovered by the compared indicators of ICTTN, in which the means had been higher for the frequencies of firms that did not invest in ICTTN, when compared to the frequencies of firms that did invest in ICTTN.

As for the inter-Bursa markets, the findings of t-test displayed a significant difference in the mean values of ICT investment between the Main Market and the ACE Market in the Bursa. In fact, the mean of Main Market was higher than that for ACE Market. Meanwhile, as for inter-population groups of ICT governance mechanisms, the results showed insignificant difference for ICT investment between firms that adopted ICT governance and those that did not. Likewise, an insignificant difference was also revealed for the correlation between ICT investment and ICT governance structures (ICT governance committee and ICT senior management).

Moreover, the inter-board characteristics for the population groups displayed significant differences that existed between the presence and non-presence of boards with ICT educational background (BICTEDU), boards with ICT professional qualifications (BICTPRO), and boards with ICT-related training (BICTTR). Besides, a significant difference in the means of ICT investment was also higher among firms with the frequencies of more than the median value of boards with ICT industrial experiences (BICTIE).

Next, as for inter-ownership structures, a significant difference for ICT investment had been found between the frequencies of firms that had involvement with government (GOWN) and foreign ownership (FOWN). The results revealed that the means of ICT investment had been higher for firms with both government and foreign ownerships, in comparison to those with no involvement of both ownerships. In addition, significant differences in the means of ICT investment were also demonstrated through the comparison between the frequencies of firms with more than the median value for concentrated ownership (COWN) & foreign ownership (FOWN) and those less than the median value of both ownerships.

In terms of inter-company characteristics, only firm size (FSIZE) displayed a significant difference for ICT investment between the frequencies of firms with more and less than the median value of FSIZE. Furthermore, the results indicated that ICT investment was better served under firms with more than the median value of FSIZE compared to those with less than the median value of FSIZE. In contrast, the t-test results for financial leverage exhibited an insignificant difference between the frequencies of firms with more and less than the median value for financial leverage.

On top of that, regression analyses were conducted to fulfil the examination from the second to the fifth research objectives outlined in this study. Basically, the main regression model applied in this study had been based on the dynamic panel model (DPM), which refers to *Equation 3* as the model embedded the element of ―dynamic" effects, including lagged dependent variables ($Y_{j,t-1}$) as an independent variable on the right equation of the model. Besides, the System Generalized Method of Moments (SGMM) was selected as the most efficient estimation method for the dynamic model built in this study.

Thus, the regression results, as discussed in this part, are in accordance with the results of System GMM (SGMM). For further robustness check, apart from the main method employed to estimate the model of this study, several estimation methods, such as Pooled OLS (OLS), Fixed Effect (FE), and Difference Generalized Method of Moments (DGMM), were performed. Moreover, Table 5.24 presents the summary of the regression results generated from the System GMM.

Next, the second research objectives have been established to examine a significant effect of ICT investment on the performance of firms in the Malaysian technology-based sector. In fact, the findings from the System GMM support hypothesis H_1 due to the significant effect of ICT investment on firm performance in the Malaysian technology-based sector. Besides, the result of hypothesis H_1 is supported by a significant and negative effect of ICT spending in year *t* (H_{1a}) on ROE. Although ICT investment was not expected to exhibit significantly positive effect on firm performance during the initial period of spending, the result showed that ICT spending in year *t* had the ability to positively influence Tobin‘s Q. Other than that, the hypothesis H_1 is also supported by a significant and positive effect of ICT spending incurred in year *t-1* (H_{1b}) on Tobin's Q, while significant and negative effects of ICT spending incurred in year *t-1* on ROA and ROE. Meanwhile, hypotheses H_{1c} and H_{1d} of ICT spending incurred in year *t-2* ($ICTSPE_{t-2}$) and year *t-3* ($ICTSPE_{t-3}$) are not supported the hypothesis H_1 as the effects of both variables had been insignificant for all financial performance.

Next, the third research objective focused on examining the significant effect of ICT governance mechanisms, which comprised of processes and structures, on the performance of firms in the Malaysian technology-based sector. ICT governance processes refer to the adoption of ICT governance standards or frameworks (ADICTG), whereas ICT governance structure is comprised of ICT governance committee (ICTGCOM) and ICT senior management (ICTSM). The ADICTG, nevertheless, did not have any significant effect on all firm performance measures, thus fails to support hypothesis H_2. In addition, the result of ICTGCOM also does not support hypothesis H_{3a} as statistically significant and negative effect of ICTGCOM was found upon ROA, ROE, and Tobin's Q. Surprisingly, the results for ICTSM support hypothesis H_{3b} mainly because its effect had been statistically significant and positive upon Tobin's Q, but insignificant on ROA and ROE.

Meanwhile, Research Objective 4 focused on the examination of significant effects of boards with diverse ICT expertise, such as boards with ICT educational background (BICTEDU), boards with ICT professional qualifications (BICTPRO), boards with ICT industrial experiences (BICTIE), and boards with ICT-related training (BICTTR) on the performance of firms in the Malaysian technology-based sector. From the findings, hypothesis H_6 is fully supported in this study due to significantly positive effect of BICTIE on all performance measures, whereas H_5 is not supported due to the significantly negative effect of BICTPRO on Tobin's Q. As the effects of BICTEDU and BICTTR had been insignificant on all performance measures, thus H_4 and H_7 are not supported in this study.

Moving on, the fifth research objective examined the significant effects of concentrated ownership (COWN), managerial ownership (MOWN), government ownership (GOWN), and foreign ownership (FOWN) on firm performance in the Malaysian technology-based sector. Besides, hypothesis H_8 for COWN is not supported in this study because all financial performance measures were not significantly affected by COWN. Meanwhile, the results for MOWN revealed that hypothesis H_9 is positively supported by Tobin's Q, but this is not the case for ROA as the effect of MOWN on ROA was significantly negative, while insignificant for ROE.

Other than that, hypothesis H_{10} for GOWN is supported by ROA due to the statistically significant and positive effect of GOWN on ROA. Nevertheless, the results showed that H_{10} is not supported by ROE and Tobin's Q due to insignificants effects of GOWN on both ROE and Tobin's Q. Lastly, the results do support hypothesis H_{11} for FOWN mainly because its effect had been significantly positive on ROA, but not supported by ROE and Tobin's Q because of insignificant effects of FOWN on ROE and Tobin's Q, as depicted in this study.

Table 5.24 Summary of the Results

Variables		Hypotheses	Dependent Variables	Results from the SGMM
ICTSPE	H_1	Investment in ICT spending has a significant effect on the firm performance in the Malaysian technology-based sector.		Supported by the $H_{1(a)}$ under the effect on ROE and TQ Supported by the $H_{1(b)}$ under the effect on ROA, ROE and TQ
$ICTSPE_t$	H_{1a}	Investment in ICT spending in year *t* has a negative effect on the firm performance in the Malaysian technology-based sector.	ROA	Insignificant and not supported
			ROE	Supported with negative and significant effect
			TQ	Not supported but positive and significant effect
$ICTSPE_{t-1}$	H_{1b}	Investment in ICT in year *t-1* has a positive effect on the firm performance in the Malaysian technology-based sector	ROA	Not supported with negative and significant effect
			ROE	Not supported with negative and significant effect
			TQ	Supported with positive and significant effect
$ICTSPE_{t-2}$	H_{1c}	Investment in ICT in year *t-2* has a positive effect on the firm performance in the Malaysian technology-based sector	ROA	Insignificant and not supported
			ROE	Insignificant and not supported
			TQ	Insignificant and not supported
$ICTSPE_{t-3}$	H_{1d}	Investment in ICT in year *t-3* has a positive effect on the firm performance in the Malaysian technology-based sector	ROA	Insignificant and not supported
			ROE	Insignificant and not supported
			TQ	Insignificant and not supported
ADICTG	H_2	The adoption of ICT governance standards or framework (processes) has a positive effect on the performance of companies in the Malaysian technology-based sector.	ROA	Insignificant and not supported
			ROE	Insignificant and not supported
			TQ	Insignificant and not supported
ICTGCOM	H_{3a}	The presence of ICT governance committee structure has a positive effect on the performance of companies in the Malaysian technology-based sector.	ROA	Not supported with negative and significant effect
			ROE	Not supported with negative and significant effect
			TQ	Not supported with negative and significant effect
ICTSM	H_{3b}	The presence of ICT senior manager has a positive effect on the performance of companies in the Malaysian technology-based sector.	ROA	Insignificant and not supported
			ROE	Insignificant and not supported
			TQ	Supported with positive and significant effect

Table 5.24 Summary of the Results (continued)

Variables		Hypotheses	Dependent Variables	Results from the SGMM
BICTEDU	H_4	Boards with ICT educational background have positive effects on the performance of companies in the Malaysian technology-based sector.	ROA	Insignificant and not supported
			ROE	Insignificant and not supported
			TQ	Insignificant and not supported
BICTPRO	H_5	Boards with ICT professional qualifications have positive effects on the performance of companies in the Malaysian technology-based sector.	ROA	Insignificant and not supported
			ROE	Insignificant and not supported
			TQ	Not supported with negative and significant effect
BICTIE	H_6	Boards with ICT industrial experiences have positive effects on the performance of companies in the Malaysian technology-based sector.	ROA	Supported with positive and significant effect
			ROE	Supported with positive and significant effect
			TQ	Supported with positive and significant effect
BICTTR	H_7	Boards with ICT-related trainings have positive effects on the performance of companies in the Malaysian technology-based sector.	ROA	Insignificant and not supported
			ROE	Insignificant and not supported
			TQ	Insignificant and not supported
COWN	H_8	Concentrated ownership has a positive effect on the performance of companies in the Malaysian technology-based sector.	ROA	Insignificant and not supported
			ROE	Insignificant and not supported
			TQ	Insignificant and not supported
MOWN	H_9	Managerial ownership (insider) has a positive effect on the performance of companies in the Malaysian technology-based sector.	ROA	Not supported with negative and significant effect
			ROE	Insignificant and not supported
			TQ	Supported with positive and significant effect
GOWN	H_{10}	Government ownership has a positive effect on the performance of companies in the Malaysian technology-based sector.	ROA	Supported with positive and significant effect
			ROE	Insignificant and not supported
			TQ	Insignificant and not supported
FOWN	H_{11}	Foreign ownership has a positive effect on the performance of companies in the Malaysian technology-based sector.	ROA	Supported with positive and significant effect
			ROE	Insignificant and not supported
			TQ	Insignificant and not supported

6.3 Implications of the Study

Both theoretical and practical implications of the study are discussed in the following sub-sections.

6.3.1 Theoretical Implications

This present study explicitly examined the effect of ICT investment, ICT governance mechanisms, boards with diverse ICT expertise, and ownership structures on firm performance in the Malaysian technology-based sector. Moreover, issues related to ICT governance mechanisms and boards with diverse ICT expertise had been found to be rather scarce in past studies, specifically in the context of the effect of ICT investment and corporate governance in ICT on firm performance.

To further examine the effect of ICT investment and corporate governance in ICT on firm performance, several new variables, especially those related to corporate governance practices in ICT, had been proposed in conjunction with several lagged year effects of ICT investment. For instance, three predictors have been introduced under the context of ICT governance mechanisms; adoption of ICT governance standards or frameworks, presence of ICT governance committee, and ICT senior management. Besides, the elements of boards with diverse ICT expertise were comprised of boards with ICT educational background, boards with ICT professional qualifications, boards with ICT industrial experiences, and boards with ICT-related training.

Moreover, issues related to concentrated, managerial, government, and foreign ownerships, which have been commonly highlighted in the field of corporate governance studies, have also been embedded in this study. In addition, this study contributes to the extant literature by providing more evidence concerning firms in the Malaysian technology sector.

On top of that, this study covers a wider range of theoretical perspectives, for example, the resource dependency theory (RDT) and the agency theory. Basically, RDT suggests that investment in acquiring resources is the key element for company survival (Pfeffer & Salancik, 1978). Meanwhile, in the context of ICT investment, acquisition of ICT is essential as strategic resources to sustain high performance, especially in the technology sector (Straub et al., 2006). However, in this present study, ICT investment in the Malaysian technology sector has yet to be encouraged as the trend of investment fluctuated inconsistently, which also resulted in mixed findings for firm performance over the period of 2010 to 2014.

The mixed findings found in this study are generally described by the significantly negative effect on ROE, which is in line with the prediction of RDT, as investment in ICT assets spent in year *t* would also reduce the performance of firm in year *t*. Besides, the statistically significant and positive result on Tobin‘s Q was not only affected by the lagged one-year ICT investment, as predicted in hypothesis, but it was affected since the year of investment incurred, which refers to year *t*. Moreover, the effect of adopting ICT governance standards or frameworks (ADICTG) appeared insignificant upon firm performance, which was also against the prediction of RDT, which depicted that ADICTG could enhance the performance of firm through the effectiveness of ICT compliance culture in the company to satisfy ICT governance best practice (Singh et al., 2010).

Meanwhile, in terms of the presence of ICT governance committee (ICTGCOM), its effect had been statistically significant and negative on ROA, ROE, and Tobin's Q. In contrast, the result of ICT senior management (ICTSM) was significantly positive on firm performance when measured with Tobin's Q. These two results of variables implied that the potential of the agency problem to occur as the management level appeared to be the top contributor in improving firm performance, especially through their important role in overseeing major ICT projects, compared to the role of ICTCGOM.

Besides, the results showed that the boards with ICT professional qualifications (BICTPRO) had an effect on Tobin's Q, which was statistically significant and negative. The result also showed statistically significant and positive effect of boards with ICT industrial experience (BICTIE) on ROA, ROE, and Tobin's Q. These results have supported RDT and suggest the role of BICTIE as a resource provider that can aid in improving companies' ICT strategies and planning with their ICT expertise.

Meanwhile, in terms of ownership structures, the result of managerial ownership (MOWN) was significantly negative for ROA, but statistically significant and positive on Tobin's Q, which implies that the MOWN seems to support RDT under the measure of Tobin's Q, but not ROA. Besides, the significantly positive effect of government ownership (GOWN) and foreign ownership (FOWN) on ROA exhibited that both variables do support RDT. Moreover, the results suggest that compared to the involvement of MOWN; GOWN and FOWN appeared as better resource providers to the Malaysian technology sector, especially not only in providing adequate financial support, but also technology expertise in order to spur ICT investment growth in this sector (Choi et al., 2012; Uwuigbe & Olusanmi, 2012).

In conjunction with the result of ICTSM, ICT senior managers seemed to shoulder the responsibilities of company ICT strategy, in comparison to the ICT governance committee, which leads to the tendency of agency problem. However, the inward flow of GOWN and FOWN in the Malaysian technology sector emerged as the best supporter not only because of their strong financial support and expertise, but also as the best solution to solve agency problem in the sector.

6.3.2 Practical Implications

In order to establish the effect of ICT investment, ICT governance mechanisms, boards with diverse ICT expertise, and ownership structures on firm performance; additional evaluation by specific proxies to represent each main independent variable had been performed. Thus, this study is essential for companies and potential shareholders, especially in the Malaysian technology sector, in several ways. Since failure to manage ICT investment effectively is usually associated to poor firm performance and lack of ICT corporate governance, it is important for companies, especially in the Malaysian technology sector, to ensure that any ICT investment made must be accompanied by proper conduct of ICT corporate governance.

For example, as highlighted in this study, several vital elements of ICT investment, ICT governance mechanisms, boards with diverse ICT expertise, and ownership structures have been introduced so as to ensure the successful implementation of investment that can improve the worth of a company. The results obtained from this study provide valuable information not only for potential investors, stakeholders, and the public in general, but also for the company‘s board of directors and the top management level. In addition, the results may also offer guidance to companies so as to ensure that their ICT implementation is properly governed under appropriate ICT standards and handled by the right person.

Meanwhile, in terms of evaluating ICT investment, this study adhered to the measurement of ICT investment, as proposed by past studies, by taking into account the elements of lagged year effect of investment. In this present study, lagged one-year to lagged third-year effects of ICT investment was introduced to determine the best return towards firm performance. Moreover, based on the established theory, the effect of ICT investment, which is incurred in the present year, usually will not immediately influence firm performance. However, it is not impossible for a company to receive immediate returns from ICT investment if its implementation is supported by strong ICT corporate governance practices.

Next, concerning the adoption of ICT governance standards or frameworks, most firms in the Malaysian technology-based sector were found to be in compliance with the ICT governance standards or ICT frameworks. However, the effect of ICT governance committee (ICTGCOM) had been statistically significant and negative on firm performance. Surprisingly, the result displayed that the presence of ICT senior management (ICTSM) in technology companies had a significantly positive effect upon firm performance. Thus, the overall results of ICT governance mechanisms implied that companies in the Malaysian technology sector were seen to have better served under the guidance of ICTSM, instead of ICTGCOM.

Although it was expected that companies would better achieve their performance goals via good ICT governance practices by ICTGCOM, there might be a reason why firm performance had been affected negatively by ICTGCOM. Furthermore, firms in the technology sector should note that the lack of ICT expertise among ICTGCOM, as determined in the present study, was likely to be a reason for the poor performance exerted by companies in the Malaysian technology sector for the period of 2010 to 2014. In addition, although ICTSM displayed a positive impact on firm performance, undue reliance of ICTGCOM on ICTSM capabilities in handling ICT-related matters should be highly emphasized. Otherwise, the reliance solely on ICTSM competencies may also potentially lead the ICT managers to misconduct ICT resources against the company‘s ICT investment objectives.

Regarding the boards with diverse ICT expertise, firms in the Malaysian technology sector are suggested to acquire more diverse ICT expertise among their board members to reduce ICT gaps among boards, as well as to facilitate their ICT-related decisions in the boardroom discussion. The elements of boards with diverse ICT expertise emerged as an important element in the Malaysian technology companies in driving successful ICT development through innovation processes. At present, this study found that companies in the Malaysian technology sector perform better when they have boards with ICT industrial experiences. The findings further indicated that companies in the Malaysian technology sector strived to spur their ICT development through diverse ICT expertise among their boards, especially through their extensive experience and wide range of knowledge in the ICT fieldwork.

Turning to the boards with ICT educational background, ICT professional qualifications, and ICT-related training; the findings lend some insights to the companies to enhance their board effectiveness with diverse expertise in ICTs as these three variables did not support in improving firm performance in the Malaysian technology sector. However, it should create awareness for these companies regarding the importance of having boards with ICT educational background and ICT professional qualifications because they are well-equipped and trained professionals with ICT knowledge, especially when dealing with ICT strategic issues. Besides, companies should also realize on the important needs of providing adequate ICT training programs to their board members. This is because; sufficient training programs in ICT can enhance the understanding among the board members with the latest ICT development, besides exposing them to more opportunities, especially in ICT investment activities.

The results of the ownership structures showed that involvement of managerial, government, and foreign ownerships had a positive effect on firm performance in the Malaysian technology sector for the duration of 2010 to 2014. During the post-crisis period, many sectors, including the technology sector, have tried to revive their ICT strategy development, which would help to re-stimulate their economic growth. Moreover, it has been observed that the Malaysian technology sector enjoys the increment in ICT investment growth rate after getting involved with government and foreign ownerships.

Moreover, various investment incentives introduced by the Malaysian government have induced continuance in foreign capital inflows, thus facilitating the development of ICT in the Malaysian technology sector. Although the managerial ownership has been identified as the second largest shareholder in the Malaysian technology sector, the decreasing trends of ownership over these observed periods convey a message that the influences of foreign investors have led to prevent from the likelihood of expropriation of company resources at the management level or any tendency of agency problem from occurring. Furthermore, companies should be aware on the important needs of proper governance conduct in order to prevent agency problem from occurring so as to ensure that the actions taken by managers are in line with the interest of other company's shareholders. For example, appropriate incentives (compensation, bonus, promotion, etc.) for managers have to be considered to ascertain that the focus of managers is on maximizing the company's value rather than their respective value.

6.4 Limitations of the Study and Area for Future Research

The findings of this present study are, however, subject to several shortcomings. First, data related to financial performance, ICT investment, and other corporate governance variables are particularly observed only during the post-crisis period (from financial year (FY) 2010 until FY 2014). Hence, data related to financial performance, ICT investment, and other corporate governance variables during the crisis and pre-crisis period may also be weighed in for future research to further describe the effect of ICT investment, as well as other corporate governance variables, on firm performance based on three different phases: periods of pre-crisis, during crisis, and post-crisis.

Second, this paper collected data from annual reports based on the availability of companies in the Malaysian technology sector listed on the Bursa Malaysia website. Furthermore, due to some requirements concerning the date of International Financial Reporting Standard (IFRS) implementation and the year that imposed ICT mandatory standards as well as the incentives given by the Malaysian Government to businesses in the acquisition of ICT resources; some companies were excluded from this study. As such, this study is comprised of balanced panel data, but it is unnecessary to have balanced data for this study as there is no mandatory requirement for ICT disclosure imposed by the Malaysian regulatory body depicted in the annual reports gathered from Malaysian companies.

Moreover, future studies may also consider questionnaire and interview approaches to explore from a different standpoint. Third, while data on the Malaysian technology sector provide richer understanding to this research, the context of this study should also consider generalizing the results to other sectors as well because ICT rules and regulations, as well as standards of ICT adoption, has been imposed by the Malaysian government to all critical sectors, such as the Government and the financial sector. Other than that, this study also can be generalized to other sectors in the Malaysian Public Listed Companies in order to observe the extent of their practices, especially in ICT investment, ICT governance mechanisms, and boards with diverse ICT expertise because varying nature of business has different needs of ICTs.

Next, the other types of ownership, for example, family and non-family managerial ownerships may also be considered in the future research to further describe the types of dominated ownership that might affect firm performance, for example, those within the Malaysian technology sector. Lastly, pertaining to the theories of agency and resource dependence employed in this study, future studies could extensively examine the effect of ICT investment and other corporate governance variables on firm performance in the light of other theories, such as stewardship theory, institutional theory, stakeholder theory, and resource-based view.

6.5 Conclusion of the Study

The present study was pursued with the attempt to examine the effect of ICT investment, ICT governance mechanisms, boards with diverse ICT expertise, and ownership structures on firm performance in the Malaysian technology sector. In general, this study suggests that ICT investment, ICT governance mechanisms, boards with diverse ICT expertise, and ownership structures do matter in the context of companies in the Malaysian technology sector. In fact, this study enhances the existing literature of ICT investment and corporate governance by providing rather comprehensive understanding on the real effects of implementation of ICT investment and corporate governance best practices in the Malaysian technology sector. In precise, this study has introduced some important aspects of ICT corporate governance, such as ICT governance mechanisms and boards with diverse ICT expertise, in the context of general corporate governance best practices. Furthermore, the findings of this study have some implications for policy makers, practitioners, and investors. Thus, future studies should extend the elements of these recommendations in order to further elaborate the real practices of ICT investment, as well as other corporate governance factors, not only from the light and nature of business environments in the technology sector, but also in the context of other business sectors.

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APPENDIX I

Sample Studies of the Effect of ICT Investment on Firm Performance

Author(s)	Sample	Method(s)	Independent Variables ICT Measures	Dependent Variables Firm Performance Measures	Results
Arabyat (2014)	22 banks based in Jordan, over 1993-2010 periods	Panel least squares regression	Computer budget ratio and the capital budget ratio	ROA and ROE	Positive and significant on both measures
Makinde (2014)	4 mega banks in Nigeria	Pooled multiple least square and panel multiple regression model	ICT investment , investments in other assets and operating costs (investments in non ICT, labor, overheads)	ROA and ROE	Positive
Safari & Zhen Yu (2014)	11 privately-owned banks and 6 publicly-owned banks over 1990 to 2011	Stochastic frontier analysis (SFA) methods	Hardware and software investment, IT services and ownership	Efficiency (Total Costs) Personnel expenses, interest expenses paid to term deposits, fixed assets depreciation Expenses, administrative costs and other expenses	Mixed
Spyros & Euripidis (2014)	743 European hospitals	Econometric analysis	R&D, ICT personnel, ICT investment, ICT budget, Website and E-business	Product innovation and process innovation	Mixed
Romdhane (2013)	15 Tunisian banks over the period 1998–2009	Data Envelopment Analysis (DEA) method and the Stochastic Frontier Analysis (SFA) method	Investments in tangible assets (hardware), intangible assets (software) and investments in training and maintenance	Cost Efficiency 1. The price of labour 2. The price of financial capital 3. The price of physical capital (wk)	Positive
Ugwuanyi & Ugwuanyi (2013)	4 banks in Nigeria for a seven year period (2005 to 2011)	OLS - Multiple regression	IT expenditures, total number of IT branches and ATM machines	ROA	Negative

Hung et al. (2012)	Banking	Two-stage least squares method	ATM investment	ROA, ROE, operating income ratio and net income ratio	Positive
Zhang et al. (2012)	126 stock exchange listed manufacturing firms from 1999 to 2007	Multiple regression model	Capital structure, capital intensity and time-lagged effects	Tobin‘s Q	Tobin‘s Q was not significant in the first 3 years but began to rise in the fourth year
Ekata (2011)	Banking		IT Expenditures **(**IT hardware cost, IT software cost, IT service cost, IT training cost, IT outsourcing cost), IT budget and IT employee	ROA, ROE and profits	Negative
Liang et al. (2010)	Mixed (meta-analysis), 50 published empirical studies between 1990 and 2009	Integrated model (direct and indirect model)	**Technology resources:** IT investment, IT infrastructure, IT assets, and Software system application **Organization resources:** Knowledge resource and human resource **Mediator:** Capability (Internal and external)	**Productivity:** Production manufacturing effectiveness, e-Business effectiveness **Efficiency:** Operational (production) cost reduce, COGS/S, SGA/S **Profitability:** ROI, ROA, ROS, income, profits, sales revenue & operational costs	Mixed
Zehir et al. (2010)	81 national and multinational companies, which traded on ISE (Istanbul Stock Exchange)	Questionnaire and regression analysis	IT decision making, IT level, IT perception and IT usage	Technology orientation, Future orientation, & Firm Performance (Sales profitability, market growth, profitability per customer, turnover profitability, investment profitability, growth of profitability & ROA)	Mixed
Gaith et al. (2008)	68 Malaysian construction firms	Regression analysis, Pearson‘s 2- tailed test	Investment in equipment, communication, IT specific labour, R&D and IT training	Firm performance	Positive

Chari et al. (2008)	117 firms and data obtained from obtained IT investment data from annual IT surveys reported in the publication Information Week for 1997	Regression analysis	The ratio of dollar investment in IT to sales **Other independent variable:** Diversification	Tobin's Q	Positive
Jun (2008)	22 Korean securities firm	Fixed and random effects models and panel GMM (generalized method of moments) techniques	The computer budget ratio and the capital budget ratio	ROA, ROE, and profits	Positive
Thouin et al. (2008)	Data obtained from the annual survey of IT usage in the U.S healthcare conducted by the Dorenfest Institute for Health Information Research and Education (for the year 2003)	Regression analysis	IT Budgets, IT outsourcing and IT personnel	Profits	Mixed
Beccalli (2007)	737 European banks over the period 1993-2000	Ordinary least squares (OLS) regressions, and two-stage least squares (2SLS)	Spending in hardware, software and IT	Total costs, cost efficiency, and profit efficiency, ROA and ROE	Mixed
Shin (2006)	A data set of IS budgets from 1995 to 1997	Ordinary least squares (OLS) regression Data obtained from the	IS budget **Moderator:** Strategic direction	ROA, ROE and profits	Positive

		Information Week, and the Compustat database			
Mahmood & Mann (2005)	Data was taken from the Computerworld's list of ―The Premier 100" organizations for the years 1991, 1992, and 1993	Multidimensional cluster analysis and multivariate analysis	IT budget as a percentage of revenue, percentage of IT budget for staff, percentage of IT budget for training, market value of IT as a percentage of revenue & percentage of employees provided with PCs and terminals	ROI, ROS, Income, Revenue, Market value, Leverage, productivity measures (sales by total assets and sales by employees)	Mixed
Kim (2004)	Data on firm-level IT spending is a survey done by Korea In-formation Society Development Institute (KISDI) in 1996	Regression analysis	IT capital stock	Marginal product of IT capital, profitability, productivity, and market valuation of IT capital	Mixed
Yaylacicegi & Menon (2004)	48 hospitals for each year with a total of 1088 observations for the 23-years span (1979 to 2001)	Ordinary Least Squares regression (OLS) and the Polynomial Distributed Lagged (PDL) regression model Data was obtained from the Washington State Department of Health hospital database	IT Capital (data processing, communications, and patient records accounts) and Medical IT Capital (equipment used for diagnosis and therapeutic purposes, e.g., magnetic resonance imaging)	Productivity	The positive impact from IT spending is felt at the sixth year after the spending, and only for the next two years (8 year above not significant)

Anderson et al. (2003)	661 firm-year observations for automate firms and 542 observations for informative firms Data on firm performance:1987 to 2000 Data on IT spending: 1990 to 1996	Box-Jenkins methods Data of IT spending was obtained from InformationWeek surveys	IT spending	ROA	Positive
Brynjolfsson & Hitt (2003)	527 firms in all industries for 1987 to 1994	Cobb Douglass function and regression analysis Data was obtained from Computer Intelligence InfoCorp (CII), Compustat Database	Computer capital, non-computer capital, IS staff and non-IS labor and expense	Total sales and value added	Positive
Devaraj & Kohli (2000)	8 hospitals in healthcare industry for 36 monthly periods	Regression analysis	IT labor, IT support and IT capital	**Financial performance:** • Net patient revenue per day: the ratio of the total revenue realized by the hospital to the total number of days • Net patient revenue per admission: the ratio of the total revenue realized by the hospital to the total number of patient admissions **Quality index:** • Mortality rates: the percentage of mortalities within 30 days of an operative procedure divided	Mixed

				by the total number of operative procedures • Customer satisfaction: the percentage of top-box scores	
Francalanci & Galal (1998)	52 U.S life insurance companies from 1982 to 1995	Generalized estimating extension (GEE) of the Generalized Linear Models (GLM) random estimator Data was obtained from Life Office Management Association database, Annual and 10k reports, Best Insurance reports, Compustat database	IT expense, work composition (clerical, managerial, professional intensity) and combined effects (interaction between IT expense and work composition)	• Premium income per employee and • Total operating expenses to premium income	Mixed * Used of predefined lag effects
Byrd & Marshall (1997)	350 companies for the 3 years, 1989, 1990, and 1991	Structural Equation Modelling (SEM) Data was obtained from the IDG's ComputerWorld	• The value of supercomputers, mainframes, and minicomputers • The percentage of IT budget spent on IT staff • The IT budget as a percentage of revenue • The percentage of IT budget spent on IT staff training	ROI, ROS, market value, sales by total assets & sales by employees	Mixed
Brynjolfsson & Hitt (1996)	367 firms in all industries for 1987 to 1991	Cobb Douglas function, regression analysis: OLS and 2SLS Data was obtained from International Data Group (IDG) survey, Computer Database	Computer Capital, non- computer capital, IT staff and non-IT staff and expenses	Total sales (output)	Positive

Brynjolfsson & Hitt (1993)	380 firms from all industries for 1987 to 1991	Cobb Douglas function, Iterated Seemingly Unrelated Regressions (ISUR) and 3SLS Data was obtained from International Data Group (IDG) survey, Computer Database	Computer capital, non- computer capital, IT staff and non IT staff expenses	Productivity Output	Positive
Mahmood & Mann (1993)	100 firms in all industries for 1989	Pearson correlation and Canonical correlation analysis Data was obtained from Computerworld premier 100, Compact Disclosure database	• The annual IT budget as a percentage of the organization's revenue • Value of the organization's IT as a percentage of its revenue • Percentage of the IT budget spent on IT staff • Percentage of the IT budget spent on training IT staff • PCs and terminal per employees	Growth in revenue, sales by total assets, ROS, ROI, sales by employees and market-to-book value	Mixed Pearson: weak, negative (mixed) Canonical: more significant relationship (mixed)
Weill (1992)	33 valve manufacturing firms (6 years data) for 1982 to 1987	2SLS From survey and interview	IT investment (ratio of IT expenditures to total annual sales) was categorized into strategic, informational and transactional **Moderator**: Conversion effectiveness	Sales growth, ROA, Non-production labor per million dollars sales (LABOUR) and percent change in LABOUR	Mixed
Brynjolfsson et al. (1989)	Mixed sectors for the year 1975 to 1985	Data was obtained from Compustat	Total capital stock, IT stock capital and IT investment	Firm size	Increased IT investment was associated with decreasing firm size * Introduced the lagged effect model

APPENDIX II

Sample Studies of the Effect of Corporate Governance on Firm Performance

Author(s)	Sample	Method	Dependent variables	Independent variables	Results Details
			Financial Performance Measures	Corporate Governance Measures	
Haider et al. (2015)	Islamic banks in Punjab, Pakistan (2008-2012)	Correlation and linear regression	ROA, ROE, & EPS	Board size	Positive
				Number or meeting	
				Audit committee size	
Johl et al. (2015)	700 public listed firms in Malaysia for the year 2009	Ordinary Least Square (OLS) regression	ROA	Board independence and board meeting	Negative and insignificant
				Board size and accounting expertise	Positive
Naushad, & Malik (2015)	24 GCC banks based on the criteria of total assets for the financial year 2012 to 2013	Multiple regression	Tobin's Q & Return on Total Assets (ROTA)	Board size	Negative: ROTA & Tobin
				CEO Duality	Positive: ROTA & Tobin
				Agency costs (Block Ownership GCC)	Mixed
Yusoff et al. (2015)	60 financial companies in the MPLCs (2006 and 2013)	Spearman's rho correlation	ROE & EPS	Board size	Negative
				Board independence and CEO duality	Have not influenced
Wahba (2015)	40 Egyptian listed firms during the	The generalized least squares method	ROE & Tobin's Q	Board composition and board leadership structure	Negative

	period from 2008 to 2010				
Al-Matari et al. (2014)	162 non-financial companies (2011 and 2012)	Multiple linear regression	Tobin's Q	Board size, board meeting, audit and executive committee independence	Significant positive
				Board independence, legal counsel	Significant negative
				CEO tenure, CEO compensation, audit committee size	Insignificant positive
				Board change, role of secretary, executive committee size, audit committee meeting, executive committee meeting	Insignificant negative
Qasim (2014)	281 firm/year observations in the Abu Dhabi exchange Shareholding Company's guide for years 2007-2011	Pooled OLS regression models	ROA & Tobin's Q	Institutional ownership, governmental ownership and board size	Significant positive
				Audit quality	Insignificant positive
Zakaria et al. (2014)	73 Malaysian listed Trading and Services sector (2005 to 2010)	Panel random effects model	ROA	Concentrated ownership	Positive effect on firm performance but not significant for pre-crisis period
				Managerial ownership	Positive and significant effect on firm performance
				Government ownership	Negative effect on firm performance
				Foreign ownership	Positive effect on firm performance for post-crisis period

Aggarwal (2013a)	20 Indian companies, which are non-financial companies; listed on the NSE (during 1st April, 2010 to 31st March, 2012)	Multiple regression	ROA, ROE, Return on Capital Employed (ROCE) and Profit before Tax (PBT)	Board Size Independence of Board from Management Separation of CEO and Chairman Financial Expertise of Directors Number of Board Meetings Role of External Auditors Committees of the Board	The governance rating of company has a significant positive impact on its financial performance.
Aggarwal (2013b)	50 Indian companies listed on S&P CNX Nifty 50 Index (2010-11 to FY 2012-13)	Multiple regression	ROA, ROE, ROS, & ROCE	Governance rating	Positive, but not significant
Goh et al. (2013)	132 firm-year observations based on 32 plantation firms (annual report from 2003-2006)	Partial least squares (PLS) regression	ROA	**Ownership concentration:** High level ownership concentration	Negative
				Low level ownership concentration	Positive
				Moderator: Board independence & Separation of CEO-chairs	Negative
Wan Yusoff & Alhaji (2012)	813 listed companies representing nine sectors of the main board of Bursa Malaysia from 2009 to 2011	Spearman‘s correlation matrix	ROE & EPS	Non-executive directors and board size	Inconsistence relationship
				Board leadership structure	No relationship
Sami et al. (2011)	1236 firm-year observations (2001 to 2003)	Regression	ROA, ROE, & Tobin's Q	Board composition	Positive and significant
Ibrahim & Abdul Samad (2011)	2030 observations for 290 companies across seven years from 1999 to 2005	Descriptive and correlation	ROA, ROE, & Tobin's Q	Board size, duality and independent directors	Board size, independent director and duality for family and non-family ownership has a strong significant influence on firm performance

Haniffa & Hudaib (2006)	347 companies listed on the Kuala Lumpur Stock Exchange (KLSE) between 1996 and 2000	Cross-sectional OLS regression model	ROA & Tobin's Q	Board size	ROA: Positive & significant TQ: Positive & significant
				Board composition	ROA: No significant TQ: No significant
				Role duality	ROA: Negative & significant TQ: No significant
				Multiple directorships	ROA: No significant TQ: Positive & significant
				Top five largest shareholders	ROA: Positive & significant TQ: Positive & significant
				Managerial shareholdings	ROA: Negative & significant TQ: No significant

APPENDIX III

Sample Studies of the Effect of ICT Governance on Firm Performance

Author(s)	Method(s)	Sample	Issues	Variables		Results
				Dependent	Independent	
Jamba, Tsokota, & Mamboko (2013)	: Case study through a semi-structured interviews	A Zimbabwean based investment holding company	: Addressed on how proper IT governance practices impact on organization effectiveness and how these are influenced by enterprise leadership at boardroom level	**Effectiveness:** IT decision making, active participation, challenges of IT decision making structure and IT strategy and policy	**IT Governance:** Processes, structures and outcome metrics	: The results can be concluded that senior management involvement in IT governance issues contribute immensely to organization effectiveness.
Neff et al. (2013)	: Case studies	: 5 exploratory case studies in global multi-business firms	: Addressed on how IT governance, resource relatedness and business performance are related. : To determine which IT governance levers in organizations that will increase business performance.	**Business performance:** Operational efficiency of specific business processes, measures of which include customer service, flexibility, information sharing, and inventory management	**IT Governance:** Processes, Structures and Relational Mechanisms **Mediator:** IT relatedness and business process relatedness	: The study revealed that IT governance maturity was positively associated with business process performance with the consolidation initiatives in IT and business processes relatedness.
Kaur et al. (2012)	: Model development : Survey : Partial least square based structural equation modeling	: 144 surveys of Malaysian listed companies were relevant to the study	Analyzed the impact of IT governance effectiveness in private sector organizations in a developing country such as Malaysia	**Impact:** Organizational performance	**IT governance effectiveness:** Reporting structure, Committee structure, Corporate communication, Collaboration and Process	: The result found that Committee Structure and Collaboration were positively significant related with organizational performance while others effectiveness have weak relationship with organizational performance

Flores et al. (2011)	: Survey : 3 tools were utilized to analyze the results of the survey: box plots, tests for normality and statistical measurements	22 professionals answered the survey (15 IT Security, 9 IT Assurance and 11 IT governance)	Examined how COBIT associated with IT governance support information security and generate future value in terms of reducing negative consequences from security incidents.	**Future value of Investment:** Net Present Value (NPV)	**COBIT:** comprises 19 control objectives under Plan and Organize, Acquire and Implement, Deliver and Support, and Monitor and Evaluate	: Study result showed that investments in IT governance control objectives strengthen security objectives and beneficial for a firm to engage in.
Lazic et al. (2011a)	: Case studies : Theoretical framework development	11 multinational corporations	Considered how IT governance and business performance is related and how this relationship is moderated	**Business Performance:** (1) reputation among major customer segments, (2) frequency of new product or service introduction, (3) return on investment, (4) net profits, (5) technological developments and/or other innovations in business operations, (6) product quality, (7) market share gains (8) revenue growth.	**IT Governance:** Processes, Structures and Relational Mechanisms **Mediator:** IT relatedness and business process relatedness	: A theoretical based framework is proposed to further explain the relationship between IT governance and firm performance. : The result found that IT governance is positively related business performance through the increase of IT relatedness and business process relatedness

Lazic et al. (2011b)	Case studies	CIOs of the 100 largest firms in Germany were approached via email, which yielded 11 interviews in total	To analyse the impact of the governance of IT on the business performance of the firm	**Business Performance:** Cost savings, customer satisfaction, development of new business fields / products, time to market, agility in economic turmoil	**IT Governance Maturity:** IT governance processes, IT governance structures and IT governance relational mechanisms	The higher the maturity of IT governance processes, structures and relational mechanisms, the higher the business process relatedness
					Mediator: IT relatedness, Business process relatedness and Resource relatedness	**IT relatedness:** Positive relationship has been indicated **Business process relatedness:** Strongly supported the original hypothesis **Resouce relatedness:** The results could not be confirmed
					Moderator: Absorptive Capacity of IT Department	Strongly supported the original hypothesis
Estrada (2010)	: Mixed Approach Explicative – Causal: qualitative & quantitative : A quasi–experimental design was posited	The research universe encompasses medium and large Mexican firms, both those listed on the Mexican stock exchange, as well as unlisted firms.	Highlighted the importance of companies to have a board with sufficient IT proficiency to capitalize on the benefits of presently available technologies.	**Value creation** (or higher efficiency in relevant and selected management metrics)	Level/degree of alignment between IT governance practices and corporate governance practices	The result of this study is expected the positive impact on companies incorporating aligned IT governance and corporate governance practices to enhance board contributions to companies' results.

Simmonson, Johnson, & Ekstedt (2010)	Case studies	35 case studies at various types of organiations in financial services, manufacturing, telecommunications and public service	Considered the relationship between the maturity of IT governance and IT governance performance	IT Governance Performance	IT Governance Maturity: Based on COBIT domains and processes (Plan and Organize, Acquire and Implement, Deliver and Support, and Monitor and Evaluate	: The result found that IT governance maturity levels were positively correlated to IT governance performance. : Organizational structure and relationship, mature quality management and cost allocation were most correlated to IT governance performance.
Van Gremberg en & De Haes (2010)	Correlation	ISACA members, from different worldwide regions from different types of industries 538 surveys were reliable out of total 572.	Explored the relationship between Enterprise Governance of IT practices and business performance	Business performance	**Enterprise governance of IT (EGIT):** COBIT and Val IT frameworks **Mediator:** Business/ IT alignment	: Little support to identify a direct link between EGIT practices and business performance.
De Haes & Gremberg en (2009)	: Delphi method : one in-depth case and five mini-cases and are based on multiple interviews with both business and IT managers, questionnaire	22 experts out of 29 continued to be involved in the full Delphi research effort from various industries	Explored on how IT governance is implemented in companies and analyzed the relationship between the IT governance implementations and companies' business/IT alignment.	Business/IT Alignment	**IT Governance Implementations/ Practices:** Processes, Structures and Relational Mechanisms	The highly aligned companies did indeed leverage more mature IT governance practices compared to companies with poor business/IT alignment.

Boritz & Lim (2008)	: Regression	937 companies (474 companies in 2004 and 463 companies in 2005) that received adverse opinions on their ICOFR from January 2004 to December 2005	: Documented the impact of IT governance on the likelihood of reducing reporting material IT control weaknesses and its impact on firm financial performance. : Documented the relationship between IT governance effectiveness, IT controls effectiveness and firm financial performance.	**Financial performance: Growth** (measured as the percent change in sales from one year to the next calculated by dividing net sales by the inventory, accounts receivable, and total assets.) and **Profitability** (measured by Return on Assets and Return on Sales)	**IT Control Weaknesses IT Governance** (*IT knowledge* at top executives and boards, *IT governance mechanisms*-IT strategy committee and CIO's tenure)	The results showed that strengths (weaknesses) in these proxies (IT governance mechanisms and IT knowledge) are associated with the likelihood of a company reporting fewer (more) material IT control weaknesses.
Boritz & Lim (2007)	: Regression	84 US public companies that employed an important IT governance mechanism, the IT strategy committee in 2004	: Discussed on the contribution of top management's IT knowledge and the firm's use of IT governance mechanisms on firm's financial performance.	**Financial performance: Growth** (measured as the percent change in sales from one year to the next calculated by dividing net sales by the inventory, accounts receivable, and total assets.) and **Profitability** (measured by Return on Assets and Return on Sales).	**IT Governance mechanisms:** IT strategy committee and the CIO **IT knowledge:** IT knowledge of board of directors Board and IT knowledge of top executives	: The results found that top management's IT knowledge and companies that implemented IT governance mechanisms contribute to higher firm's financial performance
Guldentops (2007)	: Conceptual : Model development	15 interviewees (Chief Information Officers) were participated.	: Discussed the seven principles of the Val IT framework	N/A	N/A	: The study found that adoption of these seven principles was not yet well advanced.

APPENDIX IV

Sample Studies of the Effect of Board Diversity on Firm Performance

Author(s)	Method(s)	Sample	Issues	Variables		Results
				Dependent	Independent	
Al-Musali & Ku Ismail (2015)	Hierarchical regression analysis	128 Kuwaiti listed banks in the GCC countries during the period 2008 to 2010	Proposed that the effectiveness of board meetings (measured by the frequency of board meetings) would moderate the board diversity–IC performance relationship.	Intellectual capital performance (IC): Value Added Intellectual Coefficient (VAIC) method	Educational level diversity and nationality diversity (local and foreigners)	Not related to IC performance
					Moderator: Board meeting effectiveness	Significant negative on IC performance
Cimerova et al. (2015)	OLS regressions	UK firms that represent more than 95% of the market capitalization of the London Stock Exchange between 2002 and 2012	Examined the impact of cultural diversity in boards of directors on firm performance.	Tobin‘s Q and ROA	Cultural diversity	TQ: Negative ROA: Negative
					Board characteristics: Gender diversity	TQ: Negative ROA: Positive
					Board independence	TQ: Negative ROA: Negative
					Board age	TQ: Positive and significant ROA: Positive
					CEO/ Chairman duality	TQ: Positive ROA: Negative
					Board size	TQ: Negative ROA: Negative

Makhlouf et al. (2015)	The development of conceptual framework	N/A	Proposed a conceptual framework to investigate the relationship between board diversity, in terms of gender diversity and members' age, and the firm performance	Tobin's Q and ROA	1) Average age 2) Gender	1) Youngers directors are expected to carry out risky strategies to improve future firm performance 2) Women directors are expected to enhance firm performance
Thanh Tu et al. (2015)	OLS regression model	70 largest banks in the ASEAN banking system in period from 2009 to 2013	1) To study the level of gender diversity in board of directors and top executive of ASEAN banking sector. 2) To assess the impact of gender diversity on bank's performance, in case of ASEAN banking system.	ROA & ROE	Gender diversity in the board of managements (BOM)	Significant positive impact on firm performance
					Gender diversity in the board of directors (BOD)	Neutral effect on firm performance
Eulerich et al. (2014)	: Multiple regression model	: Annual financial statement based on 2009, 2010 and 2011. : 149 publicly traded German companies, which are listed in the blue-chip indices DAX301, MDAX2, SDAX3 and TecDAX	Examined and presented a comprehensive literature on the relationship between diversity within management boards and corporate performance for the German two-tier system	**Corporate performance:** Earnings before interest, tax, depreciation and amortization (EBITDA)	Gender	Negative significant impact on firm performance
					Age, nationality and functionality	Negative impact on firm performance

Lenard et al. (2014)	cross-sectional time series panel regressions	: Contained of boards' information which derived from Risk Metrics database from 2007 to 2011 : Compustat database and CRSP database for the years 2005-2011	To study gender diversity on the board of directors and the relation to risk management and corporate performance as measured by the variability of stock market return.	Firm risk: the variability of stock market return	Gender diversity	The higher the percentage of female directors on the board, the lower the variability of corporate performance
Tarus & Aime (2014)	: Fixed effects regression model : Moderated regression analysis	: 55 firms listed in Nairobi Stock Exchange (NSE) (2009) at the end of 2010 : Secondary data based on annual report from 2002 to 2010	Examined the effect of boards' demographic diversity on firms' strategic change and the interaction effect of firm performance	**Strategic change:** composed of six dimensions : 1) advertising intensity (advertising expenses/sales); 2) plant and equipment newness (net plant and equipment/gross plant and equipment); 3) nonproduction overhead (selling, general, and administrative expenses/sales); 4) inventory level (inventories/sales); 5) financial leverage (debt/equity).	1) Age 2) Educational 3) Tenure 4) Board functional background diversity **Moderator:** Firm Performance (ROA)	1) Age diversity produced less strategic change 2) Functional diversity was associated with greater levels of strategic change 3) The moderated regression results did not support hypothesis that high firm performance enhances board demographic diversity–strategic change relationship 4) High level of firm performance, board demographic diversity produced less strategic change
Abdullah & Ku Ismail (2013)	Multiple regression	: Data based on 2007 annual report of 100 non-financial firms listed on the Malaysian stock	Addressed on several diversity issues related to gender, age and ethnicity at directory level.	Tobin's Q and ROA	Director's gender	Negatively associated with Tobin's q and ROA.
					Ethnicity	Positively associated with ROA
					Age	Negatively related to ROA.

		exchange				
Galia & Zenou (2013)	: Conceptual paper : Longitudinal analysis : Probit regression models to examine the relationship between board diversity indicators (age and gender) and the probability to innovate in four types of innovation	176 French firms based on data from French Community Innovation Survey (CIS) in 2008 and annual reports	Provided better understanding of the link between board diversity and innovation, by considering various patterns of diversity as well as various types of innovation.	Innovation: 1) Product innovation 2) Process innovation 3) Organizational innovation 4) Marketing innovation	Board gender	1) Significant evidence of a positive relationship between gender diversity on boards and marketing innovation 2) Negative relationship between gender diversity and product innovation.
					Board age	Age diversity showed a positive relationship with product innovation and a negative impact one on organizational innovation.
Darmadi (2012)	: Cross-sectional regression model	Annual report based on 2008 based on 169 listed firms in the Indonesia Stock Exchange (IDX)	Examined the associations between diversity of board members and financial performance of the firms listed on the Indonesia Stock Exchange (IDX)	Tobin's Q and ROA	Gender	Both accounting and market performance have significant negative associations with gender diversity.
					Nationality	Nationality diversity was found to have no influence on firm performance
					Age	The proportion of young members was positively related to market performance

Van Ness et al. (2010)	Ordinary least square (OLS) regression analysis	: Data from Standard and Poor's (S&P) 500 companies (2006 and 2007) : Involved by 188 companies in the non-regulated industries	Focused on the contribution to the literature through examination of the influence of corporate boards and its impact on firm financial performance.	Financial performance: 1) Revenue 2) ROA 3) Financial leverage 4) Market Price to Book Ratio 5) Free Cash Flow to Net Income	1) Occupational experience 2) Board size 3) Tenure 4) Age 5) Gender 6) Proportion of Outside Directors 7) CEO/ COB Duality	1) Board size and heterogeneity of director expertise were positively related to revenue growth 2) The ratio of directors with education expertise and the ratio of directors of finance expertise have a negative effect on this performance measure 3) The results showed that both CEO/COB duality and average tenure of board of directors have a positive effect on return on asset growth. 4) Board size was negatively related to the debt to asset ratio but negatively related to free cash flow-to-net income 5) No significant impact of outside directors, gender, or average board age on financial performance

Marimuthu & Kolandaisamy (2009a)	: Non-probability sampling approach : Pooled Least Square (PLS) regression method	Top 100 non-financial listed companies over the period 2000 to 2006	Explored on how demographic diversity in top level management affects firm financial performance. : ***Top level management refers to both top management team (TMT) and board of directors (BOD)***	ROE	Ethnic and gender diversity of top management levels	1) Demographic diversity in TMTs had no impact on firm financial performance 2) Demographic diversity in BOD had a partial impact on firm financial performance : **gender effect** did not contribute significantly toward firm financial performance : **ethnic diversity** was significantly, positively and consistently correlated with financial performance
Marimuthu & Kolandaisamy (2009b)	: OLS regressions using on the cross-sectional data are	Secondary data of non-financial listed companies over the period 2000 to 2006	Examined the effect of demographic diversity on boards of directors with regard to firm financial performance	ROA & ROE	1) Gender 2) Ethnicity	**ROA:** : Ethnic diversity was significantly (positively) correlated with performance : Gender diversity was not correlated with performance **ROE:** : Gender effect did not have any impact on firm financial performance throughout the years except in year 2005 : Ethnic diversity had significant impact on financial performance in the second half of the period from 2004 to 2006
Marimuthu (2008)	: Statistical techniques such as correlation and regression	Secondary data from the top 100 non-financial companies listed on the Main Board over a period of 2000 to 2005	Examined the relationship between ethnic diversity on boards of directors with firm financial performance	ROA & ROE	Ethnic diversity is measured by the percentage of Non-Malay directors and	Increased ethnic diversity (board diversity) on boards of directors would lead to higher firm financial performance.

APPENDIX V

Sample Studies of the Effect of Concentrated Ownership on Firm Performance

Author(s)	Method(s)	Sample	Firm Performance Variables	Results
Basyith et al. (2015)	Tobit regression	45 listed firm in the Indonesian Stock Exchange, secondary data (2010- 2014)	ROA	Block holder ownership was positively significant associated
Lee & Lee (2014)	Hierarchical regression analysis	1827 observations listed on the Korean Stock Exchange (KSE) 2010 to 2012	Tobin's Q	Ownership concentration has a significant negative effect on firm performance
Zakaria et al. (2014)	1) Regression based on panel fixed effect model 2) Regression of 3 stage crisis periods (panel random effect model)	Secondary data from 2005 to 2010 at 73 Malaysia Public Listed Trading and Services Firms	ROA	Ownership concentration was positively related to firm performance
Mule et al. (2013)	Multiple regression analysis	Employed secondary data on 53 firms listed on the Nairobi Securities Exchange over a period of five years that is 2007 to 2011	ROA, ROE & Tobin's Q	Ownership concentration was found to be negatively related to all the three measures of performance in firms
Alimehmeti & Paletta (2012)	OLS regression	203 listed firms in Italy. The sample data are collected from Amadeus for two periods: pre and post crisis (2006-2007 and 2008-2009)	ROA	The positive relationship between ownership concentration and firm value.
Darmadi (2012)	Cross-sectional regression models	169 firms, the total number of public firms listed on the IDX as at 31 December 2007	ROA & Tobin's Q	Concentrated ownership (largest shareholders) was found significantly associated with accounting performance but has no significant impacts on Tobin's q. Block holder ownership was negatively influence the accounting measure
Fauzi & Locke (2012)	OLS regression	79 New Zealand listed firms for the period of 2007–2011	ROA & Tobin's Q	Block holder ownership decreased firm performance.

Wahla et al (2012)	Multiple regression analysis	138 firms of 7 non-financial companies of Karachi stock exchange (2008 to 2010)	Tobin's Q	No association
Garcı´a-Meca & Sa´nchez-Ballesta (2011)	Panel data	Spanish non-financial firms listed on the Madrid Stock Exchange that it was 254 firms - year observation for the period from 1999 to 2002.	Tobin's Q	Ownership concentration was positively effect on firm value, however at high levels of ownership concentration was negatively effect on market valuation.
Sulong & Mat Nor (2010)	Panel data analysis, hierarchical regression (generalized least square (GLS) estimation technique)	403 firms listed on the Bursa Malaysia over a four-year period from years 2002 to 2005.	Tobin's Q & Dividend	Positive
Ganguli & Agrawal (2009)	OLS & SLS regression	100 Indian firms which were listed in Indian Stock Exchange based on 2007	Tobin's Q	Positive
Sulong & Mat Nor (2008)	Regression	406 listed firms on the Main Board of Bursa Malaysia. A cross-sectional analysis, annual reports (2002 and 2005)	Tobin‘s Q Ratio (Q-Ratio)	There was insignificant relationship between ownership concentration and firm value.
Tam & Tan (2007)	Structural equation modelling (SEM)	The KLSE Annual Companies Handbook from 1994 to 2000 (Malaysia‘s top 150 publicly listed firm)	ROA & Tobin's Q	Negative impact of ownership concentration levels on firm performance
Haniffa & Hudaib (2006)	OLS regression	348 Malaysian listed companies on the main board of the KLSE between 1996 and 2000	Tobin's Q	Positive
Demsetz & Lehn (1985)	2-SLS	Cross-section sample over 511 U.S. companies, average of variables for 1976-1980	**Accounting profit rates:** Book value of assets, sales of capital expenditures, advertising expenses and R&D expenses	No relationship between ownership concentration (presence of block holders) and company performance

APPENDIX VI

Sample Studies of the Effect of Managerial Ownership on Firm Performance

Author(s)	Method(s)	Sample	Firm Performance Variables	Results
Basyith et al. (2015)	Tobit regression	45 listed firm in the Indonesian Stock Exchange, secondary data from 2010 to 2014	ROA	Negative and significant
Nath et al. (2015)	Regression	9 pharmaceutical companies listed on the Dhaka Stock Exchange (DSE), 10 years (2005-2014)	ROA	Positive but insignificant impact on ROA while negative insignificant impact on Tobin's Q.
Zakaria et al. (2014)	1) Regression based on panel fixed effect model 2) Regression of three stage crisis periods based on panel random effect model	Secondary data from 2005 to 2010 at 73 Malaysia Public Listed Trading and Services Firms	ROA	Positive and significant
Fauzi & Locke (2012)	OLS regression	79 New Zealand listed firms for the period of 2007–2011	ROA & Tobin-Q	Positive and significant
Uwuigbe & Olusanmi (2012)	Multivariate multiple regression	31 firms of all Nigerian firms in financial sector during 2006-2010.	ROA	Positive
Wahla et al. (2012)	Multiple regression	7 non-financial sectors of Karachi stock exchange. Total number of companies under these sectors is 138.	Tobin's Q	Negative
Din & Javid (2011)	2SLS regression	60 firm non-financial firms of manufacturing firms in Pakistan during 2000-2007.	ROA, ROE & Tobin's Q	Positive
Sulong & Mat Nor (2010)	Panel data analysis, hierarchical regression (generalized least square (GLS) estimation technique)	403 firms listed on the Bursa Malaysia over a four-year period from years 2002 to 2005.	Tobin's Q & Dividend	Negative and significant

Sulong & Mat Nor (2008)	Regression	406 listed firms on the Main Board of Bursa Malaysia. A cross-sectional analysis through annual reports for the years 2002 and 2005	Tobin's Q Ratio (Q-Ratio)	Negative
Haniffa & Hudaib (2006)	OLS	347 Malaysian companies listed on the main board of the KLSE between 1996 and 2000	ROA	Negative but insignificant

APPENDIX VII

Sample Studies of the Effect Government Ownership on Firm Performance

Author(s)	Method(s)	Sample	Firm Performance Variables	Results
Musallam (2015a)	Generalized Least Square (GLS) & OLS Regression	190 non-financial listed companies on Bursa Malaysia from 2009 to 2014	ROE	Negative and significant
Musallam (2015b)	Generalized Least Square (GLS) method	Companies that are listed on Bursa Malaysia during the period of 2000 to 2009	Total Investment Return of company	From 7 GLICs, only 2 GLICs showed positive and significant impact on market performance while other 5 GLICs did not affect market performance.
Tran et al. (2014)	Regression	38,143 Vietnamese firms-year observations for the period 2004-2012	ROA, ROE, Turnaround & Value added per employee	Negative effect on firm profitability
Zakaria et al. (2014)	1) Regression based on panel fixed effect model 2) Regression of three stage crisis periods (panel random effect model)	Secondary data from 2005 to 2010 at 73 Malaysia Public Listed Trading and Services Firms	ROA	Negative related to firm performance
Menon & Ng (2013)	Regression	28 non-financial GLCs from the Putrajaya Committee list from 16 industries (2007-2011 secondary data)	Tobin's Q	Negative and significant impacted on private firms

Phung & Hoang (2013)	Regression	Using data from Ho Chi Minh Stock Exchange and Hanoi Stock Exchange during the period of 2007 and 2012	Tobin's Q & ROA	A nonlinear relationship (U-shaped)
Goh, Khan, & Rasli (2013)	Ordinary least squares and two-stage least squares regressions	192 firms over the three-year sample period (2004 to 2006).	Tobin's Q	Positive
Najid & Rahman (2011)	Regression	47 GLCs and 47 non-GLCs companies listed on Bursa Malaysia over a 6-year period of 2001-2006	ROA, ROE, Expense to Assets, Cash to Assets, Sales to Assets, Expenses to Sale & Tobin's Q	Positive
Mohd Ghazali (2010)	Regression	2001 annual reports of 87 non-financial Malaysian listed companies	Tobin's Q	Positive and significant
Sulong & Mat Nor (2010)	Panel data analysis, hierarchical regression (generalized least square (GLS) estimation technique)	403 firms listed on the Bursa Malaysia over a four-year period from years 2002 to 2005.	Tobin's Q & Dividend	Positive and significant
Lau & Tong (2008)	Linear regression	15 Malaysian GLCs over six years—i.e. 2000 to 2005	Tobin's Q	Positive relationship between the degree of government ownership and firm value
Sulong & Mat Nor (2008)	Regression	406 listed firms on the Main Board of Bursa Malaysia. A cross-sectional analysis through annual reports for the years 2002 and 2005	Tobin‘s Q Ratio (Q-Ratio)	Positive and significant in 2002 and insignificant in 2005
Tam & Tan (2007)	: Regression : Structural equation modelling (SEM)	The KLSE Annual Companies Handbook from 1994 to 2000 (Malaysia‘s top 150 publicly listed firm)	ROA & Tobin's Q	Negative

APPENDIX VIII

Sample Studies of the Effect of Foreign Ownership on Firm Performance

Author(s)	Method(s)	Sample	Firm Performance Variables	Results
Musallam (2015b)	Generalized Least Square (GLS) method	Companies that are listed on Bursa Malaysia (2000 to 2009)	Total Investment Return of company	Positive impact on market performance
Zakaria et al. (2014)	1) Regression based on panel fixed effect model 2) Regression of three stage crisis periods based on panel random effect model	Secondary data from 2005 to 2010 at 73 Malaysia Public Listed Trading and Services Firms	ROA	Positive impact on firm performance
Phung & Hoang (2013)	Regression	Using data from Ho Chi Minh Stock Exchange and Hanoi Stock Exchange during the period of 2007 and 2012	Tobin's Q & ROA	Positive impact on both firm performance measurement
Darmadi (2012)	Cross-sectional regression models	169 firms, the total number of public firms listed on the IDX as at 31 December 2007	ROA & Tobin's Q	No significant association with market performance
Uwuigbe & Olusanmi (2012)	Multivariate multiple regression	31 firms of all Nigerian firms in financial sector during 2006-2010.	ROA	Positive and significant
Mohd Ghazali (2010)	Regression	2001 annual reports of 87 non-financial Malaysian listed companies	Tobin's Q	Positive and significant
Sulong & Mat Nor (2010)	Panel data analysis, hierarchical regression (generalized least square (GLS) estimation technique)	403 firms listed on the Bursa Malaysia over a four-year period from years 2002 to 2005.	Tobin's Q & Dividend	Positive and significant
Lau & Tong (2008)	Linear regression	15 Malaysian GLCs over six years—i.e. 2000 to 2005	Tobin's Q	Negative
Sulong & Mat Nor (2008)	Regression	406 listed firms on the Main Board of Bursa Malaysia. A cross-sectional analysis through annual reports (2002 and 2005)	Tobin‘s Q Ratio (Q-Ratio)	Negative and significant