BIG DATA ANALYTICS ADOPTION AND ITS IMPACT ON ORGANIZATIONAL PERFORMANCE IN MALAYSIAN SMALL MEDIUM ENTERPRISE

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AI	Artificial Intelligence
ASEAN	Association Of Southeast Asian Nations
AVE	Average Variance Extracted
BDA	Big Data Analytics
BI	Business Intelligence
BSC	Balanced Scorecard
CAGR	Compound Annual Growth Rate
CB-SEM	Covariance-Based SEM
CEO	Chief Executive Officer
COVID-19	Coronavirus Disease 2019
CR	Construct Reliability
DMP	Decision-Making Process
DOI	Diffusion Of Innovation
GDP	Gross Domestic Product
HTMT	Heterotrait-Monatrait
ICT	Information And Communications Technology
IDC	International Data Corporation
IoT	Internet Of Things
IR	Industrial Revolution
IS	Information System
IT	Information Technology
MCO	Movement Control Order
MDEC	Malaysia Digital Economy Corporation
MIRF	Malaysia International Retail And Franchise Exhibition
MIT	Massachusetts Institute Of Technology
NSDC	National Sme Development Corporation
OECD	Organization For Economic Co-Operation And Development
PLS	Partial Least Square
R&D	Research And Development
RBV	Resource Based View
RFID	Radio-Frequency Identification

ROI	Return On Investment
RPA	Robotic Process Automation
SAMENTA	Small And Medium Enterprises Association
SEM	Structural Equation Modelling
SMEs	Small Medium Enterprise
SPSS	Statistical Package Of Social Science
SPV	Shared Prosperity Vision
TOE	Technological, Organizational And Environmental
UK	United Kingdom
US	United States
VIF	Variation Inflation Factor
VRIN	Valuable, Rare, Imperfectly Imitable And Nonsubstitutable

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ABSTRAK

Walaupun sumbangan sektor perkhidmatan dari perusahaan kecil dan sederhana (PKS) adalah penting terhadap ekonomi Malaysia, kadar penggunaan analisis data raya (BDA) oleh PKS di Malaysia kekal rendah dan masih di peringkat penerokaan. Sektor perkhidmated PKS adalah sektor yang paling terjejas semasa pandemik COVID-19, oleh itu, amatlah penting bagi mereka untuk mendapatkan pandangan yang tepat pada masanya daripada BDA. Ini membolehkan PKS membuat keputusan strategik, mengubah kedudukan perniagaan daripada reaktif ke arah pendirian yang lebih proaktif pada zaman digital- pasaran tertumpu kini. Berdasarkan model Teknologi, Organisasi dan Alam Sekitar (TOE), kajian ini berhasrat untuk menyiasat pengaruh faktor TOE terhadap keputusan penggunaan BDA dan kesannya terhadap prestasi organisasi. Sebagai tambahan, berdasarkan Resource-based View (RBV), kajian ini menegaskan kepentingan untuk memahami kesan BDA ke atas proses membuat keputusan (DMP) untuk mendapatkan pemahaman yang lebih mendalam tentang hubungan antara penggunaan BDA dan prestasi organisasi. Akhirnya, dengan menggunakan Balance Scorecard (BSC), kajian ini menggabungkan ukuran bukan kewangan seperti kepuasan pelanggan, kecekapan proses perniagaan dalaman, pembelajaran dan pertumbuhan dengan ukuran kewangan dalam menilai prestasi organisasi. Data dikumpul melalui instrumen dalam talian - kaedah soal selidik melalui platform Survey Monkey daripada 158 syarikat PKS di bawah sektor

perkhidmatan di Malaysia. Penyenaraian dipilih daripada ahli Persatuan Perusahaan Kecil Sederhana (SAMENTA) Malaysia dan dianalisis dengan kedua-dua IBM SPSS Statistics 27 dan SmartPLS 4. Keputusan menunjukkan bahawa daripada dua belas hipotesis yang diuji, tujuh hipotesis adalah disokong. Faktor kelebihan relatif, kerumitan dan tekanan persaingan didapati mempunyai kesan positif terhadap penggunaan BDA. Sebagai tambahan, penggunaan BDA didapati mempengaruhi DMP dan prestasi organisasi dengan ketara. DMP juga didapati mempunyai pengaruh yang signifikan terhadap prestasi organisasi. DMP yang dikenal pasti sebagai pengantara antara penerimaan BDA dan prestasi organisasi, menunjukkan bahawa kejayaan pelaksanaan BDA memerlukan bukan sahaja aset data dan kepakaran analitik tetapi juga pemahaman tentang proses pengantaraan yang membolehkan nilai perniagaan strategik. Penemuan ini menawarkan pandangan yang berharga untuk PKS Malaysia, kerana ia mendedahkan pemacu penting penggunaan BDA dan implikasinya terhadap prestasi organisasi. Kajian ini menyerlahkan kepentingan peranan DMP dalam membawa manfaat melalui penggunaan BDA dalam persekitaran perniagaan yang berkembang pesat hari ini. Secara keseluruhannya, kajian ini akan memberi bukti empirikal BDA sebagai disiplin penyelidikan, daripada peringkat pra-penggunaan kepada pasca-penggunaan, sementara menyumbang kepada literatur system informasi, penemuan juga boleh membantu pihak berkenaan dalam merangka strategi masa depan mereka untuk projek BDA.

BIG DATA ANALYTICS ADOPTION AND ITS IMPACT ON ORGANIZATIONAL PERFORMANCE IN MALAYSIAN SMALL MEDIUM ENTERPRISE

ABSTRACT

Despite the importance of services sector in small medium enterprises (SMEs) towards Malaysia economy, the rate of adoption of big data analytics (BDA) by SMEs in Malaysia remains low, it is still at exploratory stage. As the most hit sector during the pandemic COVID-19, it is important for SMEs services sector to get timely insight from BDA, which allows them to make strategic decisions, changes the business position from being reactive towards a more proactive stance in today digital-focused market. Building on Technological, Organizational and Environmental (TOE) model, this study intends to investigate the influence of TOE factors has on BDA adoption decision and its impact on organizational performance. Furthermore, drawing from the perspective of the Resource-based View (RBV), this study asserts the importance of comprehending the impact of BDA on the decision-making process (DMP) to gain a deeper understanding of the link between BDA adoption and organizational performance. Finally, drawing on Balance Scorecard (BSC), this study incorporated non-financial measures such as customer satisfaction, internal business process efficiency, learning and growth with financial measures in assessing organizational performance. Data was collected via online instruments, questionnaires via Survey Monkey platform from 158 SMEs companies under services sector in Malaysia. Listing selected from members of Small Medium Enterprises Association (SAMENTA) Malaysia and analysed with both IBM SPSS Statistics 27 and SmartPLS

4. The findings indicated that out of the twelve hypotheses tested, seven were supported. The factors of relative advantage, complexity, and competitive pressure were found to have a positive impact on BDA adoption. Furthermore, BDA adoption was found to significantly influence DMP and organizational performance. DMP also found to have significant influence on organizational performance. DMP identified as a mediator between BDA adoption and organizational performance, indicate that successful implementation of BDA requires not only data assets and analytics expertise but also an understanding of the mediating processes that enable strategic business value. These findings offer valuable insights for Malaysian SMEs, as they uncover the significant drivers of BDA adoption and its implications for organizational performance. The study emphasizes the importance of DMP in leveraging the insight derived from BDA adoption in today's rapidly evolving business environment. Taken together, this study would provide empirical evidence of BDA as a research discipline, from pre-adoption to post-adoption stage, while contributing to IS literature, the findings could also assist relevant stakeholders in crafting their future strategy for BDA project.

CHAPTER 1

INTRODUCTION

1.1 Introduction

In this chapter, various aspects will be discussed, including the background of the study, problem statement, research objectives, research questions, scope of study, significance of the study, definition of key terms, and organization of the thesis.

1.2 Background of the Study

Since the 1970s, Malaysia, classified as an upper middle-income country, has undergone a remarkable transformation in its economic structure. Initially reliant on agriculture, the country shifted its focus to manufacturing in the mid-1980s, followed by a transition to modern services in the 1990s. To further progress in a more inclusive manner and promote high value-added economic activities, Malaysia introduced the Shared Prosperity Vision (SPV) 2030. This vision aims to empower entrepreneurs and Small and Medium Enterprises (SMEs), fostering their increased participation and contribution to the economy.

SMEs are vital component of the country. They are crucial for expansion of industries, the generation of employment opportunities, and the alleviation of poverty (Ismail et al., 2018). In the Organization for Economic Cooperation and Development (OECD) countries, SMEs comprise 99% of all businesses and contribute approximately 50-60% of the total value added. In Malaysia, SMEs make up 98.5% of the total business establishments, playing a significant role in the economy. These SMEs currently provide employment to approximately 5.7 million people. In the year 2018, SMEs made a noteworthy contribution of RM521.7 billion, accounting for 38.3% of Malaysia's gross domestic product (GDP) (Department of Statistics Malaysia,

2019). With SPV 2030, government is looking at boosting SMEs contribution to the GDP from the present 38% to 50% by 2030.

The areas of focus for Malaysia should include embracing digital adoption, fostering digital entrepreneurship, and promoting innovation. These aspects are vital for staying competitive and thriving in today's digital-driven economy. According to the Malaysian Business Sentiment Survey 2019/2020, to maintain competitiveness, Malaysian organizations must recognize the crucial role of technology. Embracing and leveraging technology will be instrumental in ensuring their continued competitiveness in the borderless global economy (Monash University Malaysia, 2020). Furthermore, adoption of digital technologies is no longer optional for businesses with the emerge of Coronavirus Disease 2019 (COVID-19) (*SME Corporation Malaysia - Challenges in Digital Adoption*, n.d.).

In the recent announced Budget 2022 Malaysia, one of the main pillars is to stimulate economic growth in the new economy and digital era, including to digitalize SMEs operations. This is to encourage SMEs to investigate digital transformation and technology adoption while setting SMEs ahead of Malaysia's journey to SPV 2030. Aligned with the Industrial Revolution 4.0 or Industry4WRD, the Government has pledged to allocate RM45 million as an incentive for technological transformation in SMEs and middle-aged companies operating in the manufacturing and services sectors. This initiative aims to support these businesses in embracing advanced technologies and adapting to the demands of the fourth industrial revolution.

The challenges face by SMEs regarding their overall performance have been a critical issue (Al-juboori et al., 2021). The two major forces that Malaysia SMEs face is the rapid rate of technological change and increasing industrialization. In general,

the challenges and opportunities face can be categorised into three categories: Technological, Organizational and Environmental.

From Technological perspective, the Fourth Industrial Revolution or IR 4.0 and the changes that it brings have disrupted and redefined the norm. Organizations have been able to enhance their position in the value chain, emphasizing higher value activities and strategic approaches, thanks to the advancements in cloud computing, big data analytics (BDA), Artificial Intelligence (AI), Internet of Things (IoT), Robotic Process Automation (RPA), and blockchain. However, it is crucial to recognize that these trends also have the potential to disrupt and reshape SMEs.

From Organizational perspective, one common similarity the SMEs have is they are constantly finding innovation solutions to respond to competitors, customers, and regulators for better organizational performance. However, in recent report by SME Corp Malaysia (*SME Corporation Malaysia - Challenges in Digital Adoption*, n.d.), many SMEs are still ill-equipped to make the transition towards digitalisation.

From Environmental perspective, Malaysia has actively undertaken substantial initiatives to create a conducive ecosystem that promotes digital entrepreneurship. The rate of change is likely to accelerate as further development occurs especially in relation to the initiatives by Malaysia Digital Economy Corporation (MDEC), who plays a pivotal role in spearheading efforts to establish a sustainable digital ecosystem that propels Malaysia's digital economy towards greater progress and development. Specifically, MDEC is taking a lot of initiatives in developing Malaysia into a prominent BDA hub within the ASEAN region, catering to diverse sectors across industries. Their efforts are focused on fostering a thriving BDA ecosystem that enables businesses in Malaysia to leverage the power of data analytics for enhanced performance and competitiveness. The speed of digitalization for SMEs is being

accelerated by the pandemic COVID-19. MDEC has urged Malaysian SMEs to accelerate and scale up their digital transformation journey.

Former Malaysian Prime Minister, Tun Dr Mahathir Bin Mohamad, emphasized the importance of SMEs adapting to digital disruption. He urged SMEs to embrace technology, specifically BDA, and make data-driven decisions to capitalize on growth opportunities presented by the digital business environment. This call to action aimed to encourage SMEs to leverage technology and data for their advancement and success (SME Annual Report, 2019).

This section provides an overview of big data and its analytical methods, and their relevance to organizational performance and decision-making processes (DMP). In addition, this section outline SMEs in Malaysia, including definitions, general performance, and the pivotal role of the services sector. Lastly, the adoption of BDA by SMEs in Malaysia, its impact on their performance, and the challenges they face will be discussed.

1.2.1 Big Data and Analytics: An Overview

With the wide spread of information communication technology (ICT), IoT, cloud computing platforms, the amount of data is growing exponentially. Today's digital landscape sees an overwhelming proliferation of data, not just from conventional transactional sources, such as retail outlets or financial institutions, but also from diverse digital interactions, including social media, multimedia, geospatial systems, and various sensor-generated streams (Manyika et al., 2011). Currently, the world generates a staggering 2.5 quintillion bytes of data each day, with 90% of this data being generated in the recent two years (Marr, 2018). This phenomenon is what is known as the 'Big Data' era.

The origin of the term of big data is because we are producing a large amount of data every day. Since then, many characteristics have been added to define big data. Doug Laney (2001) was the first one talking about 3Vs, which are volume, variety and velocity in big data. There are more Vs added by the leading big data solution providers, IBM and Microsoft added veracity and variability, McKinsey added value. Recently, there are 7 Vs in the literature: volume, velocity, variety, veracity, variability, visualization and value (Mikalef et al., 2017; Seddon & Currie, 2017).

Volume refers to the size or magnitude of the data, which is continuing to expand and has evolved from terabytes to petabytes and exabytes. Variety in the realm of data pertains to the assortment of data sources and types, encompassing both structured and unstructured formats., such as traditional transactional data, online games, user-generated text, images, and videos, social network data, sensor-based data, Web and mobile clickstreams, and spatial-temporal data (Hashem et al., 2015). Velocity refers to the speed at which data is gathered and analysed in real-time. or near real-time from digital devices (Gandomi & Haider, 2015).

Veracity is the trustworthiness of data, it ensures that the data use is trusted and authentic as coping with biases, doubts, impression, fabrications (Sivarajah et al., 2016). The inconsistency in data flow caused variability, which refers to the changes in data and how it affects the interpretation by users (Sivarajah et al., 2016). Visualization refers to sense-making activities, interpreting the patterns and trend from data (Seddon & Currie, 2017). Value refers to business value or economical insights generated by big data that create competitive advantage for organizations, through extraction and transformation (Wamba et al., 2015). This is the excitement around big data, where value is derived from the complex combination of all the Vs, the goal for many organizations (Riggins & Wamba, 2015).

The digital age has brought immense challenges for organizations in managing big data. Traditional databases and business intelligence tools, designed for structured data, falter when faced with the heterogeneity and scale of big data (Kambatla et al., 2014; Saggi & Jain, 2018). The need for robust, agile solutions is evident, as businesses seek to centralize information and enhance decision-making processes (DMP) (Gupta & George, 2016; Lavalle et al., 2011).

The field of Big Data Analytics (BDA) has evolved in response to these challenges. BDA applies advanced analytic techniques to large data sets, enabling organizations to uncover hidden patterns, correlations, and other insights (Russom, 2011). While the concept of analytics isn't new, the ability to process vast amounts of data in the digital economy sets BDA apart, offering unprecedented opportunities for insight and innovation (Fan & Bifet, 2013; McAfee et al., 2012).

Several authors provide varying perspectives on BDA's definition, emphasizing different aspects such as the process, technology, and organizational performance. However, there's consensus on BDA being a comprehensive approach for managing, processing, and analysing big data to generate actionable insights (Akter & Wamba, 2016; Frost & Sullivan, 2015; Grover et al., 2018; Kwon et al., 2014; Wamba et al., 2017). Following Grover et al., (2018), this study defines BDA as the application of statistical, processing, and analytics techniques to big data for advancing business.

BDA methods such as descriptive, predictive, and prescriptive analytics play distinct roles in interpreting big data. From explaining historical data to forecasting future scenarios and advising on potential outcomes, these methods require sophisticated tools and platforms for data processing (Casado & Younas, 2015; Kambatla et al., 2014; Marz & Warren, 2015).

The trend toward analytics reflects the industry's shift towards a more integrated and comprehensive platforms that offer end-to-end solution. Gartner highlights the importance of augmented analytics, an approach integrating machine learning and AI into the data analytics process, enhancing efficiency and insight generation (Mitchell, 2023; Richardson et al., 2021)

In its Magic Quadrant for Analytics and Business Intelligence Platforms, Gartner evaluates leading platforms based on their ability to execute and completeness of vision. Recent updates to the quadrant reflect the dynamic nature of the market, which become increasingly customer-centric has created demand in unified view of the customer experience that put Microsoft, Salesforce and Qlik in the leading category (Mitchell, 2023)

Figure 1.1 Magic Quadrant for Analytics and Business Intelligence Platforms 2023

Source: Mitchell (2023)

In conclusion, the landscape of big data and analytics is complex and ever evolving. As data continues its exponential growth, the tools, methodologies, and frameworks used to analyse and derive value from this data must evolve in tandem. Organizations embracing these advancements position themselves to gain significant competitive advantages, driving innovation and success in the digital era.

Given this ever-evolving landscape, it is essential to delve deeper into the practical applications and implications of BDA within organizations. As companies harness the power of data, they encounter both opportunities and challenges. How does BDA influence the core functions and performance of businesses, especially in DMP? And how have leading businesses leveraged these insights to gain an edge in the competitive market?

1.2.2 BDA's Role in Organizational Performance and Decision-Making

The pervasive impact of BDA on organizational performance and decision-making processes DMP cannot be overstated (Chatterjee et al., 2023; Fanelli et al., 2023). Recognized for its strategic importance, BDA enhances business effectiveness and efficiency, thus fostering improved organizational performance (Acciarini et al., 2023; Dubey et al., 2020). This potent tool's unveiling in 2011 marked a pivotal moment, highlighting its sweeping applications across diverse sectors of the global economy (Manyika et al., 2011).

BDA is critical among its applications in organizations is its profound influence on market analysis and business decision-making (Chatterjee et al., 2023). Iconic retailers like Amazon and Walmart have harnessed BDA for nuanced market analysis, tailoring sales strategies based on customer preferences (Marr, 2016). In today's information-saturated era, customers grapple with excessive choices and insufficient guidance, complicating their purchasing decisions. Amazon, the colossal

online retailer, navigates this challenge by deploying big data to refine its marketing and customer service. Their sophisticated recommendation system anticipates customer needs, drawing on data points like purchase history, product reviews, and search patterns, thereby driving nearly 35% of the platform's purchases. Similarly, traditional retailers like Walmart leverage real-time data for analytics, ensuring agile responses to sales fluctuations across various locations.

Moreover, data-driven decision-making is becoming a staple in organizational strategies. For instance, Apixio, a California-based cognitive computing firm, employs BDA to parse unstructured data from diverse healthcare sources, aiming to bolster decision-making, curtail costs, and enhance patient outcomes (Marr, 2016). Similarly, in agriculture, John Deere's BDA approach, utilizing aggregated field data, guides farmers on crop strategies and planting decisions. The hospitality sector, including companies like Airbnb, also capitalizes on big data, analysing customer feedback to refine their offerings and strategic planning.

These instances underscore BDA's multifaceted role in global economic sectors. Its applications extend from personalizing customer experiences to real-time error rectification, enhancing decision-making quality, and decoding implicit customer interactions (Aggarwal & Manuel, 2016; Del Vecchio et al., 2018). By analysing and fine-tuning data, organizations can optimize internal processes and overcome operational hurdles. However, the impetus for adopting BDA should be anchored in concrete business needs rather than mere technological trends.

Despite acknowledging data as a strategic asset, many organizations falter in converting it into actionable analytics. Effective data management is imperative for digital transformation, analytics competition, or evolving into a data-driven entity. BDA's essence is not just in managing voluminous data but in fostering innovation and

adaptability in a dynamic business environment. This necessitates a digital intuition—interpreting extensive data to discern patterns, foresee trends, and facilitate informed decisions. Without identifying specific business challenges or opportunities, the return on investment (ROI) from BDA remains constrained.

BDA's influence extends significantly to organizational DMP. It's a pivotal element in business operations, enabling proactive management and informed decisions through real-time insights (Bhimani & Willcocks, 2014; Chatterjee et al., 2023; Gandomi & Haider, 2015; Li et al., 2022). This technology-fuelled ecosystem, with its advanced analytical methods and tools, helps organizations extract meaningful knowledge from data, thus enhancing decision-making across domains (Saggi & Jain, 2018).

However, several impediments hinder BDA's expanded usage. These include gaps in understanding business and data strategies, deficient data governance protocols, lack of a unified vision, and challenges in deriving value from projects specifically in SMEs (Chatterjee et al., 2023; Mangla et al., 2021) Often, the failure in BDA initiatives is attributed to poor management and utilization of insights, causing disruptions in established practices (Lavalle et al., 2011; Ransbotham et al., 2016; Sharma et al., 2014).

Competitive dynamics may compel organizations to embrace BDA, yet investments won't yield returns if the internal framework doesn't support swift, data-informed decisions. Prioritizing value creation and ROI is essential when adopting BDA. DMP is profoundly affected and often transformed by BDA (Chatterjee et al., 2023; Gandomi & Haider, 2015). While the impact of BDA on DMP is becoming increasingly important for organizations, its influence and application in specific sectors and economies hold unique narratives. One such sector where the

transformative power of BDA, coupled with other macroeconomic challenges, takes on special significance is the realm of SMEs. In places like Malaysia, SMEs form the bedrock of the national economy. However, the challenges they face, especially in the services sector, provide a unique context to understand the interplay between technological advancements like BDA and the changing economic landscape.

1.2.3 SMEs in Malaysia: An Overview

SMEs form the backbone of Malaysia's economy, playing a critical role in economic growth, job creation, and social cohesion. Despite their significance, SMEs face unique challenges, which have been amplified by the COVID-19 pandemic, particularly within the services sector. This overview delves into the definition, performance, and role of SMEs in Malaysia's economy, with a keen focus on the services sector.

In Malaysia, SMEs are categorized based on two criteria: the number of full-time employees and annual sales turnover. According to SME Corporation Malaysia and the Department of Statistics Malaysia, SMEs are legally defined depending on their operational sector: the manufacturing sector includes companies with sales turnover not exceeding RM50 million or staff not exceeding 200 people; for services and other sectors, the cap is at RM20 million turnover or a workforce not exceeding 75 people (SME Corp Malaysia, 2022).

In July 2013, SME definition was endorsed at the 14th National SME Development Council (NSDC) Meeting (SME Corp, 2016). In general, SMEs Malaysia are defined by category namely micro, small and medium is presented as follows Table 1.1. The definition covers all sectors, namely services, manufacturing, agriculture, construction, and mining & quarrying.

Table 1.1 Malaysia SMEs Definition

Size	Manufacturing Sectors	Services and Other Sectors
Medium	Sales Turnover: RM15 mil ≤ RM50 mil OR Employees: from 75 to ≤ 200	Sales Turnover: RM3 mil ≤ RM20 mil OR Employees: From 30 to ≤ 75
Small	Sales Turnover: RM300, 000 < RM15 mil OR Employees: From 5 to <75	Sales Turnover: RM300, 000 < RM3 mil OR Employees: From 5 to < 30
Micro	Sales Turnover: < RM300, 000 OR Employees: < 5	Sales Turnover: < RM300, 000 OR Employees: < 5

Source: SME Corp. Malaysia

Historically, SMEs have been instrumental in Malaysia's economic landscape, contributing significantly to the country's GDP, employment, and innovation. As of 2022, SMEs contributed 38.4% to the GDP, displaying steady growth (Department of Statistics Malaysia, 2023). The services sector and manufacturing sector were the primary contributors to the GDP of SMEs in 2022, accounting for the largest share of the overall SMEs GDP, which accounted for 82.4% of overall SMEs GDP. Services sector contributed 63.6% to SMEs GDP while manufacturing contributed 21.0% to SMEs GDP. Remaining 15.4% was contributed by agriculture, 9.3%; Construction, 4.5%; and mining and quarrying, 0.5% (Department of Statistics Malaysia, 2023).

SMEs' performance is a crucial indicator of economic health. Moreover, the significance of SMEs in Malaysian economy can be seen from studies which set to investigate SMEs performance, challenges and growth in Malaysia from different perspectives (Baharuden et al., 2019; Hedelin & Allwood, 2002; Lo et al., 2016; Musa & Chinniah, 2016; Palanimally, 2016; Ramayah et al., 2013; Rosli & Sidek, 2013; Selamat et al., 2011; Yuan et al., 2019; Yusoff et al., 2018).

In recent years, particularly with the onslaught of the COVID-19 pandemic, SMEs have faced unprecedented challenges. A report by the International Labour Organization highlighted that the services sector, primarily composed of SMEs, was

significantly impacted due to restrictions and reduced consumer spending (Lim, 2020). Consequently, there was a substantial reduction in SMEs' business performance, with 70% indicating a significant decrease in business activities within a week (Annuar, 2020). The Department of Statistics Malaysia reported a stark decline in SMEs' GDP growth by 7.3% in 2020, the first of such occurrence since 2003 (Department of Statistics Malaysia, 2020).

The COVID-19 pandemic fast-tracked the digital transformation across various sectors. SMEs in the services sector particularly recorded a surge in e-commerce transactions, with a 32.7% increase in income in early 2020 compared to 2019. In the first quarter of 2021, e-commerce income stood at RM254.6 billion, a 30% rise from RM195.9 billion in the corresponding period in 2020 (Sigala, 2020).

However, digital adoption among SMEs isn't uniform or without challenges. SMEs encounter challenges such as limited access to financing, technological adoption, and skill deficits, which impede their growth and sustainability (Mustafa & Yaakub, 2018). A 2020 survey by Workday revealed that only 25% of Malaysian organizations fast-tracked their digital transformation plans due to the pandemic. In contrast, 60% slowed down their initiatives. Additionally, a survey by the SME Association of Malaysia showed only 26% of SMEs adopted digitalization or e-commerce platforms post-pandemic (Lim, 2021). This shows a lack of urgency among Malaysian SMEs in terms of adopting digitalisation measures as quickly as possible.

The reluctance towards digital adoption among SMEs is often attributed to perceived high costs, complexity, and lack of urgency. They also face challenges in online connectivity, customer and supplier communication, and a need for enhanced infrastructure (“COVID-19: Impact on Malaysian Businesses | EY Malaysia,” 2020).

The services sector is particularly crucial for Malaysian SMEs, contributing 19.2% of total SME exports and accounting for 64.1% of employment in SMEs (Department of Statistics Malaysia, 2023). Growth in this sector, especially in sub-sectors like accommodation, finance, insurance, real estate, and business services, has been significant, though it faced a slowdown in 2020.

The COVID-19 pandemic severely affected this sector, causing an unparalleled decline in economic activities. This was exacerbated by travel restrictions and a decrease in tourist arrivals, affecting sectors like travel, accommodation, and food and beverages. Despite these challenges, the services sector holds potential for recovery and growth, especially with the accelerated adoption of digitalization, offering new avenues for expansion in e-commerce, the gig economy, and ICT-related services (Ministry of Finance Malaysia, 2021).

The Malaysian government has implemented measures to support SMEs, particularly during economic downturns. For example, during the tax holiday period in 2018, the government introduced initiatives to alleviate living costs, such as setting RON95 petrol prices and offering special payments for civil servants and pensioners. These measures indirectly supported consumer spending, benefiting the services sector (SME Corporation Malaysia, 2018).

In the realm of digital adoption, while SMEs acknowledge digitalization's potential, the uptake has been slow due to concerns over costs, human capital, information security, and resistance to change (Tham & Atan, 2021). The government, in collaboration with private entities like Huawei, has conducted studies to understand and address these challenges, aiming to facilitate digital transformation among SMEs (SME Corporation Malaysia, 2018).

SMEs remain pivotal to Malaysia's economic stability and growth. The sector's resilience, especially in services, is being tested in the face of current global challenges. However, there's a silver lining as the adversity accelerates digital transformation, opening new growth pathways. While the government's role is crucial in facilitating this transition, SMEs' ability to adapt, upskill, and innovate will define their sustainability and success in the evolving economic landscape.

This evolving economic landscape, highlighted by an increasing reliance on digital processes, brings to the fore another critical element in the toolbox of SMEs — BDA. As digital transformation fast becomes a necessity rather than a choice, the integration of BDA into SMEs' operations presents a new frontier for innovation, competition, and growth. The following section explores the adoption, performance, and challenges of BDA among Malaysian SMEs, shedding light on the intricacies of this digital revolution and its impact on the business strategies of these enterprises.

1.2.4 SMEs and BDA in Malaysia: Performance, Adoption and Challenges

Since its strategic inception in 2013, Malaysia has positioned itself as a frontrunner in BDA among ASEAN countries, leapfrogging others like Thailand and Indonesia through a well-orchestrated BDA roadmap. This vision is propelled by the Malaysia Digital Economy Corporation (MDEC), tasked with nurturing both domestic and international digital capabilities.

This transition establishes a bridge between the general overview of SMEs and their digital transformation journey, and the specific exploration of how BDA is influencing their strategies and operations. It acknowledges the ongoing digital changes, setting the stage for a deeper dive into how BDA is becoming a game-changer in the SME landscape.

The integration of BDA in business operations extends beyond mere financial gains. It has a profound impact on various aspects of organizational performance, including operational efficiency, customer service, and innovation capabilities. According to a report by the MIT Sloan Management Review, companies that have embraced BDA are more likely to innovate and create new products and services compared to their counterparts who have not adopted this technology (Ransbotham & Kiron, 2017).

In Malaysia, SMEs that have employed BDA have experienced tangible benefits. For example, a local SME in the retail sector utilized BDA to optimize its marketing strategies, resulting in a 3% revenue increase and generating over 3,000 potential customer leads within a short span. Such instances highlight the significant returns that can be garnered from investing in BDA, both in terms of financial and non-financial metrics (Manyika et al., 2011).

However, the adoption of BDA is not widespread among Malaysian SMEs, primarily due to challenges related to costs, lack of expertise, and technology integration complexities. Despite these challenges, it is imperative for SMEs to consider BDA adoption to enhance competitiveness and ensure sustainability in the rapidly evolving digital marketplace.

The digital era, characterized by the proliferation of IoT, mobile applications, and social media, generates immense data that can be harnessed for business insights, market opportunities, and operational efficiency. However, the adoption rate of BDA among Malaysian SMEs remains low compared to larger organizations.

The urgency for digital transformation among SMEs has been further underscored by the COVID-19 pandemic, which has highlighted the need for businesses to be agile, adaptable, and data-driven (The Edge Markets, 2020). Despite

this, a study by SME Corporation Malaysia indicated that about half of the SMEs surveyed cited financing as the primary barrier to technology adoption, followed by challenges related to employee skill sets, technological complexity, and strategic alignment (SME Corporation Malaysia, 2018). This data reveals a gap between the recognition of the benefits of BDA and the actual implementation of this technology among SMEs in Malaysia. The barriers to adoption are not merely financial but also relate to human capital, organizational culture, and technology infrastructure.

According to recent survey - Malaysia BDA and AI Adoption Blueprint 2021, Malaysia is at Level 3 (Systematic) (Figure 1.2) in its BDA maturity (BIGIT Sdn Bhd, 2021), moving from Among all sectors, telecommunications, media and entertainment, aviation, and financial services have achieved the highest level of maturity in terms of BDA and AI (BIGIT Sdn Bhd, 2021).

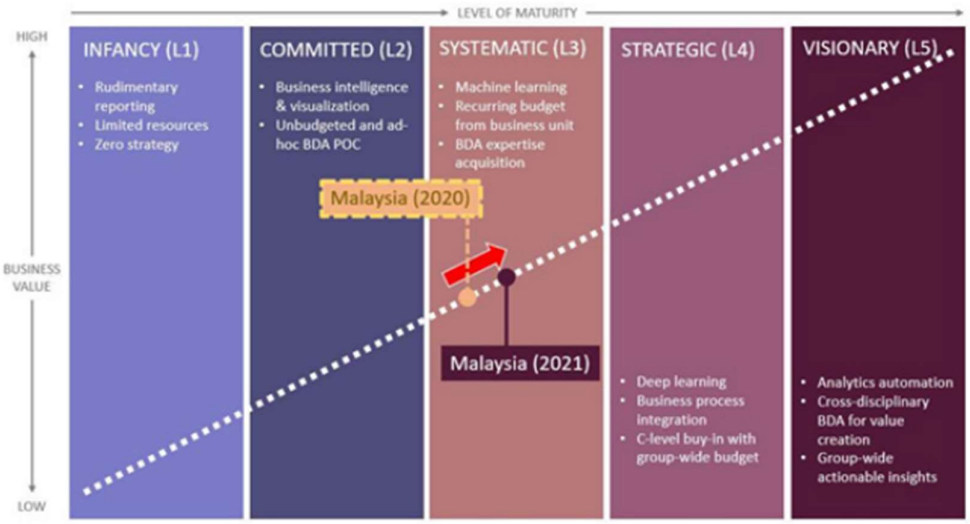

Figure 1.2 Malaysia's BDA Maturity (Overall)

Source: BIGIT Sdn Bhd (2021, p.7)

According to a study conducted by IDC for MDEC, the BDA market in Malaysia is projected to experience significant growth, with its value expected to increase from USD $1.1 billion (RM 4.5 billion) in 2021 to USD $1.9 billion by 2025.

The services sector is anticipated to contribute 64% of the overall data-driven spending, while the banking and telecommunications sectors are estimated to contribute nearly one-third of the total expenditure. MDEC is dedicated to supporting talent development in the field of BDA, as the agency believes it will enable Malaysia's talent and economic players to tap into the global economy, which is projected to generate revenue worth USD $13 trillion by 2030 (The Sun Daily, 2021). According to the study, it is predicted that the BDA market in Malaysia will experience growth. The services sector is expected to account for 64% of the overall data-driven spending, while the banking and telecommunications sectors will contribute approximately one-third of the total expenditure.

For SMEs, however, several significant challenges impede BDA adoption. The BIGIT survey identified key organizational barriers including a lack of skilled data professionals, budget constraints, absence of a clear business strategy for BDA, and insufficient support from stakeholders (BIGIT Sdn Bhd, 2021). Technological challenges also present a hurdle, with concerns over data governance, technology complexity, and a lack of industry-specific use cases demonstrating the efficacy of BDA.

Earlier, the SME Corporation Malaysia study underscored financing as a major obstacle, along with skill gaps, technology integration issues, and inadequate networking and regulatory support (SME Corporation Malaysia, 2018). These challenges indicate a need for a multifaceted approach to address the financial, structural, and cultural barriers to BDA adoption among Malaysian SMEs.

To accelerate BDA adoption among SMEs, a multi-pronged strategy involving various stakeholders, including government, industry bodies, and educational institutions, is essential. Government initiatives could include financial incentives,

grants, and educational programs to alleviate the financial burden and enhance the skill set of the SME workforce. Industry bodies could facilitate knowledge sharing, provide platforms for collaboration, and advocate for policies that support SMEs' technological advancement.

Educational institutions play a critical role in equipping the future workforce with the necessary skills in data analytics and technology management. Incorporating BDA-focused curricula and providing practical training can help bridge the skill gap in the industry.

BDA holds transformative potential for SMEs in Malaysia, offering avenues for enhanced performance, innovation, and competitive advantage. However, its adoption is encumbered by challenges spanning financial, organizational, and technological domains. Overcoming these hurdles requires a collaborative approach involving policy support, investment in human capital development, and fostering an organizational culture that embraces digital transformation. By addressing these challenges, SMEs in Malaysia can harness the full potential of BDA, driving growth, innovation, and sustainable development in the digital economy.

Although SMEs in Malaysia as well as they expose to the rapid rate of technological change and increasing industrialization. BDA adoption rate for SMEs in Malaysia remains low (Tien et al., 2019), utilization data analytics is uncommon for SMEs in Malaysia (SME Corporation Malaysia, 2018), it is still at exploratory stage (Hong & Ping, 2020). The importance of SMEs to nations economic is undeniable, Maroufkhani et al., (2019) urge future studies to look into factors influencing BDA adoption for organizations like SMEs and ensuring that SMEs get value from BDA adoption.

1.3 Problem Statement

The challenges face by SMEs regarding their overall performance have been a critical issue (Al-juboori et al., 2021). Although SMEs in Malaysia have shown positive performance in recent years, their contribution to the total economy of the country remains comparatively small when compared to other advanced and developing nations (Kee & Rahman, 2020). Many studies reported that failure rate for SMEs is very high. Almost 60% of SMEs cease businesses within initial five years of business (Ahmad & Seet, 2009; Chong, 2012; Kee-Luen et al., 2013; Yusoff et al., 2018). SMEs in Malaysia encounter plenty of challenges and roadblocks to remain competitive in the marketplace. In general, the challenges face can be categorised into: Technological, Organizational and Environmental categories.

Services sector, being the largest sector of SME establishment in Malaysia with 85.5% of total SME establishment is particularly hard hit by COVID-19. Studies have identified technology as competitive resources and predictor for SMEs performance in Malaysia (Abdullah et al., 2013; Alam & Noor, 2009; Bakar et al., 2020; Ismail et al., 2018; Ismail et al., 2014; Lo et al., 2016; Ramayah et al., 2013; Teh & Kee, 2019). According to the Malaysian Business Sentiment Survey 2019/2020, technology is crucial in assisting Malaysian organizations to remain competitive in the borderless global economy (Monash University Malaysia, 2020), that was before the pandemic of COVID-19. The COVID-19 pandemic has expedited the uptake of technology adoption among businesses, the education sector, and society at large. Research indicates that the economic benefits derived from digital trade in Malaysia could increase from RM31 billion in 2019 to RM222 billion by 2030, provided they are fully harnessed (Ministry of Finance Malaysia, 2021). This opens up new growth opportunities for various service-based industries and the corresponding supporting

sectors, as services sector was the hardest hit sectors by the pandemic (Lim, 2020). This reflects the importance of technology or digitalization for SMEs in services sector.

Over the last decade, we have witnessed how technology disrupt the business world. Digitalization and BDA lead us to a new data-driven business era (Carillo, 2017), which challenge and reshape business models in many traditional industries with the objectives at optimizing existing business process and cost reduction (Loebbecke & Picot, 2015). In the real world of dynamic competition, more and more organizations leverage on BDA adoption to increase their decision-making efficiency and gain competitive advantage (Constantiou & Kallinikos, 2015; Gupta & George, 2016; Sivarajah et al., 2016). Increasingly, large organizations in various sectors are adopting BDA to improve their organizational performance. T

his is witness through the adoption of BDA by Malaysian public listed companies like Celcom, Malaysia Airpots, Telekom, Petronas, CIMB banks and so on in recent years. BDA is view as a strategic asset for competitive differentiation, especially in business processes. Large companies have a clear rationale for technology adoption as it enhances efficiency, competitiveness, and economies of scale. By adopting advanced technologies like automated production processes and data-driven quality control, these firms can reduce costs and boost profit margins. However, the situation is not as straightforward for SMEs when it comes to digitalization. SMEs often view digitalization as complex, costly, and unnecessary (Tong & Gong, 2020).

Although SMEs in Malaysia as well as they expose to the rapid rate of technological change and increasing industrialization. BDA adoption rate for SMEs in Malaysia remains low (Tien et al., 2019), utilization data analytics is uncommon for SMEs in Malaysia (SME Corporation Malaysia, 2018), it is still at exploratory stage

(Hong & Ping, 2020). The importance of SMEs to nations economic is undeniable, Maroufkhani et al., (2019) urge future studies to look into factors influencing BDA adoption for organizations like SMEs and ensuring that SMEs get value from BDA adoption.

In a recent Malaysia AI Blueprint 2020 Annual Report by BIGIT Sdn Bhd (2020), majorities of barriers for Malaysian organizations are lies in the areas of technology-organization-environment (TOE), a framework by Tornatzky and Fleischer (1990). Topics under TOE such as, leadership, talent management, technology and tools, information eco-systems, company culture, data privacy, business value and DMP, which have an enormous impact on 'big data' adoption were said to be under research in BDA field (Fosso Wamba et al., 2015). Thus, it is worth the effort to investigate on factors influencing BDA adoption among SMEs in Malaysia, specifically in these areas.

One of the main challenges in BDA adoption Malaysia organizations is, lack of business understanding or strategy (BIGIT Sdn Bhd, 2020). Organizations are under appreciating the value of data, many do not see the return on investment of BDA. As what Mathieson, (1991) pointed in IS research - no matter how good is the technology or system, the systems or technology that are not used cannot be effective, even though they can provide many benefits or advantages. Studies continues to show that organizations are struggling with BDA adoption and deployment, almost half of big data related projects were never completed in large organizations (Marr, 2015). Even with BDA adoption, most of organizations still fail to create value from BDA adoption (Lycett, 2013; Mithas, Lee, Earley, Murugesan, & Djavanshir, 2013; Sharma et al., 2014), in particular, BDA investments often do not yield significant return due to organizations' lack of readiness to make decision based on the insight derived from

big data (Ross et al., 2013). Although analytics has been viewed as a crucial part of DMP, 55% respondents from a recent survey feels that senior management of organizations often do not support big data decision models as a strategic tool (Hagel, 2015). Encouraging analytics activities can often be a challenge as it requires questioning established conventions and customary practices (Ransbotham & Kiron, 2018).

To derive the maximum value from BDA adoption, organizations need to prioritize a targeted approach that aligns with their business needs, rather than solely concentrating on technology (Aggarwal & Manuel, 2016; Del Vecchio et al., 2018; Grover et al., 2018). The focus of BDA is on innovating the next big shift for organizations to keep pace with the fast-changing business environment. This requires businesses to develop a sense of digital intuition, which constitutes leveraging insights from huge amount of data to find patterns, anticipate trends, make informed decisions, and manage change. Thus, investment in BDA will not bring return if internal setup does not allow organizations to quickly make decision and change based on what the data is telling them.

The aim of adopting BDA is to achieve strategic business value, which in turn enhances organizational performance. However, the limited understanding of the connection between BDA adoption and organizational performance has hindered the early growth of BDA adoption (Akter et al., 2016; Kiron et al., 2014; Manyika et al., 2011). The hypothesis "business analytics leads to value" needs further analysis (R. Sharma et al., 2014). Specifically, Abbasi et al., (2016) urge researchers to rethink the DMP for better performance prior to the big data era and adapt them for the use in this digital age. In short, DMP as a result from BDA adoption are particularly concerned

among many processes that are impacted and often transformed by BDA (Brynjolfsson et al., 2011; Gandomi & Haider, 2015).

In the field of BDA, may studies has tended to focus on big data challenges and opportunities (Boyd & Crawford, 2012; Chen & Zhang, 2014; Dhar & Mazumder, 2014; Sivarajah et al., 2016; Wang et al., 2016). There are some researches on BDA adoption (Agrawal, 2015; Malladi, 2013; Maroufkhani et al., 2023; Verma & Bhattacharyya, 2017b), however the literature and empirical study in this area are still very limited, especially in Malaysia (Maroufkhani et al., 2023). Specifically, the research on BDA adoption and organizational performance is limited, scholars see the needs to go beyond stages after BDA adoption to assess the performance (Côrte-Real et al., 2014). Frizzo-barker et al., (2016) in their review of big data empirical studies found that most of the empirical studies were focused on what and how to integrate BDA into business, these studies did not investigate on the value BDA bring to the adopters. Abbasi, Sarker and Chiang (2016) reported that there is no empirical research on how BDA can improve organizational performance. Similarly, the recent study by Müller, Fay, and Brocke (2018) only focuses on impact of technical BDA adoption on organizational performance, it did not study the impact brought by other BDA assets or BDA enable capabilities.

This study aims to develop a conceptual research model that integrates the innovation characteristics of BDA to fully understand the direct and indirect effects of the determinants on the various stages of BDA adoption within an organization. and BDA decision-making capabilities to diffuse BDA in the value chain activities. The conceptual research model draws upon the theoretical perspectives of the technology-organization-environment (TOE) framework (Tornatzky & Fleischer, 1990), to understand how these factors influences the decision in BDA adoption. In addition,