IMPACT OF BUSINESS INTELLIGENCE (BI) CAPABILITIES ON ORGANIZATIONAL PERFORMANCE: BI SYSTEM SUCCESS AS MEDIATOR AND INFORMATION TECHNOLOGY GOVERNANCE AS MODERATOR

PHAN KOO YUEN

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PHAN KOO YUEN

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TABLE OF CONTENTS

LIST OF TABLES

Page

LIST OF FIGURES

Page

LIST OF ABBREVIATIONS

ACE market	Access, Certainty, Efficiency market
AI	Artificial Intelligence
AIS	Accounting Information System
ANOVA	Analysis of variance
ASEAN	Association of Southeast Asian Nations
AVE	Average Variance Extracted
BCa	Bias-Corrected and Accelerated
BI	Business Intelligence
BI&A	Business Intelligence and Analytics
BIS	BI System Success
BSC	Balanced scorecard
BSK	Business Knowledge
CB-SEM	Covariance-based Structural Equation Modelling
CEO	Chief Executive Officer
CFA	Confirmatory Factor Analysis
CIO	Chief Information Officer
COVID-19	Coronavirus Disease 2019
CR	Composite Reliability
CRM	Customer Relationship Management
CRV	Cross-validated redundancy
CUS	Customer
D&M IS Success	DeLone and McLean IS Success
DCV	Dynamic capabilities view
DOI	Diffusion of Innovation theory
DQY	Data Quality
EFT	Extract, Transform, Load
EIS	Executive Information System
EM	Expectation Maximisation
ERP	Enterprise Resource Planning
ERPBI	Enterprise Resource Planning Business Intelligence

e-TOKAI	electronic Toolkit for ATM Occurrence Investigation
f^2	Effect size
FIN	Financial
FLX	Flexibility
FTSE	Financial Times Stock Exchange
GCI	Global Competitiveness Index
GDP	Gross Domestic Product
GN3	Guidance Note 3
GoF	Goodness-of-Fit
GST	Goods and Services Tax
HCM	Hierarchical Component Model
HR	Human resource
HTMT	Heterotrait-Monotrait ratio of correlations
IBM	International Business Machines
ICT	Information and Communication
INP	Internal business process
IoT	Internet of Things
IS	Information System
IT	Information Technology
ITG	Information Technology Governance
KLCI	Kuala Lumpur Composite Index
KPI	Key performance indicator
LEAP market	Leading Entrepreneur Platform market
LI	Leading Index
LL	Lower limit
LM	Linear Regression Model
LPG	Learning and Growth
MAS	Malaysia Airline System Bhd
MCO	Movement control order
MDEC	Malaysian Digital Economy Corp
MIS	Management Information System
ML	Machine Learning
MLE	Maximum likelihood estimation

MOSTI	Ministry of Science, Technology and Innovation
MSS	Management Support and Sponsorship
NPV	Net present value
OLAP	Online Analytical Processing
OP	Organisational Performance
OPR	Overnight Policy Rate
Pikom	National ICT Association of Malaysia
PIN	Personal identification number
PLC	Public Listed Companies
PLS-SEM	Partial Least Squares-Structural Equation Modelling
PN17	Practice Note 17
Q^2	Predictive relevance
R^2	Coefficient of determination
RBV	Resource-based view
RMSE	Root Mean Squared Error
ROA	Return on assets
ROE	Return on equity
ROI	Return on investment
SAP	System Applications and Products
SAS	Statistical Analysis System
SCM	Supply Chain Management
SEM	Structural Equation Modelling
SIG	System Integration
SME	Small to Medium Enterprise
SPSS	Statistical Package for Social Science
SQL	Service Quality
SRMR	Standardised Root Mean Square Residual
SST	Sales and Service Tax
TAM	Technology Adoption Model
TMK	Technology Management Knowledge
TOE	Technology-Organisation-Environment Framework
TRI	Technology Resources Industries Bhd
TSK	Technical Knowledge

UAC	User Access
UL	Upper limit
US	United States
UTUAT	Unified Theory of Acceptance and Use of Technology
VIF	Variance inflation factor
VRIN	Valuable, Rare, Inimitable and Non-substitutable
YTD	Year to date

LIST OF APPENDICES

KESAN KEUPAYAAN KEPINTARAN PERNIAGAAN (BI) TERHADAP PRESTASI ORGANISASI: KEJAYAAN SISTEM KEPINTARAN PERNIAGAAN SEBAGAI PENGANTARA DAN TADBIR URUS TEKNOLOGI MAKLUMAT SEBAGAI PENYEDERHANA

ABSTRAK

Dalam persekitaran perniagaan dinamik pada era Industri 4.0 hari ini, pengoptimuman prestasi organisasi menjadi isu kritikal bagi organisasi-organisasi perniagaan, terutamanya Syarikat;syarikat Tersenarai Awam Malaysia (PLC). Namun, prestasi organisasi di PLC semakin nenurun sejak tahun 2018. Justeru, Keupayaan Kepintaran Perniagaan (BI) dianggap sebagai salah satu komponen utama dalam menentukan kejayaan prestasi organisasi. Sistem BI yang berjaya berserta keupayaan benar boleh membantu organisasi meramal perubahan persekitaran dalaman dan luaran. Dalam kajian ini, teori Pandangan Berasaskan Sumber (RBV) dan Pandangan Keupayaan Dinamik (DCV) telah digunakan bersama-sama dengan Teori Kejayaan Sistem Maklumat DeLone dan McLean (D&M IS), suatu kerangka bersepadu yang dikembangkan untuk mengkaji kesan keupayaan BI terhadap prestasi organisasi PLC Malaysia melalui kejayaan sistem BI sebagai pengantara dan mekanisme tadbir urus teknologi maklumat sebagai penyederhana. Sebanyak 223 telah dikumpulkan melalui kaedah kajian soal selidik dengan hanya 207 maklumbalas layak untuk analisis. SmartPLS telah digunakan untuk menguji hipotesis H1 hingga H20. Secara keseluruhannya, kesemua dua puluh hipotesis disokong dalam kajian ini. Secara teorinya, kajian ini telah mengesahkan keteguhan ketiga-tiga teori dalam usaha memahami kepentingan sumber BI terhadap kejayaan sistem BI dan prestasi organisasi. Secara empirik, kajian ini telah mengkaji kesan kemahiran teknologi, budaya, dan

individu dalam PLC Malaysia. Tambahan pula, kajian ini menyumbang kepada literatur di mana kejayaan sistem BI telah mengantara hubungan antara keupayaan BI dan prestasi organisasi selain sumbangan teori penting tadbir urus teknologi maklumat yang diperkenalkan sebagai penyederhana dalam penyelidikan ini. Secara praktikal, kajian ini menyumbangkan implikasi berharga kepada pengamal-pengamal BI untuk menyeragamkan jenis data dan seni bina data. Kajian ini juga menambah kepada kod pentadbiran korporat oleh Suruhanjaya Sekuriti yang wajib dipatuhi oleh semua PLC di Bursa Malaysia. Kesimpulannya, kejayaan sistem BI dan kesan penyederhanaan tadbir urus teknologi maklumat akan memantapkan kelebihan bersaing PLC Malaysia dalam industri.

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ABSTRACT

In today's dynamic business environment in the Industry 4.0 era, optimising organisational performance is a critical concern for business organisations, particularly Malaysian Public Listed Companies (PLC). However, organisational performance at PLC has been on a downward trend since 2018. Business Intelligence (BI) capabilities are therefore considered as one of the key components that enables organisational performance. Successful BI systems with the right capabilities deployed can help organisations predict changes in the internal and external environment. In this study, Resource-based View (RBV) and Dynamic Capabilities View (DCV) theories were used along with the DeLone and McLean Information System (D&M IS) success theories, an integrated framework developed to examine the impact of BI capabilities on the organisational performance of Malaysian PLC via BI systems success as mediator and IT governance mechanisms (ITG) as moderator. 223 responses were collected via the questionnaire survey method with only 207 qualified as valid responses for analysis. SmartPLS was used to conduct hypothesis testing for hypotheses H1 to H20. Overall, the results showed all twenty hypotheses were supported in this study. Theoretically, this study confirmed the robustness of these integrated three theories, which helped to better understand the importance of BI resources in improving the success of BI systems and organisational performance. Empirically, this study examined the impact of technology, culture, and people

capabilities on Malaysian PLC. Furthermore, this study contributed to the literature in which BI systems success mediated the relationship between BI capabilities and organisational performance. The ITG introduced as a moderator was another important theoretical contribution to the research. Practically, this study provides valuable implications for BI practitioners to standardise data types and data architecture. This study further adds to the code of corporate governance established by the Securities Commission that all PLC in Bursa Malaysia ought to follow. In conclusion, the success of BI systems and the moderation effect of ITG will render Malaysian PLC a greater competitive advantage in the industry.

CHAPTER 1

INTRODUCTION

1.0 Introduction

This introductory chapter provides an overview of the background of the research study along with issues elaborated in the problem statement. It discusses the context of research related to the influence of Business Intelligence (BI) capabilities on BI systems success and their impact on the overall organisational performance among Public Listed Companies (PLC) in Malaysia. This is followed by research objectives and research questions. Next, the potential significance of the study is highlighted, and definitions of important key terms of the variables are presented. Finally, this chapter concludes with a brief explanation of the organisation of the remaining chapters.

1.1 Background of the Study

Overall, this study discusses the impact of BI capabilities on the organisational performance of Malaysian PLC via BI systems success as a mediator and IT governance mechanisms as a moderator. Studying the impact of BI capabilities (i.e., technology capability, culture capability and people capability) on the organisational performance of PLC is important because BI capabilities are critical resources to improve business processes, finance, customers, learning and growth of the organisation besides achieving differentiation and competitive advantage in response to market changes and adaptation.

Public Listed Companies in Malaysia have been facing problems and challenges to maintain their business performance in a rapidly changing environment.

There is an indication that the Malaysian FBM Kuala Lumpur Composite Index has fallen from 1,875.34 points (1st February 2018) to 1,492.52 points (17th January 2023). The economic growth continues to slow down year by year. Malaysia's Gross Domestic Product (GDP) has fallen sharply over the past 16 quarters from 5.9% in 2017 to -5.5% in 2020 as a result of the unprecedented lockdown imposed to control the spread of COVID-19, the trade tensions between the United States and China as well as the geopolitical uncertainties they bring. Nevertheless, the Malaysian economy has regained momentum in 2021, with growth of 8.7% in 2022, driven by the reopening of international borders (Department of Statistics Malaysia, 2022). However, the Malaysian economy is projected to slow down to 4% - 5% in 2023 due to slower global economic growth, and high cost of living and inflation which could impact local consumer and business sentiment (NST Business, 2022). Many companies are struggling to maintain profit margins during this period of economic slowdown as they are impacted by external conditions and slowing domestic demand across most sectors of the economy. As the Malaysian economy relies heavily on export-oriented manufacturing, this could adversely affect the Malaysian economy should demand for Malaysian exports fall (Nambiar, 2009), consequently, the business performance of the organisation too as PLC contribute a major part to the Malaysian economy. Therefore, PLC are one of the potential research contexts in this area.

Meanwhile, advanced business information systems and technologies have been adopted by business organisations to help them deal with the challenges. A number of studies have been conducted to examine the impact of BI capabilities and BI systems success in SMEs, and the studies have shown that BI facilitates timely decision-making, improves organisational efficiency, meets customer expectations, and thus leads to employee satisfaction (Hatta et al., 2015; Qushem, Zeki, and

Abubakar, 2017). Nevertheless, little attention has been given to specifically the relationship between BI capabilities and BI systems success, the influence of BI systems success as a mediator between BI capabilities and organisational performance, and the influence of IT governance mechanisms as a moderator between BI systems success and organisational performance among PLC in the main market of Bursa Malaysia. Although BI systems have been implemented in the private sector (Mezzanzanica, Cesarini, and Boselli, 2010), the BI systems success story in the PLC is still understudied. There is insufficient empirical evidence on the impact of BI capabilities on BI systems success and organisational performance (Magaireah, Sulaiman, and Ali, 2017; Yeoh and Popovič, 2016).

Business organisations and PLC alike are driven by uncertainty and turbulence in market trends in today's dynamic business environment. Many business organisations are unsure how to advance their business without knowing the future market trends. Continuously keeping up with the rapid growth of new technologies has always been a challenge that has resulted in organisations being unable to adapt to external or internal business processes (Sharda, Delon and Turban, 2014). Organisations that have not secured consistent support find it difficult to obtain sufficient funding and labour support to support the project development. On the other hand, most organisations are faced with tight budgets, target settings and pressure from top management to improve business performance and profitability. Furthermore, the IT infrastructure and BI systems are not flexible enough adapt to changing business needs. Despite this, due to the increasing use of software applications and the exponential growth of information related to high-quality business decisions, companies have to deal with data quality issues (Lee, Kao, and Yang, 2014).

Besides, global competition caused companies to re-transform their production/operational processes to respond to market demands (Eiskop, Snatkin, Kõrgesaar and Søren, 2014). Quick adaptation to such changes in order to stay innovative and agile which was imperative helped explain why some companies did well while others did not.

Meanwhile, adoption of Industry 4.0 supporting Big Data and Internet of Things (IoT) along with volatile business environment in ever-changing technologies and just-in-time decision makings are crucial in today's business environment. In response, the Industry 4.0 policy (Industry4WRD) has been aligned to drive digital transformation for related manufacturing/services sectors in Malaysia to become more holistic. Industry 4.0 together with the digitisation of the business ecosystem have prompted many industry players to transform their business model (Halaška and Šperka, 2020) to face economic challenges and to rejuvenate the Malaysian economy. Companies react and adapt quickly to such market demands in order to shorten product life cycles. Businesses are starting to collect data, analyse them, and interpret the results to determine the market trends and direction to stay competitive.

Industry 4.0 integrates technologies through advanced BI systems and can make better decisions to maintain organisational competency and market needs. Business Intelligence can generate numerous business opportunities for organisations (Shen, Chang, Hsu, and Chang, 2017) and also grounds for effective and accurate decisions. The integration of the physical and digital technologies along with BI capabilities could create new business models (Müller, Buliga, and Voigt, 2018) among suppliers, partners and customers, offering opportunities for them to conduct business activities and create value for customers. The new business models are driven by data quality, business values and agility to increase productivity, improve business

efficiencies, increase return on investment and boost organisational performance. Product complexity (Eiskop et al., 2014), mass customisation (Neuböck and Schrefl, 2015) and the rapid evolution of BI technology tools are forcing companies to change the way they operate to improve organisational performance.

In the following sections, the relevant research on an overview of the performance of PLC in Malaysia is discussed, followed by the respective BI systems success, BI capabilities and IT Governance mechanisms.

1.1.1 Overview of Public Listed Companies Performance in Malaysia

Organisational performance is an organisation's ability to allocate its resources to generate revenue, as measured by financial performance, evaluation of past and current levels of efficiency, and business process effectiveness (Torres, Sidorova, and Jones, 2018). Public Listed Companies play an important role by contributing a large part of the economy in Malaysia (Teoh, Chong, Lam, and Muthuveloo, 2018), for instance Bursa Malaysia offers three types of markets mainly Main Market, ACE Market and LEAP Market. As of 17th January 2023, there are 786 companies in the Main Market, 162 companies in the ACE Market and 47 companies in the LEAP Market (Bursa Malaysia, 2023). According to Bursa Digital Research, the total market capitalisation of listed companies as of 31th January 2022 was RM1.73 trillion (Chong, 2022). There were 7 Malaysian companies that made it into the Global 2000 in 2022 based on criteria for sales, profits, assets, and market value (Andrea and Isabel, 2022). Given the size of Malaysia's capital market and prudent monetary policies, PLC could have contributed significantly to the local economic growth without considering the outbreak of COVID-19.

The overall performance of PLC was on an upward trend between 2004 and 2015, but statistics showed that their performance in terms of profitability and several growth ratios had declined thereafter (Tan, 2020). Malaysia's economic performance contracted by 5.6% in 2020 (DOSM, 2020) whereby most sectors recorded negative growth in 2020 compared to 4.8% and 4.3% in 2018 and 2019 respectively, reflecting the slowdown in economic activity to contain the COVID-19 pandemic. Still, Malaysian economy gradually recovered in 2021 with growth of 8.7% in 2022. As of 1st November 2022, a total of 28 PLC (2.98%) fell under PN17 and GN3. Initially, the impact of the COVID-19 outbreak was expected to affect Malaysia's economic activities particularly in the tourism sector due to the high unemployment rate and the depreciation of the Malaysian ringgit. Malaysia had estimated the loss of economic output at RM22.8 billion in the first quarter of 2020 in a bid to contain the pandemic. Despite these challenging internal and external environments, PLC continued to be an important contributor to Malaysia's economic growth, which expanded by 9.3% in the first third quarter of 2022. The growth performance was mainly supported by the recovery in global manufacturing demand such as the reopening of international borders, the realisation of large infrastructure projects, the improvement in the labour market and the stability of government consumption spending and policy support (Bank Negara Malaysia, 2022a).

The contribution of PLC to the Malaysian economy is usually indicated by the number of indices such as FTSE Bursa Malaysia KLCI, also known as FBM KLCI (Sabariah and Norhafiza, 2016). It is a capitalisation-weighted stock market index composed of the 30 largest companies in Bursa Malaysia's main market that meet the full market capitalisation requirements. The FBM KLCI comprises stocks of the 30 largest companies, accounting for 60% of market value. The size of the Malaysian

capital market significantly influences its economic growth. Malaysia's economy grew at an average of 4.7% per year over the past 10 years (Pathum, 2018), driven by strong macroeconomic fundamentals, the recovery in corporate earnings, growth in private investment, strong inflows of foreign investment and a surge in exports (Securities Commission, 2018). Among all, the Information and Communications (ICT) sub-sector remains one of the best performing sectors due to higher global demand for semiconductors (TheStar, 2022) and the fact that people are working from home more recently (DOSM, 2020). The contribution of ICT to the Malaysian economy was 23.2% in 2021 compared to 10.5% in 2020. Most empirical studies in fact showed that ICT has a positive impact on economic growth and is considered to be one of the most important drivers of economic growth (Toader, Firtescu, Roman, and Anton, 2018).

Bank Negara Malaysia maintained the Overnight Policy Rate (OPR) at 2.75% on rising cost pressures and tighter global financial conditions. The adjustment is to ensure that monetary policy remains accommodative and moves towards sustainable economic growth with price stability (Bank Negara Malaysia, 2022b). Malaysia was ranked 32nd in the 2022 World Competitiveness Ranking but is still the most competitive country in the East Asia and Pacific region, driven from efficiency to innovation.

The Malaysian stock market reached an all-high 1895.18 points in April 2018. However, as of May 2018, the market experienced a downturn triggered by internal factors such as political uncertainties following the 14th general election. The government made several policy changes such as replacing the goods and services tax (GST) with the sales and service tax (SST) and cancelling or delaying some mega infrastructure projects. Despite this, the market has also been impacted by external factors such as ringgit depreciation, tensions between the China-US trade war, slowing

growth in China (Cecilia, 2019) and the recent COVID-19 outbreak. Malaysia's economic growth in the second quarter of 2020 was severely impacted by the outbreak of COVID-19. The FBM KLCI index has since fallen to 1,492.52 points as of 17th January 2023.

All of these factors may have impacted the telecommunications, healthcare and technology sectors, specifically the Malaysian economy and the performance of public listed companies. Among the FBM KLCI performances of listed companies in 2022, Axiata Group Bhd, Maxis Bhd, IHH Healthcare Bhd, Hap Seng Consolidated Bhd, Hong Seng Consolidated Bhd, Top Glove Corp Bhd, and Hartalega were among the biggest losers of the year due to their underperformance and correction in share prices of glove manufacturers and technology companies. For example, Axiata Group Bhd reported a net loss of -26.6% in 2022 due to foreign exchange losses contributed by its mobile operations in Sri Lanka (The Malaysian Reserve, 2022).

The energy, finance and plantation sectors were among the top performing PLC in 2022 including Dialog Group Bhd (+44.0%), Yinson Bhd (+17.0%), AMMB Holdings Bhd (+35.5%), RHB Bank Bhd (+15.1%), Hong Leong Bank Bhd (+14.4%), and Sime Darby Plantation Bhd (+32.9%). For example, the energy sector went up by 10.5% year-to-date on improved earnings on higher crude oil and natural gas prices. The finance sector went up by 6% year-to-date as banks charge higher lending rates. Meanwhile, the plantation sector benefited from higher crude palm oil prices due to the disruption in shipments of sunflower oil from Ukraine. The Malaysian economy was expected to grow between 6.5% and 7.0% in 2022. Continued support from government policies, coupled with strong global demand for manufactured goods, strong domestic demand and a recovery in inbound tourism have boosted economic

activity. Labour market and income conditions then gradually improved as economic activity picked up (Bank Negara Malaysia, 2022a).

The following section discusses the BI systems success in Malaysia and highlights some of the PLC in the main market of Bursa Malaysia in various industries that have implemented the BI systems.

1.1.2 Business Intelligence System Success

The success of the BI system plays a very important role in achieving organisational performance to generate economic stability and sustainable performance. There are many factors that affect organisational performance such as staff motivation, innovation, management involvement, total quality management and knowledge management. BI is one of the factors that influences organisational performance in this knowledge era. More and more companies are investing in BI to perform analytics and help managers make better decisions.

Malaysia is one Asian IT hub under the Digital Malaysia Master Plan. With an Economic Complexity Index (ECI) score of 1.12 in 2020, Malaysia can take up cutting-edge technologies and abilities to produce more varied and complex products supported by diversified industry sectors. The ICT sector remains one of the largest contributors to sustainable growth in Malaysia. According to GlobalData Market Opportunities Forecasts, IT spending in Malaysia is expected to reach RM103.75 billion in 2023, driven by data analytics, cloud computing, mobility, storage and business process outsourcing (James, 2020). The modernisation of the private sector value chain, public sector policies and procurement, and the expanding middle class are the key factors driving the strong IT growth in Malaysia (Business Monitor International, 2018). Malaysia was ranked 33rd in ICT adoption in 2019 Global

Competitiveness Index (GCI) 4.0 (Schwab, 2019). The data platform and analytics services sectors have continued to grow, and the government's target is to achieve 25.5% contribution of digital economy to GDP under the 12th Malaysia Plan (2021-2025). According to GlobalData Market Opportunity Forecasts, data analytics will be one leading IT solution area in terms of growth rate, standing at 17.6% during the forecast period between 2018 and 2023 (GlobalData, 2020). The Ministry of Science, Technology and Innovation (MOSTI) has deemed BI analytics important for private sector organisations to create business value for effective decision-making, productivity, growth and innovation. Therefore, it is important to assess the impact of BI systems success on the organisational performance of Malaysian PLC.

Many industries in Malaysia have a positive outlook for IT investment in 2023-2025. Malaysian Digital Economy Corp (MDEC) aims to reach RM49 billion in approved digital investments by 2025 (The Malaysian Reserve, 2023). Enterprise Resource Planning (ERP) and accounting, Customer Relationship Management (CRM), business intelligence, and marketing automation are the most used software applications in Malaysian PLC in 2012-2022. Statistical Analysis Software (SAS), Tableau, Microsoft, Oracle, IBM Cognos and Systems Applications and Products (SAP) Business Objects are the software market leaders in Malaysia competing in BI. SAS Malaysia is the leading provider of advanced and predictive analytics software in Malaysia having formed partnerships with major companies in Malaysia to improve business performance in organisations (Hamsawi, 2007). While Oracle targets enterprise reports and SAP Business Objects focuses on ad hoc queries, most BI products share common BI capabilities such as reporting, Online Analytical Processing (OLAP) and dashboard.

According to MDEC, the data analytics market in Malaysia is expected to reach RM7.85 billion in 2025 (Arjuna, 2021). Increasing demand for big data solutions in services, banking and telecommunication sectors, competition from other ASEAN countries, incremental investment in infrastructure to attract foreign investment and government initiatives are positive factors for BI growth in Malaysia (Arjuna, 2021; Digital News Asia, 2014). A survey was conducted among organisations in Asia Pacific where 51% of respondents from Malaysia were considering increasing spending on BI software in their organisations to improve decision making, increase profits and enhance customer satisfaction (Digital News Asia, 2013). Meanwhile, 56% of organisations were considering expanding BI usage in their organisations (Enterprise, 2013). Since Public Listed Companies are considered the backbone of the country's globalised economy (Teoh et al., 2018), organisations proactively seek BI capabilities and BI resources for sustainable competitive advantage (Ahmad, 2015). Once properly applied, BI can improve PLC financial performance.

Business Intelligence (BI) systems have proven critical to business success and have grown significantly over the decades. Many studies have examined the role of BI systems success on organisational performance. Watson and Wixom (2007) described in an early study that BI tools can help improve organisational performance. Likewise, previous studies discussed the importance of BI in organisations (Mathrani, 2021; Shen et al., 2017; Teixeira, Oliveira, and Varajão, 2019). Schlesinger and Rahman (2016) discussed Self-Service BI which can provide significant cost savings, minimise the number of IT development staff, and increase organisation agility.

Business Intelligence systems have been deployed in many industry sectors of Malaysian public listed companies. Industries such as telecommunication, banking, services, and construction have successfully implemented the BI solutions to help the

groups make better decisions and improve their organisation's business operations. For example, Digi.com Bhd (Digi) is one telecommunication company that is actively and successfully adopting BI systems for organisational sustainability by offering effective services to its customers. Digi implemented big data analytics and a CRM system with data mining capabilities that enabled Digi to analyse customer behaviour related to call-detail records and customer communication management (Bidin and Yunus, 2018). The BI analytics system allows Digi to track its customers' locations and time using smartphones (Azhar, 2014). The BI systems success provides Digi with the detailed analysis that enables management to make strategic and timely decisions to better serve its customers and at the same time, to optimise its operation efficiency. Telekom Malaysia Bhd (TM) implemented the BI systems to improve its upselling and cross-selling products and fraud detection, resulting in improved productivity, operational efficiencies and decision making.

In the banking industry, Maybank was well known for using the BI data warehouse system in transforming the Maybank Group into a customer-centric organisation. The BI data warehouse system integrates and mines millions of customer data to create a unique profile identification for each customer for better customer relationship and risk management. The BI analytics system enables marketing staff to communicate more effectively with customers, which in turn improves customer retention and satisfaction. At the same time, Maybank employees are able to make better decisions in their relationships with customers (Maybank, 2002). Banks use BI analytics tools to improve fraud detection and discover non-compliance.

In the service industry, Genting Malaysia Bhd used BI analytics to customise its marketing campaign to attract more customers. Genting wanted to personalise its offer and send invitations to customers, allowing them more time to plan their next

visits. The BI systems successfully used analysis algorithms to analyse the frequency of visits and the spending behaviour of customers thus improved customer segmentation and tracked how customers responded to different marketing media (Resorts World Genting, 2019). Information Technology has also been one of the key success factors for AirAsia Bhd's business model to provide better customer experiences and increase operational efficiencies. AirAsia implemented the Google BigQuery analytics data warehouse as part of its transformation into a digital airline. Customer data from the mobile application is extracted, transformed, and loaded into BigQuery for quick analysis and reporting. The BI systems have been successful in helping better decision makings in routes to fly, route-flying frequency and price mix (Min Shen, 2018). In addition, the management was able to view and better understand historical ticket booking profiles such as how long it took customers to book air tickets in advance of a flight, allowing AirAsia to manage its profits more efficiently. Besides, the manufacturing industry used BI technology to control full automation and data driven decision making. The government too used BI analytics tools to automate their tax filing and payment services.

All along, BI and data analytics have gone through various evolutions ranging from BI reporting, self-service BI to augmented analytics. Big data and cloud computing opened new avenues for BI. The latest BI tools like IBM Cognos Analytics, SAP BusinessObjects BI and Amazon QuickSight are equipped with AI, machine learning and predictive analytics to analyse large volumes of data. A BI dashboard can even access real-time data, identify business patterns and trends, forecast future performance, and offer remedial actions. These analytical tools are equipped with AI algorithms and machine learning that can consolidate data silos and aggregate them into meaningful information. The suppliers, partners, and employees can access

information instantly, analyse and share them with others. The BI systems success helps organisations in optimising their business performance, thereby increasing the organisation's profitability and productivity.

However, some organisations faced challenges when using the BI system solutions. Most PLC still focus on the basic needs of operational reporting with minimal BI capabilities, while predictive analytics and optimisation are seen as a luxury for many organisations. It was observed that IT staff lacked an understanding of how to use BI analytics to improve their business. Organisations also lacked the expertise and analytical skills to implement a BI system. IT staff and managers need serious trainings to understand how to implement a BI system. Most of the companies also have limited funding to cover BI project implementation (Hasan, Rahman, and Lahad, 2016). As BI system software is costly and requires high maintenance costs due to BI platform incompatibility, some companies are still using their legacy system that cannot be easily converted to a new BI system. To sum up, data warehouse design, data architecture, data security, data accuracy, data collection speed and data integration are the most lacking in Malaysian PLC, and this becomes a critical challenge for the success of BI systems for most PLC in Malaysia.

For example, Digi faced some data quality issues where some of the processed data could not be transformed into high quality information for decision making. The company also struggled to maintain a cross-functional view of information and lacked storage space to store daily transactions and data. The customer relationship management system (CRM) was not equipped with a powerful data mining algorithm, which in turn led to poor decision making (Bidin and Yunus, 2018). Although BI systems are designed to allow Digi to identify highly valuable (platinum membership), valuable (gold membership), less valuable (yellow membership) and non-valuable

customers, Digi employees may not have enough knowledge to retain highly valuable customers. The management processes and operational processes are all taken into consideration when dealing with the differences in customer values such as promotional discounts and priority services for valuable customers but not for less valuable customers.

1.1.3 Business Intelligence Capabilities

Business Intelligence capabilities are a critical factor in a company's competitiveness and survival (Braojos, Benitez, and Llorens, 2019). According to IBM Malaysia Chief Technology Officer, Freddy Lee, PLC that employ BI analytics capabilities tend to outperform their competitors. Three main building blocks of BI capabilities namely technology capability, culture capability and people capability are identified. Previous IS literature showed that technology capability (Mikalef, Krogstie, Pappas, and Pavlou, 2020), culture capability (Azeem, Ahmed, Haider, and Sajjad, 2021) and people capability (Bag, Wood, Xu, Dhamija, and Kayikci, 2020) have a positive significant relationship with IS success and organisational performance. Wamba, Gunasekaran, et al. (2017) tested technology infrastructure and talent capabilities as core components of big data analytics. Similarly, Jeble et al. (2018) have adopted organisational culture and technical capabilities as core components of big data predictive capability.

In this study, technology capability focuses on data quality, system integration and user access; culture capability touches on flexibility, management support and sponsorship; and people capability concerns service quality, technical knowledge, business knowledge, and technology management knowledge. According to Barney (1991), the capabilities of technology, culture, people skills and knowledge are viewed

as valuable resources in the core business and operational functions controlled by the organisations.

Teixeira, Oliveira and Varajão (2019) conducted an exploratory case study at Tintas Robbialac, SA, a Portuguese paint industry company. In the beginning, Tintas Robbialac struggled to access information in a timely manner due to a lack of BI tools and software. Nowadays, Tintas Robbialac has implemented databases and BI systems that enable the organisation to access real-time data, thus making a great impact for organisations. Business Intelligence systems have enabled them to better understand the business and support decision-making in achieving their business goals.

Inevitably, the BI systems success is associated with using the right BI analytical tools and methods to speed up the automated business processes, tasks, and transactions. Organisations can exchange information in seconds through data conversion and systems integration processes. The end results will then improve business productivity and efficiency (Masa'Deh, Obeidat, Maqableh, and Shah, 2018), upgrade product quality, reduce production costs, reach new markets and enhance decision-making (Mikalef, Pappas, Krogstie, and Giannakos, 2018; Torres et al., 2018). It has been shown that BI tools can access a company more realistically. Organisations will be easier to manage than before. However, these benefits depend on the team's ability to use the BI systems effectively and the organisation's ability to integrate, manage, share and analyse the data. The success of the BI system also depends on strong management support and sponsorship. Therefore, it is proposed that BI capability factors such as technology, culture and people have an impact on the BI systems success, which in turn affects organisational performance.

1.1.4 IT Governance Mechanisms

In addition, IT governance mechanisms have received much attention from academicians and practitioners. In this study, IT governance mechanisms are introduced as the moderator for the relationship between BI systems success and organisational performance. Implementing effective IT governance mechanisms creates business value and enhances organisational performance. IT governance mechanisms as a means of directing and coordinating IT-related decision-making can ensure that IT is aligned with corporate policies and business needs through proper communication channels. Previous studies have earlier tested IT governance mechanisms as moderator (Tanriverdi, 2006). Previous studies even emphasised the importance of IT governance mechanisms to enhance organisational performance (Wu, Straub, and Liang, 2015).

IT governance mechanisms are critical to regulate and monitor value creation in an organization and to ensure that the alignment of business strategy and IT strategy is on track to achieve the organisation's performance goals. The mechanisms enable the management to set expectations, communicate with all parties to achieve mutual understanding, and create good organisational participation and collaboration (Ali and Green, 2012). Each committee member across the organisation holds different roles, responsibilities, and authorities in making IT decisions. The positive relationship between BI systems success and organisational performance is stronger when IT governance mechanisms are higher. IT governance mechanisms can yield 20% higher returns on investment in organisations than weaker governance (Midha and Bhattacherjee, 2012; Peter Weill, 2004) and provide organisations with new business opportunities (Ali and Green, 2012). In the absence of IT governance mechanisms, there is a possibility of decline in organisational performance.

1.2 Problem Statement

The problem of organisational performance at PLC in Malaysia remains a concern. There is a trend that the Malaysian stock market has faced a variety of challenges in recent years. The FBM Kuala Lumpur Composite Index declined from 1,875.34 points (1st February 2018) to 1,492.52 points (17th January 2023). Malaysia's economic growth continues to slow down from 5.7% in 2017, 4.8% in 2018, 4.3% in 2019 to -5.6% in 2020. Nevertheless, according to the Department of Statistics Malaysia (2022), the economic growth rate of Malaysia's Leading Index (LI) accelerated to 8.8% at 109.6 points in October 2022, remaining above trend, indicating economic recovery in the near future and moderate economic outlook in 2023. According to the Malaysian Ministry of Finance, the Malaysian economy is projected to grow moderately at a rate of less than 5.0% in 2023 (Surin, 2023). The local stock market has underperformed since 2018 due to market uncertainties arising from political tensions, weak oil prices, ringgit devaluation, as well as international factors such as the China-US trade war (Intan Farhana, 2018).

PLCs' contribution to the Malaysian economy may have weakened, creating many challenges for PLC. Many companies would struggle to maintain their profit margins during an economic downturn (Teoh, Lee, and Muthuveloo, 2017). Budgets have been slashed, schedules have been crashed and top management have kept on pushing operational level to sustain a dozen of "top priority" initiatives at once (Gann, 2013). This affects the organisation's business performance when employees are overburdened with workloads while customers are disappointed with the results. In order to enjoy a high sustainable growth rate, high-performing organisations will always look for ways to achieve a sustainable competitive advantage. They continually adapt to changing environments to ensure long-term viability (De Waal, 2018). In the

past, some PLC such as Technology Resources Industries Bhd (TRI), Sime Darby Bhd, Bank Islam and Malaysia Airline System Bhd (MAS) have reported failure in their businesses (Teoh et al., 2017). TRI was involved in accounting fraud involving fictitious invoices. Sime Darby was fraught with malpractices in 2010 due to a project cost overrun scandal. Its net profit fell 28.6% from RM189 million in 2017 to RM135 million in March 2018 (theSundaily, 2018). Nonetheless, Sime Darby reported net income of RM1.93 billion in September 2022, up 8% year-on-year (Sime Darby, 2022). The positive performance was mainly due to higher production of fresh palm fruit in Indonesia and higher crude palm oil prices. Bank Islam was then involved in financial scandals, mismanagement and poor internal controls that have resulted in huge losses (Parker, 2005). Meanwhile, MAS had not performed well for about 15 years due to mismanagement in the company, high fuel costs and declining sales.

Organisations all underperformed for some specific reasons such as incomplete technology infrastructure (Al-Okaily, Teoh, and Al-Okaily, 2023), missing culture (Dubey et al., 2019), lacking talent or resources (Bag et al., 2020), inefficient management (Skevas and Cabrera, 2020), poor strategy execution (Radomska and Kozyra, 2020), or weak IT governance mechanisms (Young et al., 2019a). Most companies struggle to upgrade their existing BI infrastructure to take advantage of mobile BI data and cloud BI data where large amounts of data are generated online. The cost of upgrading to a mobile BI platform or cloud computing architecture, and system integration with other enterprise software applications to deal with different vendors worsen the situations. Most of the existing technologies may not be compatible with the new requirements for mobile BI analytics or cloud computing specifications. Data quality is one of the most important issues arising from the data collection process, data analysis to data visualisation (Kache and Seuring, 2017). Poor

data quality will bring no value to organisations (Mazzei and Noble, 2017). According to Ranjan (2008), organisations faced problems in pre-processing data due to inaccurate and irrelevant data. Organisations also face data security issues, e.g., how information should be made accessible to users and how not to prevent lose data. Moreover, information retrieval differs from web BI platform to desktop BI platform.

The information systems in some organisations were not flexible enough to quickly adapt to changing business needs. Insufficient flexibility limited the success of BI systems and shortened the lifespan of BI systems (Gebauer and Schober, 2005). The BI systems were basically not compatible with other IS applications and not scalable in terms of IT infrastructure, data, transaction volume and users. By the time organisations deliver the performance results, they may face another set of different challenges and requirements. Most importantly, a lack of interest from top management in using BI as a decision support tool could hamper the success of BI systems. The lack of skilled employees justifies the lack of commitment from top management. The lack of top management commitment to implementing BI systems then affects the funds allocated to BI technology and infrastructure (Shukla and Mattar, 2019). When an IT project is implemented, there may be limited funding to get things done. Most organisations would focus more on cutting costs than look for ways to increase profits (Gudfinnsson and Strand, 2018). In fact, Shukla and Mattar (2019) found that lack of management commitment and sponsorship are major barriers to IS success.

Besides, some underperforming organisations may not have retained their talent and resources to keep up with the competition, resulting in high turnover rates (De Waal, 2018). In many cases, most organisations often have limited resources and

competent employees for new activities. Organisations are highly dependent on skilled IT employees as they are the ones who can solve technical problems and integrate BI analytics with other systems (Akter, Gunasekaran, Wamba, Babu, and Hani, 2020; Akter, Motamarri, et al., 2020). Organisations with advanced analytical capabilities mostly have difficulty in recruiting qualified employees. Some IT employees lack the skills to use BI analytics and have limited knowledge of how BI systems can support business goals and objectives. Many organisations lack skilled employees to code and analyse structured and unstructured data, resulting in under-utilisation of data or overestimation of organisational problems (Amankwah-Amoah and Adomako, 2019). Some leaders have limited knowledge to interpret quality data, which can lead to wrong judgement decisions. Although some organisations own the data, they still lack the skilled people to analyse business patterns and customer behaviour.

Furthermore, the indirect effects of BI systems success on the relationship between BI technology, culture and people capabilities, and organisational performance have not been sufficiently explored. Not all BI capabilities had a direct effect on organisational performance. Therefore, this study addressed mediation in response to research calls from Ilmudeen (2021), Arefin et al. (2015) and Chen et al. (2014) to explain the transfer of organisational resource values to organisations. Therefore, BI system success serves as a middleman that explains how and why the BI capabilities could influence the organisatioal performance.

Previous studies, Tanriverdi 2006, examined that IT governance mechanisms do not have a significant moderating effect between IT resources and organisational performance due to the small sample size. Relatively little research has been conducted to examine the moderating effect of IT governance mechanisms on the relationship

between BI systems success and organisational performance, and such a crucial relationship has not been subjected to empirical testing.

Although some organisations consistently maintain their business performance, no company can guarantee sustainability performance and economic stability during economic downturns (Gavrea, Ilies, and Stegerean, 2011). Organisations need a set of performance measurements to measure and manage sustainability. Based on several literature and industry data, several organisations in Malaysia have adopted BI, analytics and big data (Ahmad and Hossain, 2018; Baharuden, Isaac, and Ameen, 2019; Jayakrishnan, Mohamad, Azmi, and Abdullah, 2018; Magaireh and Sulaiman, 2019; Teoh et al., 2018). Meanwhile, most of the research have focused on SMEs and the public sector, but very little on PLC in the Malaysian context in various industry sectors such as construction, consumer products and services, energy, financial services, health care, industrial products and services, plantation, property, real estate investment trusts, technology, telecommunication and media, transportation and logistics, and utilities.

This study intends to examine the influence of BI capabilities on BI systems success and its impact on the overall organisational performance of Malaysian PLC. In addition, the mediating role of BI systems success and the moderating effect of IT governance mechanisms are examined.

1.3 Research Objectives

The aim of the study is to examine the impact of BI capabilities on the organisational performance of Malaysian Public Listed Companies with the BI

systems success as mediator and IT governance mechanisms as moderator. Specifically, the research objectives are:

1. to examine the influence of data quality, system integration and user access of BI technology capability on BI systems success among PLC in the main market of Bursa Malaysia.
2. to examine the influence of flexibility, management support and sponsorship of BI culture capability on BI systems success among PLC in the main market of Bursa Malaysia.
3. to examine the influence of service quality, technical knowledge, business knowledge, and technology management knowledge of BI people capability on BI systems success among PLC in the main market of Bursa Malaysia.
4. to examine the relationship between BI systems success and organisational performance among PLC in the main market of Bursa Malaysia.
5. to examine the mediating effect of BI systems success on the relationship between data quality, system integration, user access, flexibility, management support and sponsorship, service quality, technical knowledge, business knowledge and technology management knowledge, and organisational performance among PLC in the main market of Bursa Malaysia.
6. to examine the moderating effect of IT governance mechanisms on the relationship between BI systems success and organisational performance among PLC in the main market of Bursa Malaysia.

1.4 Research Questions

The following research questions were formulated to achieve the objectives of the study.

1. Do data quality, system integration and user access positively influence BI systems success among PLC in the main market of Bursa Malaysia?
2. Do flexibility, management support and sponsorship positively influence BI systems success among PLC in the main market of Bursa Malaysia?
3. Do service quality, technical knowledge, business knowledge, and technology management knowledge positively influence BI systems success among PLC in the main market of Bursa Malaysia?
4. Does BI systems success positively influence organisational performance among PLC in the main market of Bursa Malaysia?
5. Does BI systems success mediate the relationship between data quality, system integration, user access, flexibility, management support and sponsorship, service quality, technical knowledge, business knowledge and technology management knowledge, and organisational performance among PLC in the main market of Bursa Malaysia?
6. Does the relationship between BI systems success and organisational performance among PLC in the main market of Bursa Malaysia become stronger when the influence of IT governance mechanisms as moderator is higher?

1.5 Scope of the Study

The research methodology used in this study is a quantitative approach. To obtain significant and presentable results, the scope of this study covers 758 PLC listed on the Bursa Malaysia main market (as of 3rd February 2021). Various industry sectors studied were construction, consumer products and services, energy, financial services, health care, industrial products and services, plantation, property, real estate