THE MODERATING EFFECTS OF EXTERNAL ENVIRONMENT ON THE RELATIONSHIP BETWEEN TECHNOLOGY STRATEGY AND ORGANIZATIONAL PERFORMANCE

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ABSTRACT

Technology strategy has been considered as a robust mechanism for improving business growth and achieving competitive advantage, yet there are limited empirical and confirmatory researches in this area. Therefore, this study investigates technology strategy and its relationship to organizational performance. Technology strategies consist of pioneer-follower posture, technical investments: internal R&D, the intensity of product upgrades, external technology sources, and product and process technology. This study also examines the role of external environments in moderating the relationship between technology strategies and organizational performance in the Malaysian manufacturing companies' context. This study employed a survey strategy to examine the hypothesized research model and used a probability sampling design based on the sampling frame obtained. 96 responses were collected via a standard structured questionnaire from chief executive officers and managers of Malaysian manufacturing companies. PLS-SEM technique was used for the analysis of data. The findings of the study indicated that there are five dimensions of external environments. These are dysfunctional competition, institutional support, environmental turbulence, strategic alliance for product development, and political networking strategy. The findings also revealed that technology strategies influence the organizational performance of Malaysian manufacturing companies. In particular, the findings found a significant positive impact of technology strategies on organizational performance. In terms of the moderating effect, external environments moderate the relationship between technological investments and organizational performance and the relationship between product and process technology and organizational performance. These findings suggest that technology strategy is considered a nerve system and a backboned in determining organizational performance and success. The implications of this study fold into theoretical and managerial. It further explains the construct of technology strategy and its relationships with external environments and organizational performance in manufacturing companies. Practically, the findings provide information that benefits the Ministry of International Trade and Industry, the Federation of Malaysian Manufacturers, and a broad range of relevant stakeholders in developing more industry and government agency strategic collaboration such as technology transformation programs to enhance organizational performance potentially. Understanding external environments that strengthen the relationship of technology strategy and organizational performance also enrich the technology strategy literature.

Keywords: Technology Strategy, External Environment, Organizational Performance, Malaysian Manufacturing Companies.

ABSTRAK

Strategi teknologi dianggap sebagai mekanisme yang kukuh untuk meningkatkan pertumbuhan perniagaan dan mencapai kelebihan daya saing, namun penelitian empirik dan kajian pengesahan dalam bidang ini adalah terhad. Oleh itu, kajian ini menyiasat strategi teknologi dan hubungannya dengan prestasi organisasi. Strategi teknologi terdiri daripada sikap perintis - pengikut, pelaburan teknikal: R&D dalaman, kekuatan penambahbaikan produk, sumber teknologi luaran, serta teknologi produk dan proses. Kajian ini juga meneliti peranan persekitaran luaran dalam menyederhanakan hubungan antara strategi teknologi dan prestasi organisasi dalam konteks syarikat pembuatan di Malaysia. Kajian ini menggunakan kaedah soal selidik untuk menguji hipotesis model kajian dan menggunakan reka bentuk persampelan kebarangkalian berdasarkan kerangka persampelan yang diperoleh. Sebanyak 96 maklum balas dikumpulkan melalui soal selidik berstruktur yang standard daripada ketua pengarah eksekutif syarikat-syarikat pembuatan Malaysia. Teknik PLS-SEM digunakan untuk menganalisis data. Hasil kajian menunjukkan bahawa terdapat lima dimensi persekitaran luaran, iaitu persaingan disfungsi, sokongan institusi, pergolakan persekitaran, pakatan strategik untuk perkembangan produk, dan strategi jaringan politik. Hasil kajian juga mendedahkan bahawa strategi teknologi mempengaruhi prestasi organisasi syarikat pembuatan di Malaysia. Secara khususnya, hasil kajian menemui kesan signifikan yang positif bagi strategi teknologi terhadap prestasi organisasi. Dari segi kesan penyederhanaan, persekitaran luaran mengantara hubungan antara pelaburan teknologi dan prestasi organisasi dan hubungan antara teknologi produk dan proses dengan prestasi organisasi. Dapatan tersebut mencadangkan bahawa strategi teknologi dianggap sebagai sistem saraf dan menjadi asas dalam menentukan prestasi dan kejayaan organisasi. Implikasi kajian ini dapat dimasukkan dalam teori dan pengurusan. Seterusnya, ia menerangkan konstruk strategi teknologi dan hubungannya dengan persekitaran luaran dan prestasi organisasi dalam syarikat pembuatan. Secara praktik, hasil kajian memberi maklumat yang bermanfaat kepada Kementerian Perdagangan Antarabangsa dan Industri, Persekutuan Pengilang Malaysia, dan pelbagai pihak berkepentingan dalam mengembangkan lebih banyak kerjasama strategik industri dan agensi kerajaan seperti program-program transformasi teknologi untuk meningkatkan potensi prestasi organisasi. Memahami persekitaran luaran dapat mengukuhkan hubungan strategi teknologi dan prestasi organisasi selain memperkayakan literatur strategi teknologi.

Kata kunci: Strategi Teknologi, Persekitaran Luar, Prestasi Organisasi, Syarikat Pembuatan Malaysia.

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ASEAN	The Association of Southeast Asian Nations
CEOs	Chief Executive Officers
CMV	Common method variance
E&E	Electrical And Electronic
EFA	Exploratory factor analysis
EVA	Economic Value Added
FDI	Foreign Direct Investment
FMM	Federation of Malaysian Manufacturers
FO	Foreign own
GDP	Gross Domestic Product
GMs	General Managers
IMP3	Third Industrial Master Plan
IP	Intellectual Property
IPO	Initial Public Offering
JETRO	Japan External Trade Organization
JV	Joint Venture
KCB	Kenya Commercial Bank
LO	Local owned
MDs	Managing Directors
MIC	Manufacturing Innovation Centre
MIC	Manufacturing Innovation Centre
MIDA	Malaysian Investment Development Authority
MITI	Ministry of International Trade & Industry
MNCS	Multinational Corporations
MNCs	Multinational Corporations
NCER	Northern Corridor Economic Region
NDP	National Development Policy
NEP	New Economic Policy
NPD	New Product Development
OECD	Organisation For Economic Co-Operation And Development
OPEC	Organization Of The Petroleum Exporting Countries
PLS	Partial Least Squares
PLS-SEM	Partial Least Squares Structural Equation Modeling
R&D	Research And Development
RBV	Resource-Based View
RDI	Research Development and Innovation
ROE	Return On Sale And Return On Equity
ROI	Return On Investment
ROS	Return On Sales
SBU	Strategic Business Unit
SD	Standard Deviation
SEM	Structural Equation Modeling
SMEs	Small and Medium-Sized Enterprises
SMS	Short message service
SPSS	Statistical Package for the Social Sciences
STEM	Science, Technology, Engineering and Mathematics
STMS	strategic technology management systems
TPP	Trans-Pacific Partnership

TS	Technology Strategy
TVET	Technical and Vocational Education and Training
VIF	Variance Inflation Factor
WTO	World Trade Organization

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Technology strategy is commonly acknowledged as an integral component, especially for the manufacturing industry in emerging economies, evidenced by its dynamic nature of the impact on the market and environmental situations. Manufacturing companies encounter grave but considered important challenges. In becoming competitive in the international market, Malaysia needs to bolster its economy by continuously improve its local industry. Local companies have been informed about equipping themselves with technological advancement to perform better without compromising quality. Hence, the foundations of all manufacturing companies are built upon sustainable technological capability and capacity of production and operation line. The technological capability should not only be consistently monitored but also be improved.

Meanwhile, an increasing concern of mass migration of multinational corporations (MNCs) from China to other emerging economies such as Vietnam, Thailand, and Indonesia. These are mainly aiming to save cost by these manufacturing companies for the more attractive cost of labour and materials with better tax incentives. While favourable government subsidies in addition to good logistics and continuously upgraded infrastructure. Monthly salaries for manufacturing employees in the Asia Pacific are depicted in Figure 1.1.

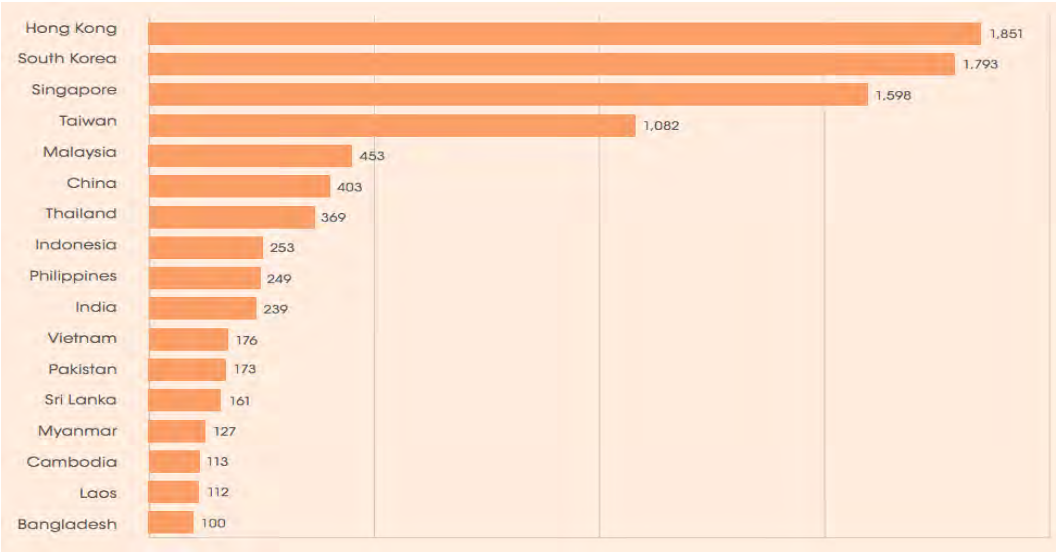

Figure 1.1
Monthly Wages of Manufacturing Workers in Asia Pacific (in US$)
Note. Japan External Trade Organization, Survey of Japanese Affiliated Firms in Asia and Oceania, December 2014.

Moreover, Diep and Pham (2015) report that despite the Global Financial Crisis in 2008, Vietnam maintained its export growth and increased global market share by becoming a regional manufacturing hub and supply chain. The crisis was severely affected China which can be witnessed with a 30 percent decline to 10 percent in 2013 of export consequently other South East Asia such as Malaysia, Singapore, Thailand, Indonesia, Cambodia, Vietnam, Laos, Philippines, and Brunei. Among these countries, Malaysia was the preferred manufacturing hub for some MNCs such as Intel Corporation, Dell, Texas Instruments, Advanced Micro Devices (AMD), STMicroelectronics, and Sony. Malaysia used to be attracted by foreign investors who benefit from its improved basic infrastructures in the 1980s compared to its neighboring countries with lower labor costs, stable financial policy (tax, exchange rate, cost of capital, and government subsidies), and political stability.

However, this incentive is no longer competitive in Malaysia due to continuous increases in inflation rate contribute to higher cost of production, making Malaysia no longer cost-effective to produce a labor-intensive product. The Malaysian inflation rate from the year 2008 to 2016 is presented in Figure 1.2. Therefore, these investors have found Vietnam as a potential country to cheaply produce as reported by the Japan External Trade Organization (JETRO, 2014) reports Vietnam is likely to benefit from declining China's export. In addition, the country can benefit from the trade agreement in Trans-Pacific Partnership (TPP) accord.

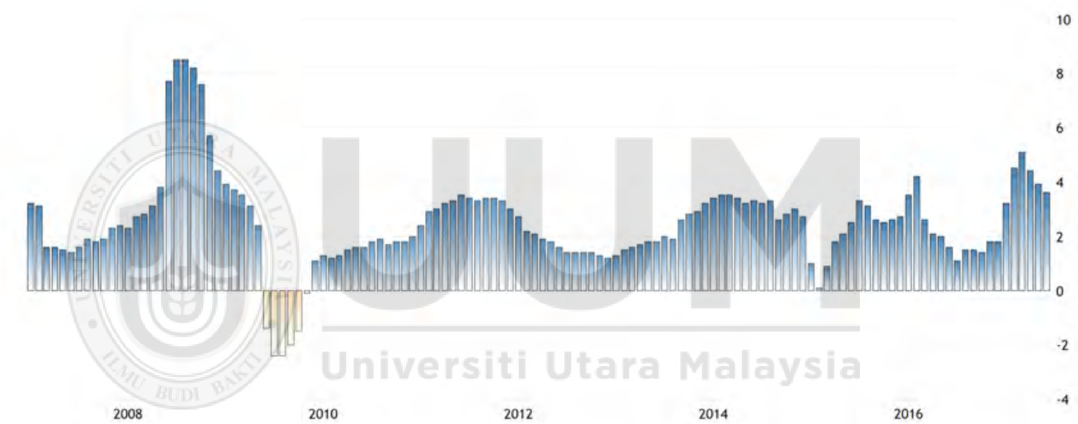

Figure 1.2
Malaysian Inflation Rate
Note. Statistic Department of Malaysia

Organizations engaging in the technology strategy can experience various financial as well as non-financial benefits. Organizations may get a significant increase in sales, profits, and productivity compared to those organizations without the presence of technology strategy. Organizations may effectively apply strategically of its technology strategy to achieve a better and sustainable financial performance concerning their respective industry. These organizations enable to make more an informed decisions with reasonable expectations of both short and long-term outcomes. Organizations are also better equipped against fluctuations in internal and external environments.

Moreover, this is not limited to financial benefits. Apart from that, the firm has equally gained an advantage from non-financial benefits to implement strategic planning. These non-financial benefits include raising awareness of external threats, a better understanding of competitors' strategies, and reducing the barrier to change.

Thus, technology strategy is emerging to radicalize the manufacturing process, especially in developed countries such as Germany, France, Britain, and the United States of America. Outsourcing was once believed to be a viable and effective way to reduce costs. Furthermore, with the unstable global economic, political condition and environment turbulence that caused unpredictable oil prices due to regional instability, especially Organization of the Petroleum Exporting Countries (OPEC). Meanwhile, an adverse impact of climate change due to global warming, mass migration of refugees from across the world affected by war, famine, and above all resource rush. An increasing innovative manufacturing model such as lean manufacturing and smart manufacturing enables developed countries to produce locally in a more efficient manner as claimed by several studies (Bhaskaran, 2012) suggests that lean manufacturing allows the manufacturer to improve the competitiveness of automotive industries by engaging all level from top management to workers. Though it is presently at a preliminary stage, eventually, those countries who take an early measure would gain an advantage in terms of market share and leadership in technological advancements, such as France, the USA, Germany, Japan, South Korea, Russia, and China.

High technology industries are significant for countries' economic advancement (Feser et al., 2008; Medcof, 2007; Xu & McNaughton, 2006). There are numbers of industries namely technology-based that critically contributes in term of innovations, technological progress, rapid economic growth, and greater employment opportunities and thus contributors to the welfare of society (Cooper & Park, 2008; Bruton & Rubanik, 2002; Deeds et al., 1998). Nevertheless, achieving rapid economic growth is difficult to accomplish (Soytas & Sari, 2009; Thompson, 1983). Therefore, the factors which influence the performance of those manufacturing companies are important to understand. Manufacturing firms are becoming an increasingly vital part of the development and economic growth of emerging economies in a country like Malaysia. The contribution from these smart manufacturing sectors is very important in terms of manufacturing output that could reach the end-user efficiently by eliminating the cost of logistics and inventory. This achievement allows manufacturers to increase output, consequently contributes to economic expansion as found by (Atesoglu, 1993).

The principal component of survival in this industry is sustaining and remaining as the technological leader while involving technological research and development (R&D). Technological R&D is considered a high cost and high investment, especially for Malaysian local companies. As witnessed from several decades ago, especially in the 1990s, Singapore used to be a low cost and strategic in term of accessibility for many MNCs to produce cheaper and repetitive manufacturing product while having better education and sophisticated infrastructure that increase the cost of living, making it no longer an attractive country for foreign manufacturing companies (Noori, 1998). Previously, a country like China used to be the technological hub for western companies to implement outsourcing and technology transfer to ensure standardized product quality at low cost from cheaper resources. Earlier, technology or knowledge used to be closely guarded secret or monopolies by developed countries but with competition pressured these companies to have no choice but to move out from their locale country to other host countries like China and currently Vietnam (Young & Lan, 1997). Therefore, workers of Chinese factories can become a user of the Chinese version of western product easily. Even if the investor has withdrawn their plant, China has no problem because they can always have the technology transfer through reengineering and reverse engineering. After all, China already adapted to those technologies. However, increasing Chinese salaries have garnered considerable attention in recent years, with an average monthly wage rise of over 10 percent since 2010 see Figure 1.1. Productivity has also increased, but China's currency has appreciated as the country's exports have increased.

Consequently, the standard of living is upgraded simultaneously, raising the cost of living while discouraging potential foreign direct investment (FDI) into China. A stronger currency, the result of the country's flourishing economy, has also mounted. What may have been cheaper in the past is now starting to look rather more expensive. Thus, the Association of Southeast Asian Nations (ASEAN) countries, namely Malaysia, Thailand, Korea, and Indonesia which were experiencing increases in the cost of labour in recent years, thereby making these countries less conducive for low-cost production (Chongvilaivan & Menon, 2017; Cho, Lee & Ro, 1996).

Technological innovation has been focused on by developing economies since the 1990s, whereas industrial restructuring has been equally emphasized to boost their international trade and product value. The product value indicates technological progress that goes into it and not by the natural resources used to create it (Bolwijn & Kumpe, 1990; Kleindorfer & Partovi, 1990). Korea is another example of how technological innovation has played an important role in industrializing the country. This technological innovation is primarily pushed by the rapid increases in labour cost and the constant pressure from cross-country competitiveness (Cho et al., 1996). Indeed, technological innovations are about the development the implementation of new technology in the manufacturing process.

The rapid changes in advanced technologies have also brought about many challenges in the manufacturing world. Herman (1998) asserts that competitive advantages often shift between firms. Firms strive to position themselves strategically. In order to acquire an enduring competitive advantage firm, firstly, understand firm comparative advantages, secondly, evaluate and plan for technological policies, and thirdly, integrate with firm business strategies and utilize its advantages. Advanced technology contributes to productivity and costs, impacting global and national structures of production, trade, and job creation (OECD, 1998). Therefore, in today's extremely competitive environment, strategic management of technology has become a much desirable affair for favorable competitive advantage and to withstand the forces of competition. These competitive advantages consist of cost leadership, differentiation, cost focus, and differentiation focus (Porter, 1985). Presumably, the pressure from competition creates varying investment justification, cost structure, and strategic priorities (Task Force on Management of Technology, 1987).

In Malaysia, technology management is no longer about managing the technology itself. It is about managing the cost of technology, especially nowadays with all the government intervention in the industry, such as by offering subsidies or providing better information, while legally enforced regulations, minimum wages, and others. The question is, how can these companies sell their product at lower prices when the cost to produce is higher. Manufacturing product locally becomes irrelevant compared to importing it from countries which can produce it in lower cost. A modernized and efficient logistic enables foreign companies to compete with local companies to provide a competitive or even cheaper priced product without having to worry about higher transportation costs as in the past. However, such practices would undermine manufacturing companies in Malaysia. This persistent unfavorable condition would certainly affect the trade balance, creating a tendency for a country to import more than exporting. There are many possible consequences if the company runs the business without properly plan for technology strategy. These consequences such as waste of valuable resources and miss opportunities to protect valuable assets and natural resources. No single strategy works for all companies. A mixed strategy outperforms a single strategy while gaining a competitive advantage, particularly in terms of strategic complexity and strategic flexibility (Porter, 1980). Despite its complexity, a mixed strategic approach supersedes the single strategic competition in terms of non-imitation. Moreover, Spillan et al. (2021) and Parnell (2002) describe mixed strategy as a strategy that incorporates cultural transformation, adaptability, efficiency, technological leadership, and marketing ability. Due to the rigidity of a single strategic approach, it is more difficult to adapt (Miller, 1992). Moreover, each company is unique and needs to craft its strategy. This strategy makes it very stimulating to study the country's technology acquisition behavior while examining whether those strategies contributed to the performance and growth of its manufacturing firms.

In many years, American and European managers are often advised by management gurus that technology strategy should be given special attention and the study on technology strategy has become increasingly important (Ford, 1988; Smith & Rogers, 2004). Ford (1988) in his research state that technology strategy is not synonymous with research and development strategy, which is solely concerned with obtaining technology through in-house activities; rather, technology strategy is the element of strategy concerned with exploiting, developing, and maintaining the sum total of the company's expertise and capabilities. The development of technology strategy is the basis to foster future strategic behaviour, leading to enhance competitiveness and growth. This is supported by Zahra (1996) who pointed that by possessing technology strategy, manufacturing companies will be able to contribute and cope with its external environment effect. To address this uncertain environment, the manufacturers should continue to examine their strategies, practices, capabilities and identify the effects of their elements towards their performance (Ketokivi & Schroeder, 2004; Germain et al., 2008).

There are several studies on technology strategy (Parker, 2000; Li & Atuahene-Gima, 2001; Zahra & Nielsen, 2002; Wilbon, 2002; Gibbons & O'Connor, 2003; Ngamkroeckjoti et al., 2005; Lin & Chang, 2006; Van de Velde, 2006; Chen et al., 2008; Jin et al., 2008; Chadee & Pang, 2008; Muhammad et al., 2009; Man et al., 2009; Ghazinoory & Farazkish, 2010; Dasgupta et al., 2011; Sikander, 2011; Husain, 2016; Nanayakkara et al., 2017). Most of these previous studies emphasized that technology strategy is generally focused on high-tech companies' contexts (Lin et al., 2006; Man et al., 2009; Li & Atuahene-Gima, 2001). Therefore, limited attention has been emphasized to further understand technology strategy, particularly in the Malaysian manufacturing industries. Nevertheless, the importance and potential of technology strategy has made the study's scope particularly important in Malaysia's manufacturing industries more unique and highly desired to explain much more intensely (Man et al., 2009). Table 1.1 shows past research on technology strategy.

Table 1.1
Past Research on Technology Strategy

Author	Context	Research Design	Response Rate
Lin et al. (2006)	US technology enterprises	Quantitative	94 firms
Wilbon (1999)	Computer software IPO firms	Quantitative	31 IPO firms
Man et al. (2009)	118 technology based small and medium sized enterprises	Quantitative	57%
Li & Atuahene-Gima (2001)	300 new technology ventures from a sample frame of 500 firms in Beijing	Quantitative	36.8%

The studies on the technology strategy of manufacturing companies are crucial to provide valuable information relevant for executives, managers, organizations, and industry (Nanayakkara et al., 2017; Zahra, 1996). Consider the significance of technology strategy research from the manufacturing company's viewpoint. This study seeks to contribute to the body of knowledge in technology strategy and organizational performance in manufacturing companies. Furthermore, the outcomes of this research will be used as a reference and guidance for managers and upper management to make better-informed judgments. On the same note, these measures would appropriately cope with the high rates of changes in the technology, while managers should be able to embrace changes for the organization's competitive advantage to be successful in the business environment.

Meanwhile, it has referred to a study on the trend of technology strategies and high-tech companies; most studies in the past focused on the impact of technology strategy on management disciplines, such as introducing new products and introducing new company performance. Nevertheless, empirical studies that link the impact of technology strategy on manufacturing companies' performance are still at an infancy stage and need to be further explored (Nanayakkara et al., 2017; Man et al., 2009; Zahra, 1996; Zahra & Covin, 1993, 1994a). Therefore, this study examines technology strategy and its dimension toward organizational performance in manufacturing companies.

Though previous researchers have initiated to examine technology strategy, however only a handful of empirical studies examined the dimensions of technology strategy and the significance of external environmental factors in manufacturing sector context (Zahra, 1996). Lee (2010) and Cho et al. (1996) suggested that research on environment of technology strategy might benefit most managers. Furthermore, external environmental factors are believed to have an influence on organizational performance. Du et al. (2020) and Ombaka et al. (2015) claimed that external environment factors play a central role in influencing organizational performance. Specifically, past research claimed that external environmental factors might influence organizational performance (Boyd et al., 1993; Cho et al., 1996; Zahra, 1996; Ombaka et al., 2015; Kimani & Ogutu, 2018).

In addition, organizational performance is examined as a dependent variable on an effect of technology strategy (Nanayakkara et al., 2017; Mithas & Rust, 2016; Zahra & Bogner, 2000; Zahra, 1996a, 1996b; Zahra & Covin, 1993; Gibbons & O'Connor, 2003). Previous literature has hypothesized a positive effect on the relationship between two constructs namely technology strategy and organizational performance. More empirical researches are needed to confirm this relationship from different contexts (Man et al., 2009; Lin et al., 2006; Li & Atuahene-Gima, 2001; Parker, 2000). On the same grounds, to determine whether this relationship is significant in the context of the manufacturing sector whether there is a need to perform empirical research.

Another area of concern in this new research is that the potential role of external environments especially in the presence of a recent transition of Industrial Revolution 4.0 in the relationship between technology strategy and organizational performance (Kimani & Ogutu, 2018). It is also worth examining in the context of the manufacturing sectors due to the complexity nature of the manufacturing. Considering their environmental contexts have the potential to explain organizational performance. Thus far, there is a paucity of empirical research on the extent to which Malaysian manufacturing companies are engaging creating value from technology strategy.

Based on the issues of technology strategy and organizational performance in the manufacturing industry, it is crucial to ensure that the research is more inclusive of providing insightful information to further the growth of this sector. Therefore, it allows Malaysian manufacturers to device an appropriate technological resource. This planning also enables manufacturers to manage wastage of material more efficiently while improving and remain sustainable in the long-term to ensure the uniqueness of the Malaysian economy. Several studies have been conducted on the manufacturing industry addressing all manufacturing sectors.

However, the fundamental key issues of technology strategy have not been thoroughly addressed. Hence, this study addresses such issues by bridging the existing gap suggested by the previous study. There are debates among scholars that discuss a variety of issues within the industry. The predominant issues in the manufacturing sector are frequently discussed as follows. Six challenges were facing the global manufacturing sector in 2015. Regulation and traceability, increasing regulation and compliance measures, complex product development and innovation, manufacturing skills gap, healthcare costs, environmental concerns, and balancing maintenance with throughput. Likely ten issues were facing the manufacturing industry in 2020. The issues are responding to pandemic (financial impact, operational options, economic recession), increasing reshoring (companies will increasingly be motivated to participate in reshoring efforts in the coming years due to rising foreign wages, raising tariffs on steel, aluminium, and electric components, and reconsidering the total cost of ownership), unemployment spikes, fluctuating legislation, increasing capacity (moving to a new facility or expanding existing facility) and demand-driven manufacturing (many manufacturers are just keeping up with work based on orders from existing customers, leaving little time or money to invest in other critical initiatives), addressing tax-related issues, maximizing automation (and all things Industry 4.0, including collaborative robotics, autonomous material movement, internet of things, and artificial intelligence), integrating software, handling global competition and making margin.

Technology leaders can earn extra by charging more for their products due to the technological barrier between their products and the customers or competitors (Khalil, 2000). This proves that technology posture can negatively affect income. For instance, Malaysian automation companies can progress even further as a cost leader than as a technology leader since their clients have been burdened with cost pressures from global competitors, which to a certain extent contribute to lower capital investments. Nevertheless, the companies that apply a lower-cost strategy in their operation will benefit from customer's production capacity expansions, leading to higher revenue growth. This is consistent with the existing report that if product technology matures (which is entirely accurate for automation technology) and superior designs are replicated, the variation in product performance is reduced, and the products become more standardized than previously was. Consequently, the price is considered a factor in a competition that can lead to cost leadership success (Utterback & Abernathy, 1975; Abernathy & Utterback, 1978; Tushman & Moore, 1982).

The past decade revealed the growing awareness of managers on the need to incorporate technology in strategic decision-making. They are increasingly finding that technology and strategy are inseparable (Kantrow, 1980). Previous studies discovered that most business failures were due to the lack of putting technology into strategy (Sterling, 2003). This explains why technology strategy has become the central investigation in the strategic management of technology studies (Husain, 2016). Technology strategy has become the critical element in strategic technology management and serves as the basis for business strategy and competitive advantage (Sahlman & Haapasalo, 2009).

Despite many studies on strategic technology management that emphasize developed and developing countries, limited studies discussed and clearly outlined the framework of formulation of technology strategies specifically on manufacturing and service industries (Husain, 2016). In addition, manufacturing has played a vital role in the economic transformation. However, an increasingly effective use of resources (technology strategy) has been emphasized extensively in the management literature, whereas the problem of acquiring resources from the environment is neglected. This study also emphasizes investigating the impact of technology strategy and external environments on organizational performance. Numbers of empirical evidence suggest that inefficient management of technology could contribute to organizational failure despite having good technology in their possession. The theoretical gap aspect contains the explanation of new approaches in creating a technology strategy framework while considering external environments in the manufacturing industry. The empirical aspect investigates the contradicting findings of past studies in this area, while the practical aspect analyzes current technology strategy practices and organizational performance measurement of the Malaysian manufacturing industry.

Past studies have investigated the relationship pattern between technology strategy, the external environment, and organizational performance. There are contradictory and inconsistent relationships between technology strategy and its dimensions in the literature. Meredith (1987) in his studies indicate that high and manufacturing technologies bring significant benefit toward small firms as it offers more value to large firms. Hence, there is a direct main effect of an aggressive technology strategy on organizational performance. In addition, there are widely recognized that the relationship between technology strategy and organizational performance is important. There is limited empirical evidence regarding how technology strategy relates to external environments and organizational performance. More fundamentally, there is no agreement on the content of technology strategy, which makes it challenging to evaluate their contribution as a source of competitive advantage.

Table 1.2 illustrates that there is a diverse interest in technology management according to respective geographical differences. Although there is an inclusive study on the diverse interest of technology management, most of the studies are dominated by matured economies (developed countries, namely North America, Europe, and United Kingdom) and very few in developing countries. Developing countries are investigated with a diverse interest of technology management as the developed countries such as diffusion, pull/markets, an adaptation of innovations and national systems and differences (Yousaf et al., 2021; Pilkington & Teichert, 2006). This could raise some concern on the generalizability and applicability of the results on developing countries. This contradiction in research findings creates a new gap in research from a diverse interest in technology management in developing countries. This has raised the need to increase studies on various topics related to the rapidly developing field of technology management.

Table 1.2
Geographical Differences in Technology Management Interests

North America	Europe	UK	Rest of the world
Dynamic organizations	Alliances and learning	Operation strategy	Diffusion
Resource based view	Learning organizations	Innovation process	Pull/markets
Technology strategy	Resource based view	PCs and electronics case studies	Adaptation of innovations
Evolution and diffusion	Knowledge management	R&D returns in uncertainty	National systems and differences
	Patents		
	Measuring R&D networks		

Note. Pilkington and Teichert (2006)

Moreover, scholars have suggested that an external environment could moderate the relationship between technology strategy and organizational performance (Man et al., 2009; Zahra & Bogner, 2000; Zahra, 1996). Man et al. (2009) took an empirical approach to examine technology strategy, the firm's relationship to the external environment, and performance in 118 of China's high-tech companies to determine a clear relationship. They found a significant impact for three of the four technology strategy dimensions on organizational performance, while the weaker impact of environmental factors shows the moderating effects between the technology strategy dimensions and organizational performance. This finding implies that China's external environment, while potentially distinct, is classified as a rapidly evolving market with less organized business models. Zahra and Bogner (2000) proposed that further studies are more appropriate to include external environments as moderating variables considering technology strategy and organizational performance. Those organizations that failed to develop a comprehensive technology strategy could significantly affect the ability to survive while ultimately weakening organizational performance.

The limited studies that examined the relationship of technology strategy with the organizational performance of Malaysian manufacturing companies and the moderating effect of external environments and on these relationships create research gaps in the studies of the technology strategy of Malaysian manufacturing companies concerning theoretical and policy implication. Analysis of technology strategy based on Resource-Based View (RBV) theory on Malaysian manufacturing companies is scantly covered in the past studies. Thus, this study attempts to fill the gaps by providing empirical evidence on the relationships.

As such, technology, which encompasses the firm's expertise and skills, impacts the firms' performance, as it defines the firms' ability to sell products or services, be accepted by the market, survive, and reach financial self-sufficiency. To ensure a successful technology strategy, executives may need to perform a competitive analysis of their products' rivals (Bettis & Hitt, 1995). The application of technology can either enhance or degrade performance (Kodama 1995; Iansiti 1995). Meanwhile, the external environment will serve as a moderator in the relationship between the technological choices made by the firm and its performance (Kerin et al., 1992). Yet, the company's technology strategy should be compatible with the environment. Nonetheless, given the paucity of evidence regarding the existence of the effects and their impact on the firm's performance, the need for more research on the subject is critical (Zahra, 1996; Miller, 1988).

These essential issues deserve serious attention because companies have a significant role in developing technologies and supporting the growth of manufacturing industry. Technology strategy is vital to ensure the survival and the financial success of manufacturing companies. Despite the development of new technology, it might not be sufficient to ensure its longevity and market growth (McGrath, 1994). Unfortunately, they must use effective technical methods to benefit financially from their inventions (McGee et al., 1995). Currently, the impact of a holistic technology strategy on the viability and development of manufacturing firms is not thoroughly studied and documented (Zahra, 1996). Addressing the research gap, the researcher intended to investigate whether or not the companies' external environments moderate technology strategies and organizational performance in the manufacturing industry in Malaysia.

Consequently, a knowledge gap in the literature has been highlighted, which this study seeks to enlighten further. Malaysia depends heavily on trading with other countries for a country with a smaller population and internal market to support manufactured goods. Thus, it can be affected if the trading partners are experiencing any types of threats. Likewise, the reliance on the industrialized means that the domino effect of the decline in the manufacturing sector's performance on the gross domestic product (GDP) is inevitable.

1.2 Problem Statement

The importance of organizations emphasizing operational efficiency (financial and non-financial) became critical for manufacturing companies has been underlined by researchers (Askary, 2017; Calişkan, 2010; March & Sutton, 1997), regulatory authorities (MITI, 2018), academic communities, and investors. In addition, it has been argued that in order to sustain competitiveness, there is a need for measuring organizational performance beyond financial measure; and, companies need to address measurements of organizational performance, which are financial aspect and non-financial aspect of companies (Papke-Shields & Malhotra, 2001; Anand & Ward, 2004; Yusuff, 2004; Hoque, 2004; Chen & Cheng, 2007; Jusoh et al., 2008). However, many existing reviews on organizational performance mainly considered the financial aspect of organizational performance (Campbell & Minguez-Vera, 2008; Certo et al., 2006; Talke et al., 2011). While, the study of Widjaja et al. (2020) divides organizational performance into three measures: financial performance, market performance, and production performance. Hakkak and Ghodsi (2015) demonstrated that incorporating non-financial success indicators improves organizational performance significantly. According to Johl and Toha (2021), de Azevedo Rezende et al. (2019) and Hussain and Hoque (2002), financial performance measures such as return on investment (ROI) or net earnings focus on non-financial factors such as consumer loyalty, product quality, productivity, and production. This diversion occurred when business leaders tended to focus on short-term achievement that can hinder long-term performance. Business leaders can monitor and assess the organization efficiently by applying non-financial measures. Thus, the non-financial measures have been the best forecasters of long-run organizational performance. Even if their measurement accuracy is lower than financial measures, they concentrate on operational elements under management’s control (Chow & Van Der Stede, 2006). Yang and Wang (2017) suggest that future studies focus on the organizational performance concept, covering financial and non-financial to attain sustainable firm performance.

Yusuff (2004) pointed out that competitiveness in the manufacturing industry will be affected if the elements of organizational performance concerning financial and non-financial shaped by its top management are not incorporated cohesively. Consequently, technology and strategy substantially impact the manufacturing's environment, particularly in the UK (Naylor & Appleby, 2013). The past decade revealed the growing awareness of managers on the need to incorporate technology in strategic decision-making. They are increasingly finding that technology and strategy are inseparable (Kantrow, 1980). Previous studies discovered that most business failures were due to the lack of technology into strategy (Sterling, 2003). This existing finding explains why technology strategy has become the central investigation in the strategic management of technology studies (Husain, 2016). Technology strategy has become the critical element in strategic technology management and serves as the basis for business strategy and competitive advantage (Sahlman & Haapasalo, 2009). Past studies have investigated the relationship pattern between technology strategy and organizational performance. There are contradictory and inconsistent relationships between technology strategy and its dimensions in the literature. Meredith (1987) in his studies indicate that high and manufacturing technologies bring significant benefit toward small firms as it offers more value to large firms. Hence, there is a direct main effect of an aggressive technology strategy on organizational performance. Technology strategy is vital to ensure the survival and the financial success of manufacturing companies. Despite the development of new technology, it might not be sufficient to ensure its longevity and market growth (McGrath, 1994). Unfortunately, they must use effective technical methods to benefit financially from their inventions (McGee et al., 1995). Currently, the impact of a holistic technology strategy on the viability and development of manufacturing firms is not thoroughly studied nor documented empirically in the literature (Zahra, 1996).

The central problem to be researched by this study is technology strategy, external environments and organizational performance. As a basis for this study, the researcher identified ten fundamental problems that demanded this investigation. The first significant issue identified for this study is a pioneer – follower posture (PFP) and organizational performance (OP) in manufacturing companies. Pioneer–follower posture in the organization has been shown to positively affect organizational performance (García-Villaverde et al., 2017). Sikander (2011) stated that the strategy factors of technology positioning could contribute to the growth of firms in the electric and electronic sector in developing countries and lead to organizational performance. Whereas research by Muhammad et al. (2009) and Lee and Tang (2018) have found limited evidence of pioneer–follower posture that provides satisfactory results, thus it has been recommended that this issue be addressed explicitly in future research.

Specifically, manufacturing companies who choose to be pioneers develop innovative technology in the market and use it by their firm, while followers adopt standards and improve products initiated by pioneers (Utterback, 1994). According to Zahra et al. (1995), the technology pioneer strategy is creating, using, and successfully commercializing technology through innovative products or services. This conceptualization combines developing the technology with commercializing it in the market (Park & Bae, 2004; Zahra, 1996). The literature discusses the possible advantages and disadvantages of the pioneer strategy in terms of demand and cost implications (Boulding & Christen, 2008) to the follower one. Among others, one of the main advantages is that disruptive ideas usually provide differentiated and technologically superior products (Utterback, 1994) and a reputation as a leader (Zahra et al., 1995). Cost side advantages include pre-emption of factor inputs as the companies can often close early negotiations with suppliers more favorably than later entrants (Boulding & Christen, 2008). Thus, new companies can use first-mover advantages to outperform incumbents (Park & Bae, 2004; Van de Vrande et al., 2011).

The disadvantages of pioneering include a higher risk in terms of the functionality of the resultant product or timely acceptance because of customer resistance (Zahra et al., 1995). Thus, they embrace the challenge of demonstrating the market potential and providing evidence for forecasted profits (Walsh et al., 2002), necessary if financing for the new project is obtained. On the other hand, followers can sometimes quickly imitate the main characteristics of products and exploit them much more cheaply than the pioneers, and hence the company's first-mover advantages may not be sustainable (María José & Pedro Manuel, 2010). Accordingly, Bantel (1998) states that choosing a suitable technology strategy, either pioneer or follower is critical for the viability of the manufacturing companies. It should be noted that the pioneer strategy may create or destroy value (Zahra et al., 1995). Although general strategic thinking seems to support the idea that being the first in the market leads to competitive advantages, Boulding and Christen (2003) evidence shows that, on average, it leads to profit disadvantage. The study supported by Oh et al. (2015) found that first-mover high-tech firms had negative correlations with sales and profits, whereas Kakati (2003) study showed that relevant aspects related to the pioneer strategy did not differentiate between successful and unsuccessful manufacturing companies since the products were in the early stage of development; and the creation of a new market or segment.

However, Aspelund et al. (2005) found that in cases where companies developed a somewhat pioneering technology, company failure was diminished. In comparison, and referring to the follower strategy, some works show that followers might reach a higher level of performance as they enter after pioneers have created the initial market. So technological and commercial uncertainties have been solved (Garcia-Villaverde & Ortega, 2006). In contrast, others found that later entrants achieve a lower level of performance (Lieberman & Montgomery, 1998).

These conflicting results may be related to the resources manufacturing companies can marshal to implement the chosen strategy (Park & Bae, 2004). In the case of pioneers, to sustain the advantage generated by a pioneer strategy (Boulding & Christen, 2003); in the case of followers, to identify unsatisfied market needs and the way to meet these needs through making improvements in incumbents' products with attributes that allow the consumer to compare them directly with those already existing (Garcia-Villaverde & Ortega, 2006). Hence, although some previous works study direct strategy – performance relationships, a more suitable procedure for understanding the implications of the chosen technology strategy is to assume. It is likely that no direct strategy – performance link exists and that the technology strategy will only contribute to the organizational performance when the firm has the requisite resources to implement the chosen strategy (Boulding & Christen, 2003). Therefore, identifying the endowment of companies' resources that enable the successful implementation of the technology strategy, either pioneer or follower, is critical to orientate manufacturing companies' decisions. Moreover, studies examining the relationship of pioneer – follower posture with organization performance such as Boulding and Christen (2003), Aspelund et al. (2005) and García-Villaverde et al. (2017) were

Western focused. Moreover, past studies seem to provide contradictory findings (Lee & Tang, 2018; Garcia-Villaverde et al., 2017; Mena & Chabowski, 2015; Sikander, 2011; Manu, 1992; Wilbon, 1999; Durand & Coeurderoy, 2001; Muhammad et al., 2009; Khalil, 2000; Lieberman & Montgomery, 1998). More so, studies that have examined such relationships are limited in Malaysia. Therefore, the current study will examine the advantages of technology-first movers jointly to test the relationship between pioneer – follower posture and organizational performance in the Malaysian context.

As scholars emphasized the importance of PFP, especially their effects on organizational performance, the importance of technological investment (TI) become a strategic issue in economic development has been extensive (Adeoti, 2001). Nevertheless, according to traditional industrial economics and modern management research, the primary indication of organizational performance is the ability to remain competitive in the market. Technological investment is described in the literature as a component of a recombination process that results in technology. Since 1995, event studies on technological investment have examined and underlined the numerous benefits of technological investment to companies engaged in competitive markets (Adeoti, 2001; Basole et al., 2013; Berghout et al., 2011; Besson & Rowe, 2012; Caggese, 2012; Carlin et al., 2011; Roignant et al., 2011; Cragg et al., 2011; Dawid et al., 2009; Dehning et al., 2004; Dimov & Milanov, 2010; Gatian et al., 1995; Ghosal & Reichert, 2009; Gomez & Vargas, 2012; Granados & Knoke, 2013; Holsapple & Wu, 2011; Huisman & Kort, 2003; Inderst & Peitz, 2012; Kim & Sanders, 2002; Kivijarvi & Saarinen, 1995; Konchitchki & O'Leary, 2011; Kong & Kwok, 2007; Lang et al., 1996; Leahy & Montagna, 2012; Lee et al., 2011; Li, 2013; Lim et al., 2011; Liu et al., 2011; Love et al., 2009; Love et al., 2011; Meng, 2008; Merali et al., 2012; Merlino, 2012; Mittal & Nault, 2009; Neuhausler, 2012; Nishihare & Fukushima, 2008; Pick & Azari, 2011; Rai et al., 1997; Ramos et al., 2011; Renkema & Berghout, 1997; Shober & Gebauer, 2011; Smit & Trigeorgies, 2007; Teo et al., 2000; Wrzaczek & Kort, 2012). Event studies provide a solid theoretical foundation for the current study's discussion of technology investments. While these studies cover many aspects of technology investment and related earnings for organizations, this study focuses on whether firms' technology investment affects organizational performance.

Earlier research explored technological investment in the face of uncertainty (Dixit & Pindyck, 1994; Lambrecht & Perrauding, 1996; Nielsen, 2001; Caggese, 2012). The empirical findings indicate that investing in risky technological ventures has a significant and negative effect. Uncertainty about the outcome of technological projects has had a detrimental effect on companies' business cycle fluctuation and growth. David (2010) examined the effect of technology adoption speed and wage differentials on total labour income in the home country, taking transition dynamics into account and numerical dynamic optimization approaches. The study's findings indicate that companies' actions in international markets may be negative in the long run, while competitors' profit from their superior manufacturing and service technology. Finally, other research implies that the primary cause is competition for risky technical investments. Nielsen (2002) emphasizes this argument, arguing that dominated strategy effects inevitably result in investments in noncompetition markets. It appears as though event studies examining the relationship between technological investment and organizational performance have received very little attention in the literature (Sikander, 2011; Keen, 1991). Those who have looked into the matter have come up with inconsistent findings. Despite the extensive research on TI in the Western literature, findings are somewhat mixed. The studies show a positive relationship between technological investment and organizational performance (Ramdani, 2012; Kleis et al., 2012; Bagheri et al., 2012; Jung, 2009; Heshmati & Loof, 2008; Weill & Ross, 2004; Kwon, 2007; Hartono, 2003; González-Benito, 2007; Zehir et al., 2010; Idris et al., 2008; Byrd et al., 2006; Indjikian & Siegel, 2005). Contrawise, Thouin et al. (2008), Macdonald (2006), Im et al. (2001), Mithas and Rust (2016) show a negative relationship. While, Roach (1991), Ho et al. (2011), and Motiwalla et al. (2005) show no relationship. This study aims to add to the literature that focuses on these two aspects that form the foundation of firm structure and their ties to organizational effectiveness. This study examines the elements affecting organizational performance, both financial and non-financial. Additionally, the subject of technology investment development and its relationship to company performance in Malaysia, particularly manufacturing firms, has been an intriguing area of study that has received little attention. There is evidence of preliminary examination, particularly in Malaysia, focused on technology investment and firm performance.

Nonetheless, Anton and Biglaiser (2013) research stressed the importance of the intensity of product upgrades (IPU) in assessing organizational performance. Pelser (2014) stated that companies should expand existing product lines and introduce improved versions of existing products to sustain industry leadership. Further, frequent product introductions have been recognized as a critical component of organizations' ongoing renewal to survive and succeed in a fast-changing business environment. The intensity of product upgrades is strongly correlated with the profit margins of businesses (Andras & Srinivasan, 2003). Similarly, other researchers have discovered a significant positive association between the intensity of R&D spending and the performance of an organization (Kotabe, 1990; Mansfield, 1981; Hufbauer, 1970). For instance, Kotabe (1990) discovered that businesses could increase their performance by concentrating their efforts on product design and development and improving their manufacturing processes. Through product diversification, firms with superior product designs acquire a competitive edge, resulting in increased profits. Additionally, manufacturing costs may be reduced due to process improvements arising from R&D, which may increase company profitability. Thus, more R&D investment may be predicted to result in improved organizational performance. However, Nunes et al. (2012), in their study argued that there is a negative linear relationship between the intensity of product upgrades and growth in non-high-tech companies because R&D investment can increase the level of risk faced by companies as it adds to the challenge of obtaining finances and managing R&D investment efficiently. The linkage between the intensity of product upgrades and organizational performance has received limited empirical attention, much of which has yielded inconsistent results. Moreover, this study did not examine the lagged impact of intensity of product upgrades on an organization's performance on non-financial variables (management skill and luck). However, the focus of previous studies on the intensity of product upgrades and financial performance shows the need for future technology strategy studies to focus on non-financial aspects of organizational performance together with financial performance.

As a critical component of any technology strategy, firms' decisions to acquire technological capabilities externally has received significant attention in previous research (Zahra, 1996; Jones et al., 2001). According to previous research (mainly in developed countries) external technology acquisition activities have such strategic benefits as expanding and renewing the technological knowledge base at a cheaper cost and maintaining flexibility (Kessler et al., 2000; Jones et al., 2001). As to the relationship between external technology sourcing (ETS) and organizational performance, previous studies has revealed inconsistent conclusions. Some empirical studies argued that the relationship between external technology sourcing and organizational performance is complementary (Cassiman & Veugelers, 2002; Piga & Vivarelli, 2004), while others argued that the relationship substitute for each other (Audretsch et al., 1996; Basant & Fikkert, 1996). In emerging economies, domestic manufacturing firms heavily rely on external technology sourcing activities in technology development (Lall, 2000). With this approach, manufacturing companies can mitigate risks and expenses while shortening the time to accumulate technological competency (Xie, 2004). Simultaneously, they may need to conduct internal research and development to assimilate external knowledge quickly, or just when they cannot maintain access to external technologies (Lee & Lim, 2001).

Researchers have been looking closely into the connections between external sources and organizational performance from several perspectives. Jones et al. (2001) and Montoya et al. (2007) focus on the effects of external technology acquisition on the market performance of the products. Meanwhile, some studies look into the relationship between performance and different variables of external acquisition, namely, mergers and acquisitions (Ahuja & Katila, 2001), technology alliances (Schoenmakers & Duysters, 2006), collaborative networks (Belderbos et al., 2018; Faems et al., 2005; Nieto & Santamarı´a, 2007), and technology licensing (Tsai &

Wang, 2007). Results have been inconsistent with these studies that have recorded negative or insignificant findings (Belderbos et al., 2018; Jones et al., 2001; Tsai & Wang, 2007) as well as positive (Tsai et al., 2011; Ahuja & Katila, 2001; Nieto & Santamarı´a, 2007). Interestingly, past literature has produced mixed results and somewhat contradictory findings concerning the influence of external technology sources and organizational performance. As suggested in the literature, the researcher sees the possibility of external technology sources as factor effects of organizational performance.

Numerous researchers have addressed the impact of pioneer – follower positioning, technical investments, the intensity of product upgrades, and external technology sources on organizational performance, and there is an ongoing discussion over the beneficial effects of product and process technology (PPT) (Roberts, 1995; Zahra & Covin, 1993). Previously published research has identified product and process technology as a constructive source of technology strategies (Zahra, 1999; Parker, 2000; Gibbons & O'Connor, 2003; Sikander, 2011). According to previous research, product technologies are the product that meets client wants (Zahra, 1993b; Zahra & Covin, 1994b). Process technologies enable a business to make items efficiently and cost-effectively. Market success requires both product and process technologies (McCann, 1991). While CEOs recognize the significance of new product development, some may not quickly recognize the value of process innovation (Ali, 1994). In recent years, the importance of process innovation in achieving competitive competency has increased (Skinner, 1992). Companies are expected to excel at process innovation to lower costs, increase quality and efficiency, and develop and market new goods (Zahra & Covin, 1994b). Additionally, manufacturers have emphasized process innovation to keep pace with global competitors, overcoming a deficiency in their companies' previous resource allocations, favouring product developments (Zahra & Das, 1993).

According to Utterback (1994), product and process technologies might be radical or incremental. While radical technologies represent significant advancements in the industry, incremental technologies are extensions of existing goods and processes. Specifically, the company produces highly innovative product technologies early in the industry's life cycle to attract clients and gain market share. A study examining PPT and OP has reaffirmed the value of product and process technology in enabling businesses to cut manufacturing costs and increase efficiency (Roberts, 1995). PPT, it has been said, is critical in achieving a strategic goal of distinctiveness, a low-cost strategy objective, configuration, product technology dynamism, and competitive intensity, all of which contribute to an organization's performance (Jones & Davis, 2000; Schoenberger, 1987; Bettis & Hitt, 1995; Noori, 1990). It is complex and critical for businesses to progress and maintain product and process technologies in this fast-paced environment, even though TS usually emphasizes utilizing many aspects of TS (Zahra, 1996). According to prior research, a diverse PPT can be viewed as a crucial aspect of a company's technology strategies and OP. Thus, the researcher anticipates the possibility of PPT exerting an effect on the efficacy of OP. However, as noted earlier, prior empirical results on the relationship between PPT and OP are inconclusive, leading the researcher to propose to revisit the relationship in the current study.

Recent research underscores the importance of a company's technology strategy for achieving superior performance (Lefebvre et al., 1992; Zahra & Covin, 1994; Naylor & Appleby, 2013). Zahra (1996) and Zahra and Das (1998) suggest that external environment may be an important moderator that affects the company's technology strategy on organizational performance. They stated that the effect of the external environments on a company's strategic choices will lead to a competitive advantage. The external environments may have a different influence that affects organizational performance because of their different risk orientation, relative capacities and past performance histories. Although recent literature on TS is one of the vital research areas that aims to find out the relationships between the external environment, TS and organizational performance, they are still limited. Limited researches have closely inspected the association between technology strategy and organizational performance, and those studies have examined insufficient aspects of TS or a single performance aspect (Man et al., 2009, Sikander, 2011). Furthermore, significant dimensions of TS for companies operating in global markets, there is a strong argument for the need for TS in the Malaysian manufacturing sector to spearhead the innovative economy (MITI, 2018). However, there is still limited research on the influence of companies technology strategy on the external environment and organizational performance among manufacturing companies in Malaysia. Therefore, an in-depth study on the influence of technology strategies on the external environment influencing organizational performance in the Malaysian context is needed.

The importance of technology strategy on organizational performance has been widely explored, and the external environments may influence it differently. Organizational performance may be affected differently based on their company's strategic choices.

Thus, the external environments could moderate the impact of technology strategies on organizational performance (Zahra & Covin, 1996). Little attention has been given in the literature to external environments (Sikander, 2011) such as dysfunctional competition, institutional support, environmental turbulence, strategic alliance for product development, and political networking strategy dimensions. Besides, it has been argued that moderating influence on the association between technology strategy and organizational performance should be investigated to recognize a significant relationship between technology strategy and organizational performance (Zahra & Bogner, 2000). Therefore, the external environment will serve as a moderator in the relationship between the technological strategies made by the firm and its performance (Kerin et al., 1992). However, the company's technology strategy should be compatible with the environment. Nonetheless, given the paucity of evidence regarding the effects and their impact on the firm's performance, the need for more research on the subject is critical (Zahra, 1996; Miller, 1988).

The previous study indicates that the external environment has a moderating effect on the technology strategy and organizational performance. For example, while pioneering can result in first-mover advantages (Ali, 1994), the duration and degree of these benefits frequently vary depending on the environment (Golder & Tellis, 1993; Kerin et al., 1993; Porter, 1985). According to Buzzell (2004), pioneering increases market share in developing and growing businesses but has little effect on market share in established and declining industries. Ali (1994) also suggests that pioneering is advantageous in dynamic and growing environments, where a business can pursue profitable markets such as telecommunications, high technology equipment, and pharmaceuticals. However, pioneering is detrimental in mature or fading industries (such as aircraft fasteners and steel). Kerin et al. (1993) argue that pioneering benefits are more durable in favourable than hostile environments. Likewise, poor economic conditions or recession can hamper technological investments, negatively impact the adoption and implementation of technology, and affect organizational performance (Ellitan, 2002). A study by Turulja and Bajgoric (2019) and Hung and Chou (2013) suggested that environmental turbulence moderates external technology sources and organizational performance. They have acknowledged that external environmental factors can moderate technology strategy's effect on organizational performance. Besides, the external environment influences the relationship between product and process technology and organizational performance. A business may benefit from exploring product technologies early in the industry's life cycle and later capitalize on process technology (Utterback, 1994). Moreover, the relationship between product innovation and performance varies by environment. There is also evidence that Hambrick (1983) discovered a significant correlation between product innovation and a high return on investment in clusters with a high degree of dynamism among high-performing capital goods manufacturers. Similarly, Zahra (1993) also discovered a positive correlation between product innovation and performance in dynamic growth and hospitable, product-driven growth environments. Meanwhile, product innovation was not associated with performance in hostile and competitive yet technologically advanced situations or stagnant and impoverished environments. Thus, it is prevalent that the inconsistency in research results may be due to the external environment studied.

Likewise, those studies primarily focus on a firm's financial performance, although it has been stated that its financial and non-financial performance should be examined jointly. This study identifies the importance of examining the impact of technology strategy on financial and non-financial performance. Therefore, this study examines technology strategy in Malaysian manufacturing companies, focusing on the relationship between pioneer – follower posture, technological investments, intensity of product upgrade, external technology sources, and product and process technology on organizational performance. Additionally, whereas prior research has concentrated on the financial element of business performance, this study will examine the sustainability approach, which encompasses both financial and non-financial performance and is referred to as organizational sustainability. In light of this, this study will explore the external environments as a moderating effect to observe the relationship between technology strategy with organizational performance in Malaysian manufacturing companies.

A difficulty in incorporating previous findings on the moderating effect of the external environment is on TS – OP, that is, the strength and form of this relationship, which cannot be determined simply from previous findings. One explanation is that researchers tend to overlook the concurrent effect of the external environment's numerous dimensions on the TS – OP. While the nature of variance in the TS – OP relationship across external environments is an empirical question, research indicates that the external environment affects the form and strength of this relationship. Thus, Table 1.3 summarized the gaps in the problem statement.

Table 1.3
Summary of Gaps

Problem Statements	Gaps
Many studies have demonstrated that pioneer – follower posture represented a technology strategy dimension (Lee & Tang, 2018; Manu, 1992). PFP is beneficial for companies (Zahra et al., 1995; Zahra, 1996) besides the positive effects of pioneer – follower posture on organizational performance (Garcia-Villaverde et al., 2017; Mena & Chabowski, 2015; Sikander, 2011). Previous research tends to focus on the impact of pioneer – follower posture on organizational performance (Muhammad et al., 2009; Lee & Tang, 2018). There is a strong association of organizational performance with pioneer – follower posture (Utterback, 1994; Walsh et al., 2002; Park & Bae, 2004). **However, these studies have examined the influence of pioneer – follower posture separately on a company's financial performance without considering operational efficiency (financial and non-financial performance).** **Therefore, there still needs to measure organizational performance beyond financial measures where firms need to address two operational efficiency measurements: financial and non-financial performance (Boulding & Christen, 2008; Van de Vrande et al., 2011; Oh et al., 2015; de Azevedo Rezende et al., 2019).** Majority of pioneer – follower posture research studies have been investigated in the Western context. In Malaysia, pioneer – follower posture is still limited to studies (Sikander, 2011).	**GAP 1:** The need to study the influence of all pioneer – follower posture on organizational performance, including financial and non-financial.
The importance of technological investment is undeniable since technological investment has become a strategic focus in organizational performance and economic development (Adeoti, 2001). Technological investment can offers distinct technological resources advantages that allow the organization to outperform its rivals (Pavitt, 1990). Technological investment can create a unique competitive advantage that improves the organizational performance (Dehning et al., 2005). Event studies on technological investment have examined and underlined the numerous benefits of technological investment to companies engaged in competitive markets (Basole et al., 2013; Berghout et al., 2011; Besson & Rowe, 2012; Caggese, 2012; Carlin et al., 2011; Roignant et al., 2011; Cragg et al., 2011).	**GAP 2:** From the review has shown that the relationship between technological investment and organizational performance remains unclear and needs further examination. Hence, the researcher will examine does technological investment have a relationship with organizational performance in Malaysia's manufacturing companies.

Above discussion shows the synthesis of these studies indicated inconclusive results (Thouin et al., 2008). So, with these inconclusive results, this study intends to reexamine the performance effects of technological investment. Majority of technological investment research studies have been investigated in the Western context. In Malaysia, technological investment is still at the infancy stage limited to studies (Sikander, 2011; Keen, 1991).	
Anton and Biglaiser (2013) research stressed the importance of the intensity of product upgrades in assessing organizational performance. Pelser (2014) stated that companies should expand existing product lines and introduce improved versions of existing products to sustain industry leadership. The intensity of product upgrades is strongly correlated with the profit margins of businesses (Andras & Srinivasan, 2003). Similarly, other researchers have discovered a significant positive association between the intensity of R&D spending and the performance of an organization (Kotabe, 1990; Mansfield, 1981; Hufbauer, 1970). While, Nunes et al. (2012), argued that there is a negative linear relationship between the intensity of product upgrades and growth. The linkage between intensity of product upgrades and organizational performance has received limited empirical attention, much of which has yielded inconsistent results. Moreover, this study did not examine the lagged impact of intensity of product upgrades on an organization's performance on non-financial variables. **However, the focus of previous studies on the intensity of product upgrades and financial performance shows the need for future technology strategy studies to focus on non-financial aspects of organizational performance together with financial performance.**	**GAP 3:** Several studies have highlighted the importance of the intensity of product upgrades toward organizational performance, but there is still insufficient evidence to conclude that IPU significantly influences OP. Thus, this study must investigate the influence of IPU on OP.
Firms' decisions to acquire technological capabilities externally has received great attention in previous research (Zahra, 1996; Jones et al., 2001). According to previous research (mostly in the context of developed countries), external technology acquisition activities have such strategic benefits as expanding and renewing technological knowledge base at lower cost, and remaining flexible (Kessler et al., 2000; Jones et al., 2001). As to the relationship between external technology sourcing and organizational performance, previous studies has revealed inconsistent conclusions.	**GAP 4:** In the aspects of external technology sources and organizational performance, this study will investigate the influences of external technology sources on organizational performance, which still needs to be measured financially and non-financial.

Results have been inconsistent with these studies that have recorded negative or insignificant findings (Belderbos et al., 2018; Jones et al., 2001; Tsai & Wang, 2007) as well as positive (Tsai et al., 2011; Ahuja & Katila, 2001; Nieto & Santamarı´a, 2007). **As suggested in the literature, the researcher sees the possibility of external technology sources as a factor effect of organizational performance.**	
Numerous researchers have addressed the impact of pioneer-follower positioning, technological investments, the intensity of product upgrades, and external technology sources on organizational performance, and there is an ongoing discussion over the beneficial effects of product and process technology (Saleem et al., 2020; Roberts, 1995; Zahra & Covin, 1993). Previously published research has identified product and process technology as a constructive source of technology strategies (Zahra, 1999; Parker, 2000; Gibbons & O'Connor, 2003; Sikander, 2011). While CEOs recognize the significance of new product development, some may not quickly recognize the value of process innovation (Ali, 1994). A study examining PPT and OP has reaffirmed the value of product and process technology in enabling businesses to cut manufacturing costs and increase efficiency (Roberts, 1995). PPT is critical in achieving a strategic goal of differentation, a low-cost strategy objective, configuration, product technology dynamism, and competitive intensity, all of which contribute to an organization's performance (Jones & Davis, 2000; Schoenberger, 1987; Bettis & Hitt, 1995; Noori, 1990). **According to prior research, a diverse PPT can be viewed as a crucial aspect of a company's technology strategies and OP. However, as noted earlier, prior empirical results on the relationship between PPT and OP are inconclusive, leading the researcher to propose to revisit the relationship in the current study.**	**GAP 5:** The need to study the influence of product and process technology on organizational performance, which includes, financial and non-financial.
The importance of technology strategy on organizational performance has been widely explored, and the external environments may influence it differently. Organizational performance may be affected differently based on their company's strategic choices. Zahra (1996) and Zahra and Das (1998) suggest that external environment may be an important moderator that affects the company's technology strategy on organizational performance. They stated that the effect of the external environments on a company's strategic choices will lead to a competitive advantage. A comprehensive technology strategy on financial performance is primarily subjective (Zahra, 1996). The external environment that	**GAP 6:** While the nature of variance in the TS - OP relationship across external environments is an empirical question, research indicates that the external environment affects the form and strength of this relationship. Thus, this research intends to fill this gap.

leads to superior performance because of the company's technology strategy remain a matter of speculation (Zahra & Covin, 1994; Sikander, 2011; Hussin, 2016) Furthermore, technology strategy has shown to behave differently to develop and deploy technological resources to achieve superior organizational performance (Hussin, 2016). **A difficulty in incorporating previous findings on the moderating effect of the external environment is on TS - OP, that is, the strength and form of this relationship, which cannot be determined simply from previous findings.** **One explanation is that researchers tend to overlook the concurrent effect of the external environment's numerous dimensions on the TS – OP.**	

1.3 Research Questions

In achieving the objectives on technology strategy on organizational performance of Malaysian manufacturing companies, this research addresses the following questions:

1. Does pioneer-follower posture have a relationship with the organizational performance of manufacturing companies?
2. Do technological investments have a relationship with the organizational performance of manufacturing companies?
3. Does intensity of product upgrades have a relationship with the organizational performance of manufacturing companies?
4. Do external technology sources have a relationship with the organizational performance of manufacturing companies?
5. Do product and process technology have a relationship with the organizational performance of manufacturing companies?
6. Do the external environments moderate the relationship between technology strategy (pioneer-follower posture, technological investments: internal R&D, the

intensity of product upgrades, external technology sources, and product and process technology) with organizational performance?

1.4 Research Objectives

The study's main objective is to assess the effects of technology strategy across five distinct dimensions: pioneer – follower posture, technical investments: internal R&D, the intensity of product upgrades, external technology sources, and product and process technology, as well as their impact on organizational performance on a financial and non-financial basis. Moreover, this research will investigate the moderating effects of external environments on the relationship of technology strategies and organizational performance. According to prior research, there have been very few empirical investigations on the relationship between organizational performances, technology strategies, and external environments. Therefore, this research will emphasize several research objectives derive from the problem statement.

1. To examine the relationship between pioneer-follower posture and organizational performance in manufacturing companies.
2. To examine the relationship between technological investments and organizational performance in manufacturing companies.
3. To investigate the relationship between intensity of product upgrades and organizational performance in manufacturing companies.
4. To investigate the relationship between external technology sources and organizational performance in manufacturing companies.

5. To assess the relationship between product and process technology and organizational performance in manufacturing companies.
6. To analyze the moderating effect of external environments on the relationship between technology strategies and organizational performance in manufacturing companies.

1.5 Significance of the Study

The significance of the study is discussed from two perspectives. There are theoretical significance and practical significance.

1.5.1 Theoretical Significance

This study contributes to the existing literature by providing empirical validation within the technology strategy paradigm. This investigation includes the relationship of organizational performance that focuses on Malaysian manufacturing firms. Hence, this study will comprehensively enrich the readers to the integration of technology strategy dimensions, external environments and organizational performance. At the same time, the study will also provide insightful information on moderating effects of external environments. Theoretically, the linkages between these constructs have never been tested before.

1.5.2 Practical Significance

This research will be conducted comprehensively on the manufacturing sector, specifically for manufacturing organizations looking forward to improving their organizational performance while remaining sustainable. Enabling these companies to identify better which technology strategy that would contribute to the organizations positively. In an effort to achieve this performance with a minimum level of wastage in the organization. Additionally, the finding of this study would provide an important input to the policymaker in terms of insightful information about the current state of manufacturing companies and their readiness to face the challenge of the technology strategy based on dimensions that are significant to these companies. These findings would allow policymakers to devise a comprehensive and feasible policy that would enhance the manufacturing industry aiming to benefit from the global changes, especially in the presence of Industrial Revolution 4.0.

There are many potential challenges and opportunities encountered by the labor markets, especially with the emergence of the artificial intelligence (AI) and expert system that allowed companies to fully autonomously transform their operations. As a result, there is a possibility that the labor market will experience a major transition; consequently, huge unemployment is inevitable. Therefore, this study could produce a new finding that allows those involved in human resource development to develop a suitable policy while enabling future human capital management to cope with the technological strategic changes. Moreover, the findings postulate to strengthen the collaboration between industry players, the government, and Malaysian universities to ensure a steady supply of industrial engineers with the mindset of embedded technology strategy. Meanwhile, a constant upskilling of the existing employee with the exposure of technology strategy. The findings of this study and the proposed framework will contribute to the extension of the current body of knowledge and literature. This knowledge can be useful for researchers to devise a feasible framework for strategic technology of management that could provide new measurement dimensions generated from this study.

1.6 Scope and Limitations of the Study

1.6.1 Scope

This study focuses on the influences of technology strategy, namely pioneer – follower posture, technological investments, intensity of product upgrades, external technology sources, product and process technology, external environments, organizational characteristics and their effects on organizational performance. The respondents of this research are limited to manufacturing companies in Malaysia (Northern Region) listed in the Federation of Malaysian Manufacturers (FMM) before the outbreak of COVID19 pandemic which is presented in Appendix A. Further explanation will be presented in Chapter Four.

1.6.2 Limitations

Identifying manufacturing companies in Malaysia that implement technology strategy especially in pioneer – follower posture, technological investments, the intensity of product upgrades, external technology sources, product and process technology, are both challenging and difficult. Although more technology strategies are being developed, this study is limited to five technology strategy dimensions. Moreover, most manufacturing companies identified technology and strategy as the key performance index (KPI) of organizational performance and survival. Additionally, since the information has to be obtained from top-level management dan senior executives of the selected companies, the researcher may encounter some difficulties obtaining the data. This process may also include the time taken for the managerial level executives to return the questionnaires and the low response rate.

1.7 Definition of Key Terms

The subsection defines terms used in this study in order to help clarify the study's context. The terms used are:

1.7.1 Technology Strategy

Technology strategy has been defined in several definitions in previous research from various perspectives (Porter, 1985; Porter, 1995; Chiesa & Mazini, 1998; Zahra & Bogner, 2000; Burgelman et al., 2001; Burgelman et al., 2003; Ngamkroeckjoti et al., 2005; Dodgson et al., 2008; Dasgupta et al., 2011). However, those definitions of technology strategy have brought the same meaning as most defined technology strategy as a tool. This study takes the content approach of defining what constitutes technology strategy. The aim of technology strategy is to conceptualize, develop, and apply technology for economic gain. In other words, technology strategy is an overall plan consisting of principles, objectives, and tactics for using technology to achieve organizational objectives.

This study examines technology strategy in Malaysian manufacturing companies, focusing on the relationship between pioneer – follower posture (PFP), technological investments (TI), intensity of product upgrade (IPU), external technology sources (ETS), and product and process technology (PPT).

1.7.2 External Environment

External environment factors have been defined as situations, factors, or events in a business's operating environment and present the business with several distinct problems (Hashim, 2005). Five external environment factors are identified in the context of this research. They are measure by dysfunctional competition, institutional support, environmental turbulence, strategic alliance for product development, and political networking strategy dimensions.

1.7.3 Organizational Performance

Organizational performance is the ultimate result of a technology strategy that attracts the interest of researchers and practitioners. Market competition for customers, inputs, and capital make organizational performance essential to the survival and success of the modern business (Richard et al., 2009). Organizational performance is defined as numerous achievements that can be measured by financial and nonfinancial indicators such as customer and employee satisfaction, quality, market share, productivity and innovation (Said et al., 2003). These elements are consolidated in measuring organizational performance. Conceptually, organizational performance is commonly defined according to the following elements, social system and ability to exploit the environments using their limited resources. However, it is also an emphasis on achieving organizational objectives by applying available resources efficiently (Georgopoulos & Tannenbaum, 1957; Yuchtman & Seashore, 1967; Lusthaus & Adrien, 1998; Saeidi et al., 2014; Asat et al., 2015). Hence, the organizational performance in this study was defined as the extent of efficient and effective resource utilization that is considered a determinant for an organization's success.

1.8 Organization of the Study

Six chapters comprise the study. This section summarizes the thesis's organization:

Chapter One – Introduction: The first chapter outlines the research problem's overall perspectives, including the research problem and raised research questions that lead to the formation of research objectives of the study. Then, the significance of the study, scope of study and definition of terms are highlighted in this chapter.

Chapter Two – Literature Review: While the second chapter reviews the previous related literature to the topics of the study pertaining to technology strategy, external environment factors, and organizational performance, the moderating effects of external environments as well as Malaysia's manufacturing companies. Chapter Two also covers theories and models of technology strategy that support the development of the research model.

Chapter Three – Conceptual Framework: In Chapter Three explains the research design and methodology used in the study. Based on the extensive literature review, the research framework, definitions and measurements of variables, sources of data, data collection process are mapped out, and hypotheses developments of each of the variables are presented in Chapter Three.

Chapter Four – Methodology: In Chapter Four of this study presents the findings, empirical results, and discussions on the relationship between technology strategy and organizational performance. This chapter highlighted the differences and consistency of the findings compared with the past empirical evidence and underpinning theory. Chapter four will further describe the research design, the justification population, sampling technique, data collection, research instruments, and data analysis.

Chapter Five – Findings and Discussions: Chapter Five comprises the analytical steps taken in this study, accompanied by the results. The findings and discussions include demographic information as well as the statistical results derived from the collected data.

Chapter Six – Conclusions and Recommendations: Finally, Chapter Six concludes the outcome of this research. The contributions and implications of the study, limitations, and suggestions on several possible future research areas are also presented in this last chapter.

1.9 Summary of the Chapter

Chapter One discusses the whole study as general mapping. It defines the term technology strategy and explanation on the relations of technology strategy to organizational performance. Focusing on the Malaysian manufacturing industry discussed the influence of technology strategy and identifying gaps based on important issues that lead to problem statements, research questions, research objectives, and significance of the study. Then, the organizations of chapters are presented to explain how the study is organized.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter articulates the critical review of literature related to the concept of technology strategy in manufacturing companies, its theories and various types of strategy, which impact technology strategy. Section 2.2 reviews the literature on organizational performance. Section 2.3 and Section 2.4 discusses the concept of technology strategy as well as its relationship with organizational performance. Discussion on external environments is presented in section 2.5. Section 2.6 provides studies on the manufacturing industry in Malaysia. The theoretical perspectives of this study are explained in section 2.7, while Section 2.8 concludes the chapter summary with underlying theories on organizational performance and technology strategies related to the external environment and manufacturing companies.

2.2 Organizational Performance

Organizations are characterized as instruments that add value to their customers' goods and services. Organizations aim to improve their organizational efficiency to gain a competitive advantage (Calişkan, 2010; March & Sutton, 1997). Gibcus and Kemp (2003) classify organizations into four distinct policy typologies: prospectors, defenders, analysts, and reactors. Different industries generate distinct outcomes due to their distinct strategies (Raymond & Croteau, 2009). Additionally, performance indicators such as sales growth and market share can influence the extent to which strategies are employed. Such shifts in empirical studies may result from the diverse organizations and sectors in which they were performed.

Numerous researchers have defined, conceptualized and even measured organizational performance in a different way. Barney (1986) said that the researchers had expressed their opinions, approaches and definitions of organizational performance. Some studies used more rigorous measurement to measure performance. Performance, a key concern for organizations, refers to organizational success and the achievement of its objectives. Some researchers try to investigate how to improve the organization's performance, while some people learn the organization's performance predictors (Mahmood & Hanafi, 2013). According to Miles and Snow (1978), March and Sutton (1997) and Rogers and Wright (1998), organizational performance has widely been studied as a dependent construct. Moreover, Chadee and Pang (2008), Wilbon (1999), Zahra (1996), Vernet and Arasti (1996), Zahra and Bogner (1999), and Dasgupta and Gupta (2014) observed that most of the research on technology strategy also attempted to use organizational performance as a dependent variable.

Dvir and Shenhar (1992) used four different dimensions of success: profitability level, generating orders, generating new opportunities, and preparing the infrastructure for the future. These dimensions measured the technological progress and performance of a strategic business unit (SBU) in electronic and computer industries, while Pegels and Thirimurthy (1996) measured the effect of technology strategy on firm performance using annual operating income in their study. Thus, organizational performance becomes a critical variable in management and finance research and maybe the most important predictor of an organization's success (Gavrea et al., 2011), garnering the attention of career scholars and practitioners (Ahmed & Manab, 2016). Research on organizational performance has benefited both organizations and institutions (Ahmed & Manab, 2016; Gavrea et al., 2011; Hunjra et al., 2010; WeiBo et al., 2010; Ali et al., 2010). Managers and business owners have been benefited from the help of organizational performance indicators. This success is evaluated and measured to achieve the business goal while meeting the expectation of stakeholders (Antony & Bhattacharyya, 2010).

Uplifting the organizational performance has been verified in many studies that required the knowledge of the competitive survival of an organization and the effects from its environment adaptation (March & Sutton, 1997). Haque and Ali (2016) suggested that the need to survive and grow in today's competitive age, the dynamic and the uncertainty of the business world have forced organizations to find capabilities that can improve their performance. They stated that organizations could step up towards achieving such capabilities by continuously scrutinizing the changes in their external environments and focusing on enhancing innovative ability.

Richard et al. (2009) mentioned that organizational performance encompasses three specific areas of firm outcomes: 1) financial performance (profits, return on assets, and return on investment); 2) product-market performance (sales and market share); and 3) shareholder return (total shareholder return, and economic value added). In the previous studies, a typical performance measure of manufacturing companies was either an aggregate of the financial or market measure (return on assets, return on investment, and market share) or a composite index of manufacturing performance or competence (Ketokivi & Schroeder, 2004). Although the concept of organizational performance was very common in the previous research, its definition varied according to context. Thus, the definition of organizational performance has been inconclusive. Table 2.1 provides a set of definitions to illustrate the concept of organizational performance.

Table 2.1
The Concept of Organizational Performance

Author	Organizational Performance Definition
Georgopoulos and Tannenbaum (1957)	Defined as the extent to which an organization, viewed as a social system fulfilled its objectives. The performance was determined through organizational structure, its working and people.
Yuchtman and Seashore (1967)	Defined as an organization's ability to exploit its environment to access and use limited resources.
Lusthaus and Adrien (1998)	The idea of an organization that achieved performance objectives based on the constraints imposed by limited resources.
Saeidi et al. (2014)	Defined by verifiable attainment, a concept that explained the extent to which an organization achieved its objectives.
Asat et al. (2015)	Referred to the organization's ability to achieve its goal through the application of available resources in an efficient and effective manner.

Note. The concept of organizational performance from 1957 – 2015.

Performance evaluation in the 1950s was concerned with the job, the people, and the organizational structure, while in 1960s and 1970s, organizational performance started to focus on new ways by exploiting its environment and utilizing its resources. Then 1980s and 1990s, organizational performance was measured mostly by the profit or else as a success factor in efficiency and efficiency and effectiveness, compared to other indicators as in Table 2.2. One of the most commonly used descriptions of organizational performance by Lebas and Euske (2002) was:

> "Performance is a set of financial and non-financial indicators that include details about the degree to which goals and outcomes are attained."

Meanwhile, Murphy et al. (1996) measured both financial and non-financial performance using various performance indicators. Thus, in the majority of cases, researchers measured organizational performance using financial measures such as return on investment (ROI), return on sales (ROS), and return on equity (ROE). Thus, companies have resorted to using both financial and non-financial performance measures to do a more detailed evaluation. Judge et al. (2003) measured organizational efficiency using financial and non-financial indicators such as process improvement, customer satisfaction, capability utilization, and product service quality.

Hakkak and Ghodsi (2015) demonstrated that incorporating non-financial success indicators improves organizational performance significantly. While, the study of Widjaja et al. (2020) divides the organizational performance into three measures: financial performance, market performance, and production performance. According to Hussain and Hoque (2002), financial performance measures such as return on investment (ROI) or net earnings draw focus away from non-financial factors such as consumer loyalty, product quality, productivity, and production. This diversion occurred when business leaders tended to focus on short-term achievement that can hinder long-term performance. Business leaders can monitor and assess the organization efficiently by applying non-financial measures. Thus, the non-financial measures have been the best forecasters of long-run organizational performance even if their measurement accuracy is lower than financial measures, they concentrate on operational elements under management's control (Chow & Van Der Stede, 2006).

Additionally, when Askary (2017) exposed a situation in which organizations participated in unethical accounting practices and omitted critical details about the company's financial data, the importance of organizations emphasizing operational efficiency (financial and non-financial) became critical for manufacturing companies, regulatory authorities, academic communities, and investors.

Table 2.2
Financial and Non-financial Performance

Financial Measure	Non-financial Measure	Content	Source
	Sales growth, Market share	The alignment of business strategy and manufacturing performance.	Papke-Shields and Malhotra (2001)
	Market share, Sales growth	The impact of environmental dynamism on manufacturing performance.	Anand and Ward (2004)
Annual sales, Annual expenses, Annual loss, Annual profit	Market share, Product variety, New technology, Research and development	The implementation of best practices by Malaysia's electronic and electrical manufacturers and the impact toward performance. Both measurements were used to best capture the overall performance.	Yusuff (2004)
	Material and labour efficiency or productivity, Process improvements and re-engineering, New product introduction, Employee development and training, Customer satisfaction, On-time-delivery, Relations with suppliers, Workplace relations, Employee health and safety, Market share, Warranty repair costs, Customer response time, Employee satisfaction	Investigation on the role of the choice of performance measures on the relationships among strategic priorities and performance and environmental uncertainty and performance of manufacturing companies.	Hoque (2004)
	Customer complaint, On time delivery, Equipment effectiveness,	This research was done to establish an integrated dynamic performance	Chen and Cheng (2007)

	Cost of quality,	measurement system for manufacturing from customer satisfaction orientation using objective-oriented factors.	
Operating income, Sales growth, Sales revenue, ROI, Cash flows, Manufacturing cost, EVA	Customer measures Internal business process measures Innovation and learning measures	Performance measurement systems were used to investigate empirically the extent of financial and non-financial performance measures and the effects on Malaysian manufacturer's performance.	Jusoh et al. (2008)
Rate of profit, Cash flow, ROI, EVA, ROA, Financial ratios	Customer criteria: Customer satisfaction, Addressing customer complaints, On time delivery, Reducing customer complaints, *Internal process criteria:* The ratio of earned income to marketing cost, The net income of full-time staff, Total revenue of the total number of personnel, The time needed to change ideas into products, The cost growth per year *The growth and learning criteria:* The employee empowerment, The quality of the information system, The arrangement of its tools and equipment to achieve organizational goals.	The research highlighted that the implementation of non-financial performance measures had a significant positive effect on organizational performance	Hakkak and Ghodsi (2015)

Note. Financial and non-financial measurement from 2001 – 2015.

Instead of relying on a unidimensional measure of organizational performance, multidimensional approaches that cover both financial and non-financial measures are more appropriate, especially when measuring practices and performance (Fullerton &

Wempe, 2009; Abdel-Maksoud et al., 2005; Ketokivi & Shroeder, 2004; Bozarth & Edwards, 1997). Moreover, studies have shown that performance measurement frameworks were developed to help organizations designed a set of performance measures that can best assess organizational performance (Lebas & Euske, 2002). Organizations sought to create market competitiveness in achieving the required organizational achievement. The objectives were to reduce costs, achieve sales, increase the number of customers and the market percentage, improve product quality, innovation, and productivity. Thus, technological strategies played an important role in achieving this goal performance indicator. The determinants of organizational performance are classified according to technology strategies in this study. This determinant corresponds to the findings of Arasti et al. (2017), as well as Yang and Wang (2017).

2.3 Technology Strategy

Technology strategy is an essential part of forming the organization's strategic posture (Zahra & Bogner, 2000). While Zhao et al. (2016) state there is only one fundamental key to cope with the poor performance challenges is technology improvement. It is an essential prerequisite for a strategy to take advantage of technology since it can work as a fundamental tool for rivalry and establish practical physical alternative actions (Itami & Numagami, 1992). Meanwhile, organizations' core capabilities consider technology a primary foundation (Itami & Numagami, 1992). Technology has become an essential variable for profit or non-profit organization to maximize company competitive advantages and measure changes in the company's performance. Zahra (1996) opined that technology had been widely recognized as a cornerstone of the organization's competitiveness through several mechanisms, such as creating barriers to entry, attracting new markets and customers and even changing competition rules in an industry. In their review, Gillespie and Mileti (1977), Technology and the Study of Organizations, broadened the importance of past technology involving machine or equipment conceptualization to incorporate delicate advancements and utilization of the qualities of the present-day industry.

Miles et al. (1978) and Porter (1985) recommended the linkage between technology and strategy and that technology assumed to be a noteworthy part in detailing the different strategies. Furthermore, the technology strategy chosen by organisations could shape the present and the upcoming competitive state within an industry. In brief, organizations' performance and achievement are fundamentally derived from the application of technology strategy. Therefore, technology strategy is how organisations utilize their technological resources and capabilities to achieve corporate objectives (Rieck & Dickson, 1993). The evolution of technology strategy can be found in several studies, which emphasized the definition, concept and application. Initially, technology policy was applied to determine the best alternative for companies to acquire, develop and deploy technology to achieve the companies' business and strategic goals (Adler, 1989; Zahra & Covin, 1993).

Moreover, Zahra (1996) applied technology strategy in many studies that stressed the acquisition and utilization of technological resources and capabilities. Zhao et al. (2016) imply improvement and optimization of existing technologies to cope with the poor performance challenges. Having a technology strategy enables new businesses to make and inform decisions regarding the development and use of technological capabilities. In addition, technology strategy is an overall consideration for firms to make choices and determine options while enhancing and utilizing companies' technological resources (Zahra & Bogner, 2000).

Narayanan (2001), in his book Managing Technology and Innovation for Competitive Advantage, expanded the idea of technology strategy as an uncovered companies' technology design. Technology selections governed the types and degree of the companies' primary technological capabilities and the product's readiness and process policies. The selections entailed the liability of the resources for fraud, preservation, utilization, and neglect of technological capabilities. His ideas focused on two key points of technology strategy, firms' selection on the types of technology whether to acquire, develop, deploy or divest and on uncovered technology designs that were not only planned but rather additionally refined. It is evidenced that the company has shown its commitment by executing resources and technology selection, which consequently can determine the technology strategy.

Husain (2016) found that chief technology officers perceived that distinct focus was given to different elements of technology strategies to be emphasized. The process of acquiring technologies was achievable when there was no conflict of interest. This conflict of interest needed to be taken care of before achieving effective technological alliances, especially equity interest, transparent indigenization plans, product development partnership and market development (Hussain, 2016).

2.3.1 Definition of Technology Strategy

Research on technology strategy has become an interest in the field of strategic management of technology. Various researchers have interpreted technology strategy in several ways. Prior researchers examined technology strategy from a variety of approaches while developing the idea. Existing research on technology strategy is fragmented. Scholars have defined technology strategy in a variety of ways. According to Dodgson (1989), Burgelman et al. (1998), and Zahra et al. (1994), indicates the need for companies to strategically deploy technology, align it to the competitive strategy undertaken by the company, and thus ensure the linkage of technology and the support of strategies on each other.

Technology strategy could be explained as:

> A technology strategy involves with decisions which establishes objective of the technology of the organization. These technological tools are mainly aimed to accomplished technological and business objectives of the organization.
>
> (Adler, 1989)

> Numerous studies emphasized on various aspects of technology, strategy or performance. Nevertheless, little effort has been performed to combine these studies. This may convince the stakeholders that technology strategies are inextricably tied to the performance.
>
> (Miller, 1988)

Technology strategy has been defined differently by scholars of various field of studies. Table 2.3 provides an overview of the different definitions used in the previous research on technology strategy in detail. Table 2.3 shows that the research on technology strategy started in 1978. From Table 2.3, Maidique and Patch (1978), the pioneer in the research on technology strategy, defined the initial concept of technology strategy in terms of six dimensions: technology selection, level of competency, the timing of technology introduction, amount of investment, organisation and policies, and technology sources. Porter (1985), Chiesa (2001) and Burgelman et al. (2003) started to research technology strategy and defined technology strategy as a tool for effective use of technology to build new (offensive) or sustain (defensive) competitive advantages.

According to Pavitt (1990), technology strategy can be defined as a set of choices that need to be made on technology development, such as broad or specialised, product or process, and a market leader or follower. Additionally, this showed that research on technology strategies has been gaining attention amongst researchers. As the study of the technology strategy is evolving, the term has also been defined from various perspectives.

Table 2.3
Various Definitions of Technology Strategy Reported in the Literature

Author	Definition of Technology Strategy
Maidique and Patch (1978)	Technology strategy's earliest concept was based on six dimensions namely technology selection, level of competence, the timing of technology introductions, level of investment, organization and policies, and sources of technology.
Porter (1985)	Effective deployment of the company's technological capabilities and resources that can enhance the company's financial performance and sustain the company's competitive advantages.
Maidique and Patch (1988)	Technology strategy consisted of a portfolio of choices and plans that enabled the firm to respond effectively to technological threats and opportunities.
Ford (1988)	A formal plan for technology resources that guided long-term decisions related to development, acquisition, implementation, and investment.

	Technology strategy consisted of policies, plans and procedures for acquiring knowledge and ability, managing that knowledge and ability within the company and exploiting them for profit.
Burgelman and Rosenbloom (1989)	Proposed an evolutionary process perspective and framed the substance of technology strategy on competitive positioning, technology and value chain, the scope of technology strategy and the depth of technology strategy.
Mitchell (1990)	Alternative frameworks for technology strategy. Technology strategy transportation, banks/financial services and even some wholesale/retail businesses were often focused around the following three generic issues; the physical system, operations or products (of the system).
Pavitt (1990)	A set of choices that needed to be made about technology development such as broad or specialized, product or process and whether to be a market leader or follower.
Wheelwright and Clark (1992)	The objective of a technology strategy was to guide the firm in acquiring, developing, and applying technology for competitive advantage.
Spital and Bickford (1992)	Technology strategy as the set of strategic decisions and action required by managers to transform input into output to gain competitive advantages.
Rieck and Dickson (1993)	Technology strategy was the process by which firms utilized their technological resources to achieve corporate objectives
Zahra and Covin (1993)	Technology policy embodied the choices companies made about acquiring, developing and deploying technology to reach the goals of their business strategy. Technology policy was the set of organizational decisions concerning aggressive technological posture, automation and process innovation and new product development.
Zahra et al. (1994)	Technology strategy specified its components and dominant orientation; it denoted the aspect of a firm's possible technological choice and action.
Porter (1995)	He suggested that a technology strategy must address at least three broad areas: 1) the technologies to be developed, 2) the need to seek technology leadership in those technologies, and 3) the role of technology licensing.
Zahra (1996a)	Technology strategy articulated a firm's plans to effectively develop, acquire, and deploy technological resources and capabilities that contributed to its competitive position and

	achieve superior financial performance.
Zahra (1996b)	Technology strategy was the plan that guided a new venture's decisions on the development and use of technological capabilities.
Pegels and Thirumurthy (1996)	Technology strategy was defined as the approaches firms used to translate R&D efforts into the advanced product and process technologies that had the potential to provide competitive advantage result to improve firm performance.
Zahra and Bogner (1999)	Technology strategy was the sum of a firm's choices on how to develop and exploit its technological resources that can profoundly affect a company's performance and survival.
Zahra and Bogner (2000)	Technology strategy was the most essential component in the formation of the organization's strategic posture.
Chiesa (2001); Burgelman et al. (2003)	Technology strategy was a tool for effective use of technology to build new (offensive) or sustain (defensive) competitive advantages.
Narayanan (2001)	Technology strategy was the revealed pattern of the firms' technology design. His ideas identified two key points of technology strategy, firms' selection on types of technology whether to acquire, develop, deploy or divest, and on an uncovered firms' technology designs that were not only planned but rather additionally refined.
Gibbons and O'Connor (2003)	Technology strategy referred to the set of choices the firm makes about the state and quality of the know-how it incorporated into the design, development and production of its product or service.
Ngamkroeckjoti et al. (2005)	Technology strategy played a role in how much scanning they used, with a more proactive technology strategy requiring more extensive scanning. Environmental turbulence, including changes in technology, can cause failure in new product development (NPD) if scanning did not make companies aware of the situation.
Lin and Chang (2006)	Technology strategy was counted as one of the most important attributes for the achievement.
Larsson (2007)	Technology strategy was defined as the pattern or plan that integrated an organization's major goals, policies, and action sequences into a cohesive whole with respect to the physical things, know-how, and procedures used to produce products and services.

Chadee and Pang (2008)	A firm's technology strategy was defined as the firm's deliberate commitment and willingness to proactively develop and acquire relevant technologies, utilized these technologies widely in the organization and consistently upgraded its employees to ensure that technologies were fully embraced within the organization.
de Meyer (2008)	The operational expression of a technology strategy was the set of projects that an organization wanted to implement. Determining a strategy included selecting the projects and the portfolio of projects.
Ghazinoory and Farazkish (2010)	Technology strategy was one of the most important aspects of any firm's strategic posture, especially in dynamic environments such as the nanotechnology-based industry.
Dasgupta et al. (2011)	Technology strategy can be briefly and broadly defined as a portfolio of choices and plans that a firm used to address the technological threats and opportunities in its external environment. The broad objective of technology strategy can be used to guide a firm in acquiring, developing and applying technology for competitive advantage.
Ahmad and Schroeder (2011)	The learning-based technology strategy along three dimensions: proactive technology posture, process adaptation and experimentation, and collaborative technology sourcing; provides an environment and context in which production technology being used and process knowledge created can be inimitable, yielding superior competitiveness.
Li-Hua and Lu (2013)	Characterized the process of technology management in Chinese firms and the features of China's technology strategy patterns, from "imitation, improvement and/to innovation". In other words, it has established the concept of China's technology strategy from technology transfer to technology innovation.

Note. Various definitions of technology strategy from 1978 – 2013.

Table 2.3 shows that most of the previous studies defined technology strategy as a firm's plans to effectively develop, acquire, and deploy technological resources and capabilities that contributed to its competitive position and organizational performance (Zahra, 1996a; Zahra, 1996b; de Meyer, 2008; Chadee & Pang, 2008; Larsson, 2007; Lin & Chang, 2006; Gibbons & O'Connor, 2003; Narayanan, 2001; Zahra & Bogner, 2000; Zahra & Bogner, 1999; Zahra et al., 1994; Zahra & Covin, 1993; Pavitt, 1990; Rieck & Dickson, 1993; Spital & Bickford, 1992; Wheelwright & Clark, 1992; Porter, 1985; Chiesa, 2001; Burgelman et al., 2003). Meanwhile, other researchers have looked at technology strategy from its strategy (Li-Hua & Lu, 2013; Pegels & Thirumurthy, 1996; Porter 1995; Maidique & Patch, 1978) and environmental perspective (Dasgupta et al., 2011; Ahmad & Schroeder, 2011; Ghazinoory & Farazkish, 2010; Ngamkroeckjoti et al., 2005). In brief, in the past studies, most researchers defined technology strategy as an organization's plans to effectively develop, acquire, and deploy technological resources and capabilities that can contribute to its competitive advantage and organizational performance. Thus, considering the definitions by previous researchers, this study adopts the definition given by Zahra (1996) that technology strategy is an essential plan to develop, acquire, and deploy technological resources and capabilities that contribute to competitive advantage and organizational performance.

Technology strategy in this study is defined in such a way that despite the fact that the differences in the characteristics have suggested that technology strategy is considered a long-term plan that led companies to utilize the committed resources toward technology in order to provide manufacturing companies with a competitive edge.

2.3.1.1 Technology Strategy Model

Adler (1989) noted that technology strategy models could be differentiated on several dimensions, two of which were corporate-level and business-level whereas, Burgelman and Rosenbloom (1989) have proposed the evolutionary process framework, which combined many of the exact basic dimensions: competitive positioning, technology and the value chain, the scope, and depth of technology strategy. These dimensions of technology strategy have gained support from several researchers (Hampson & Tatum, 1997). These dimensions also form the basis for measuring technology strategy in this study. See Figure 2.1.

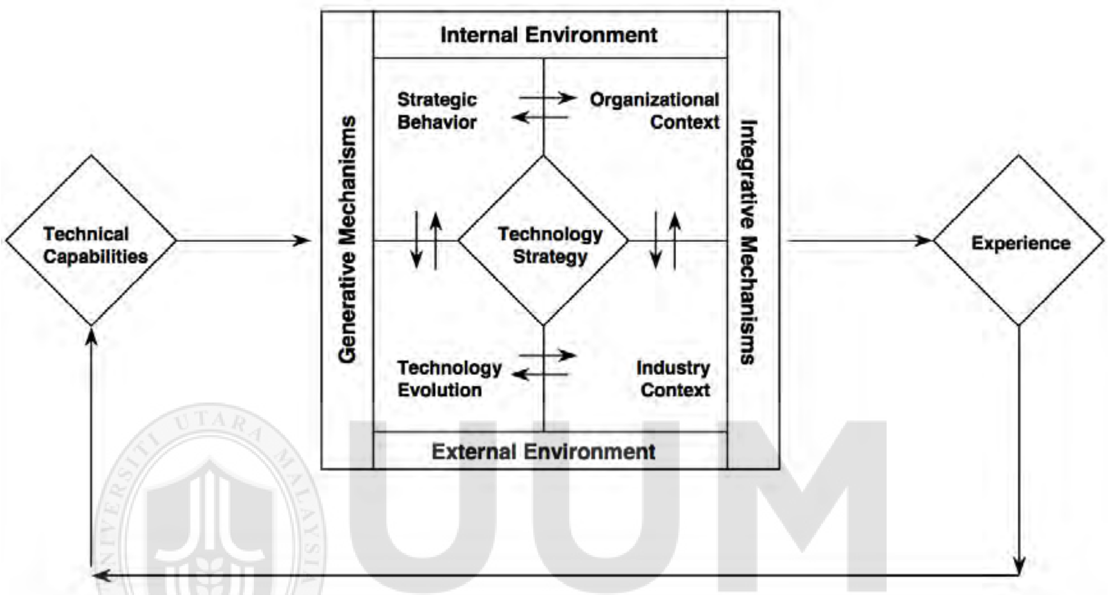

Figure 2.1
Evolutionary Process Framework for Technology Strategy

2.3.2 Technology Strategy Variables

In order to gain a sustainable competitive advantage, technology strategy is viewed as a vital plan that consists of a portfolio of decisions affecting organizational performance, particularly addressing the technological challenges and opportunities toward its ecosystems (Dasgupta et al., 2011). Technology strategy has been viewed as an important method used by organizations to achieve higher economic returns (Tsai & Wang, 2008). Many studies have been conducted on technology strategy due to its importance.

Maidique and Patch (1978) asserted that since 1978, several studies on technology techniques have been conducted. Numerous strategies have been used to measure technology strategy in the studies performed. Table 2.4, Table 2.5 and Table 2.6 show the technology strategies that were studied previously. The strategies included pioneer – follower posture, product and process technology, technology portfolio breadth, technological investments: internal R&D, external technology sources, forecasting, technological resources acquisition, technology development, technology absorption, technology indigenization, technology innovation, technology diffusion, technology commercialization, technology financing, technology phase – out, product portfolio breadth, process portfolio breadth, technology selection, technology competence, technological strength, technological cycle time, alignment, technology sourcing, technology exploiter, technology extender, technology adoption, the radicality of a new product or process technologies, intensity of product upgrades, copyrights and other means of intellectual capital protection, technology introduction and development timing, technology acquisition, technology option and research and development spending. In the literature review, the study on technology strategy was initiated in 1985 since then gained the interest of the researchers. Thus, it is believed that the studies on technology strategy shall continue to attract future researchers, indicating the importance of technology strategy in strategic technology management literature.

Previous studies on technology strategy indicated that many strategies were identified. Porter (1985), Adler et al. (1989), Bell and McNamara (1991), West (1992), Kerin et al. (1992), Kotabe (1992), Dussague et al. (1993), Utterback (1994), McGrath (1995), Cho (1996), Zahra (1999), Wilbon (1999) and Husain (2016) were among the researchers who came up with various technology strategies in their research. Additionally, some researchers have produced two to five types of technology strategy (Parker, 2000; Zahra & Nielsen, 2002; Wilbon, 2002; Gibbons & O'Connor, 2003; Ngamkroeckioti et al., 2005; Lin & Chang, 2006; Van de Velde, 2006; Muhammad et al., 2009; Chadee & Pang, 2008; Man et al., 2009; Ghazinoory & Farazkish, 2010 and Sikander, 2011).

Table 2.4

Technology Strategy in 1980s

No	Types of Technology Strategy	Frequency Count	Porter (1985)	Teece (1986)	Burgelman and Maidique (1988)	Maidique and Patch (1988)	Adler et al. (1989)
1	Pioneer – follower posture		/	/	/	/	/
2	Product and process technology		/			/	/
3	Technology portfolio breadth						
4	Technological investments: internal R&D		/		/	/	/
5	External technology sources		/		/	/	/
6	Forecasting						
7	Technological resources acquisition						
8	Technology development						
9	Technology absorption						
10	Technology indigenization						
11	Technology innovation						
12	Technology diffusion						
13	Technology commercialization						
14	Technology financing						
15	Technology phase-out						
16	Product portfolio breadth						
17	Process portfolio breadth						
18	Technology selection						
19	Technology competence						
20	Technological strength						

21	Technological cycle time					
22	Alignment					
23	Technology sourcing					
24	Technology exploiter					
25	Technology extender					
26	Technology adoption					
27	Radicality of new product or process technologies					
28	Intensity of product upgrades	/		/	/	/
29	Copyrights & other means of intellectual capital protection	/	/			/
30	Technology introduction and development timing					
31	Technology acquisition					
32	Technology option					
33	R&D spending	/	/	/	/	/

Table 2.5
Technology Strategy in the 1990s

No	Types of Technology Strategy	Frequency Count	McCann (1991)	Bell and McNamara (1991)	Chakrabrti and Weisenfeld (1991)	West (1992)	Christensen (1992)	Spital and Bickford (1992)	Kerin et al. (1992)	Kotabe (1992)	Lefebvre et al. (1992)	Dussague et al. (1993)	Zahra and Covin (1993)	Zahra and Das (1993)	Morone (1993)	Zahra and Covin (1994a)	Zahra and Covin (1994b)	Zahra and Covin (1994c)	Zahra and Covin (1994d)	Ali (1994)	Utterback (1994)	Sharif (1994)	McGrath (1995)	Zahra et al. (1995)	Clarke et al. (1995)	Zahra (1996a)	Zahra (1996b)	Cho (1996)	Pegels and Thirumurthy (1996)	Zahra (1999)	Wilbon (1999)	Zahra and Bogner (1999)
1	Pioneer – follower posture			/		/	/		/	/	/	/	/	/	/	/	/			/	/	/	/	/		/	/			/	/	
2	Product and process technology			/	/	/	/		/	/		/	/	/		/			/		/		/			/	/			/		
3	Technology portfolio breadth																										/				/	
4	Technological investments: internal R&D		/	/	/	/	/	/	/	/		/		/	/		/		/		/		/			/	/			/	/	/
5	External technology sources		/	/	/	/	/	/	/	/		/		/	/		/		/		/		/			/	/			/		/
6	Forecasting																										/					
7	Technological resources acquisition																								/							
8	Technology development																															
9	Technology absorption																															

10	Technology indigenization									
11	Technology innovation									
12	Technology diffusion									
13	Technology commercialization									
14	Technology financing							/		
15	Technology phase-out									
16	Product portfolio breadth									
17	Process portfolio breadth									
18	Technology selection	/						/		
19	Technology competence	/	/	/						/
20	Technological strength								/	
21	Technological cycle time								/	
22	Alignment							/		
23	Technology sourcing				/	/		/		
24	Technology exploiter						/			
25	Technology extender						/			

26	Technology adoption																					
27	Radicality of new product or process technologies																					/
28	Intensity of product upgrades	/	/		/	/	/	/	/	/	/		/	/	/	/	/	/	/	/	/	/
29	Copyrights & other means of intellectual capital protection		/		/		/	/		/						/	/	/		/	/	/
30	Technology introduction and development timing																					
31	Technology acquisition																					
32	Technology option																				/	
33	R&D spending	/	/	/	/	/	/	/	/	/		/	/		/	/	/	/		/		

Table 2.6

Technology Strategy in the 2000s

No	**Types of Technology Strategy**	Frequency Count	Parker (2000)	Li and Atuahene-Gima, (2001)	Zahra and Nielsen (2002)	Wilbon (2002)	Gibbons and O'Connor (2003)	Ngamkroeckjoti et al. (2005)	Lin and Chang (2006)	Van de Velde (2006)	Chen et al. (2008)	Jin et al. (2008b)	Muhammad et al. (2009)	Chadee and Pang (2008)	Man et al. (2009)	Ghazinoory and Farazkish (2010)	Dasgupta et al. (2011)	Sikander (2011)	Husain (2016)
1	Pioneer – follower posture		/				/	/	/	/			/					/	
2	Product and process technology		/				/											/	
3	Technology portfolio breadth					/				/									
4	Technological investments: internal R&D				/	/		/	/					/	/				
5	External technology sources				/									/	/				
6	Forecasting								/										
7	Technological resources acquisition										/	/							/
8	Technology development																		/
9	Technology absorption																		/
10	Technology indigenization																		/
11	Technology innovation							/											/
12	Technology diffusion													/					/
13	Technology commercialization																		/
14	Technology financing																		/
15	Technology phase-out																		/
16	Product portfolio breadth																		
17	Process portfolio breadth																		
18	Technology selection												/			/			
19	Technology competence					/							/	/				/	

20	Technological strength																
21	Technological cycle time																
22	Alignment																
23	Technology sourcing				/												
24	Technology exploiter						/										
25	Technology extender						/										
26	Technology adoption												/				
27	Radicality of new product or process technologies													/			
28	Intensity of product upgrades		/											/	/		/
29	Copyrights & other means of intellectual capital protection				/			/						/			
30	Technology introduction and development timing	/															/
31	Technology acquisition														/		
32	Technology option																
33	R&D spending																

Table 2.7
Technology Strategy Variables from the 1980s to 2000s

No	Variables	Frequency Count
1	Pioneer – follower posture	33
2	Technological investments: internal R&D	30
3	Intensity of product upgrades	27
4	External technology sources	26
5	Product and process technology	22
6	R&D spending	21
7	Copyrights & other means of intellectual capital protection	17
8	Technology competence	8
9	Technology portfolio breadth	4
10	Technological resources acquisition	4
11	Technology selection	4
12	Technology sourcing	4
13	Forecasting	2
14	Technology innovation	2
15	Technology diffusion	2
16	Technology financing	2
17	Technology exploiter	2
18	Technology extender	2
19	Radicality of new product or process technologies	2
20	Technology introduction and development timing	2
21	Technology development	1
22	Technology absorption	1
23	Technology indigenization	1
24	Technology commercialization	1
25	Technology phase-out	1
26	Technological strength	1
27	Technological cycle time	1
28	Alignment	1
29	Technology adoption	1
30	Technology acquisition	1
31	Technology option	1
32	Product portfolio breadth	1
33	Process portfolio breadth	1

Note. Technology strategy variables from the 1980s to 2000s.

Concerning Table 2.7, seven variables of technology strategy were frequently used in studies related to technology strategy. These studies showed that technology strategies such as pioneer – follower posture, technological investments: internal R&D, the intensity of product upgrades, external technology sources, product and process technology, R&D spending and copyrights and other means of intellectual capital protection have been widely accepted by most researchers (Parker, 2000; Sikander, 2011). This technology strategy is considered essential in forming the organization's strategic posture (Zahra & Bogner, 2000) and is defined as an organization that demonstrates the highest level of proactivity to develop and obtain relevant technologies. Furthermore, to enhance the human resources in the organization, these technologies are consistently utilized in ensuring that the organizations are embracing the technology (Chadee & Pang, 2008).

Based on their study, Husain (2016) and Sikander (2011) opined that future research should emphasize technology strategy. Technology strategy is important and deserves special attention, especially in the area of strategic technology management studies. Therefore, this study employs those variables to conduct structural model testing. Table 2.8 presents the critical technology strategy variables used in this study and studied by different researchers.

Table 2.8
Technology Strategy Variables Used in this Study and Studied by Different Researchers

Variables	Researchers
Pioneer – follower posture	Porter (1985); Teece (1986); Burgelman and Maidique (1988); Maidique and Patch (1988); Adler et al. (1989); Bell and McNamara (1991); West (1992); Christensen (1992); Kerin et al. (1992); Kotabe (1992); Lefebvre et al. (1992); Dussague et al. (1993); Zahra and Covin (1993); Zahra and Das (1993); Morone (1993); Zahra and Covin (1994a, 1994b); Ali (1994); Utterback (1994); Sharif (1994); McGrath (1995); Zahra et al. (1995); Zahra (1996a, 1996b); Zahra (1999); Wilbon (1999); Parker (2000); Gibbons and O'Connor (2003); Ngamkroeckioti et al. (2005); Lin and Chang (2006); Van de Velde (2006); Muhammad et al. (2009); Sikander (2011).
Technological investments: internal R&D	Porter (1985); Burgelman and Maidique (1988); Maidique and Patch (1988); Adler et al. (1989); McCann (1991); Bell and McNamara (1991); Chakrabrti and Weisenfeld (1991); West (1992); Christensen (1992); Spital and Bickford (1992); Kerin et al. (1992); Kotabe (1992); Dussague et al. (1993); Zahra and Das (1993); Morone (1993); Zahra and Covin (1994b, 1994d); Utterback (1994); McGrath (1995); Zahra (1996a, 1996b); Zahra (1999); Wilbon (1999); Zahra and Bogner (1999); Zahra and Nielsen (2002); Wilbon (2002); Ngamkroeckioti et al. (2005); Lin and Chang (2006); Chadee and Pang (2008); Man et al. (2009).
Intensity of product upgrades	Porter (1985); Burgelman and Maidique (1988); Maidique and Patch (1988); Adler et al. (1989); McCann (1991); Bell and McNamara (1991); West (1992); Christensen (1992); Kerin et al. (1992); Kotabe (1992); Dussague et al. (1993); Zahra and Covin (1994b, 1994c); Ali (1994); Utterback (1994); McGrath (1995); Zahra (1996a); Pegels and Thirumurthy (1996); Zahra (1999); Wilbon (1999); Zahra and Bogner (1999); Li and Atuahene-Gima (2001); Man et al. (2009); Ghazinoory and Farazkish (2010); Sikander (2011).
External technology sources	Porter (1985); Burgelman and Maidique (1988); Maidique and Patch (1988); Adler et al. (1989); McCann (1991); Bell and McNamara (1991); Chakrabrti and Weisenfeld (1991); West (1992); Christensen (1992); Spital and Bickford (1992); Kerin et al. (1992); Kotabe (1992); Dussague et al. (1993); Zahra and Das (1993); Morone (1993); Zahra and Covin (1994b, 1994d); Utterback (1994); McGrath (1995); Zahra (1996a, 1996b); Zahra (1999); Zahra and Bogner (1999); Zahra and Nielsen (2002); Chadee and Pang (2008); Man et al. (2009).
Product and process technology	Porter (1985); Maidique and Patch (1988); Adler et al. (1989); Bell and McNamara (1991); Chakrabrti and Weisenfeld (1991); West (1992); Christensen (1992); Kerin et al. (1992); Kotabe (1992); Dussague et al. (1993); Zahra and Covin (1993); Zahra and Das (1993); Zahra and Covin (1994a, 1994d); Utterback (1994); McGrath (1995); Zahra (1996a, 1996b); Zahra (1999); Parker (2000); Gibbons and O'Connor (2003); Sikander (2011); Saleem et al. (2020).

This study aims to unravel some of the critical elements in the current manufacturing businesses. The manufacturing industry has encountered some critical decisions in the practice of its technology strategy. This study proposes the constructs of technology strategy. There is a pioneer – follower posture, technological investments: internal R&D, the intensity of product upgrades, external technology sources and product and process technology.

2.3.2.1 Pioneer – Follower Posture

Pioneer – follower posture refers to the organization's inclination to create and manipulate technology as a means of situating itself as a leader (Sikander, 2011; Zahra & Covin, 1993; Oster, 1999; Adler, 1989; Maidique & Patch, 1988). Pioneer – follower posture, sometimes referred to as technological pioneering (Zahra et al., 1995; Porter, 1985; Utterback, 1994), is the most potentially feasible strategy. The pioneering and the followership represent the technological posture continuum to the extent that the company is one of the first to lead its industry in creating technologies (Jones, 2017). According to Table 2.8, pioneering is the most commonly known technology strategy (Porter, 1985; Teece, 1986; Burgelman & Maidique, 1988; Maidique & Patch, 1988; Christensen, 1992; Kerin et al., 1992; Kotabe, 1992; Lefebvre et al., 1992; Dussague et al., 1993; Zahra & Covin, 1993; Zahra & Das, 1993; Morone, 1993; Zahra & Covin, 1994a, 1994b; Ali, 1994; Utterback, 1994; Sharif, 1994; McGrath, 1995; Zahra et al., 1995; Zahra, 1996a, 1996b; Zahra, 1999; Wilbon, 1999; Parker, 2000; Sikander, 2011).

Meanwhile, in other studies, pioneer – follower posture has been referred to as technology timing. Technology timing can be identified as the desire of the company to compete with rival companies in presenting new products (Hung-Chia, 2013; Maidique & Patch, 1988; Miller, 1988) based on the level of determination of the company to become the leader in the research on new technologies, products' introduction, manipulation of new technologies, or the introduction of cheaper products. A company can either initiate or become followers of technological change in the industry (Song et al., 2013). Pioneer and followers are the two extremes of a technological posture's continuum indicating the different positions of the followers (Kerin et al., 1992).

Currently, major industrialized countries like Japan, the USA and some parts of Europe remain leaders in technology development and innovation (de Meyer, 2008). De Meyer examined the strategic aspects of timing the perfect market decision results. Qualitative decisions were addressed as a problem of strategy entry as the firms needed to decide whether to become pioneers or followers, whereas quantitative market entry decisions were addressed as a time-and lead bound problem to decide on the timing the new products should enter the market. Previous studies suggested that significant consequences may be associated with the mistiming of new technology introduction. The tactical result of entry time is a problem to offset the risk of early entry and the missed opportunities of late entry. The problem escalates when the product life cycle is wholly short, especially in high-tech markets. Therefore, the organization may lose the perfect timing of entry. However, the successful organization of the mix is then expected to become the pioneer.

Burgelman and Rosenbloom (1989) described competitive positioning as a critical aspect of technology strategy that can be quantified through a firm's technological posture. According to Maidique and Patch (1988), one of the most important strategic decisions confronting firms in technology – intensive industries is whether to be the first or second mover. A pioneering business is defined as the first to commercialize a product through radical innovation. A follower firm employs a follow-the-leader approach by slowly duplicating its rivals' innovations (Ali, 1994). Generally, pioneering firms have highly sophisticated technological capabilities that enable them to achieve enormous competitive advantages. Among the benefits of becoming a pioneer are setting quality specifications, capturing premium market segments, managing distribution networks, establishing competition laws, enhancing prestige, and profiting handsomely from its initial location (Zahra et al., 1995; Golder & Tellis, 1993; Schmalensee, 1992; Pavitt, 1990; Porter, 1985). These benefits are frequently attractive to investors seeking a quick ROI by investing in early pioneers in the field of technology.

Nonetheless, there are risks involved in pioneering to own a considerable investment in the product and market development. This risk arises from unpredictable demand and an unclear pace of consumer education about technology (Porter, 1985; Teece, 1986; Wilbon, 1999). Previous studies have shown that although there are many advantages to become a pioneer in the market, there are also sometimes advantages to become followers. Followers enable businesses to assess the market's attractiveness, critical success factor (CSF), lower entry cost (Yip, 1982) and the capitalization capacity on pioneering research and development investments (Zachary et al., 2015; Wesseling et al., 2015; Lieberman & Montgomery, 1998). For stock investors, the short-term ROI is smaller due to the comparatively low risk associated with followers. On the contrary, the risk assumed by the firms for implementing follower strategies could trigger enthusiasm among investors, especially for the firm who wish to remain as a pioneer in the industry since it is complex to forecast whether companies developing ground-breaking products will be able to maintain their pioneering advantages while continuing to produce high returns.

However, given that investors' primary objective in the stock market is to optimize the returns on their investments while minimizing the risks associated with that objective, pioneering businesses offer the opportunity to realize these results. The evidence suggests that pioneers earn a greater rate of return and enjoy a market share advantage (Lee & Tang, 2018; Mena & Chabowski, 2015; Zahra, 1996a; Kalyanaram & Urban, 1992). Investors commonly agree that high return accompanied by higher risk. As a result, they value pioneering companies more highly especially true in industries that rely heavily on technology. Rapid technological developments, frequent product launches, fluctuating consumer demand, and evolving industry standards often preclude long-term speculation. Meanwhile, American and European pioneers turn up to be the best innovators due to their capability to innovate (Manu, 1992) and differentiate the outputs that enable them to achieve competitive advantage and gain higher performance.

Previous studies showed that imitators could reduce their investment costs and ultimately defeat pioneers (Lieberman & Montgomery, 1998). The classic example is Diner's Club, the first credit card quickly passed by its imitators, Visa and MasterCard (Levitt, 1966). Additionally, recent examples, such as Alibaba Group, demonstrate that leading companies are more likely to be more valuable, owing primarily to their pioneering posture, although they exhibit numerous risky characteristics. Alibaba, for example, is a pioneer in building e-commerce infrastructure. From the investor perspective, many benefits derive from the investment in pioneering that could generate higher returns and enhance earnings. This initiative could expand beyond the short-term risk observed by the company. Hence, this study anticipates that technological postures impact the organizational performance of manufacturing companies.

2.3.2.2 Technological Investments: Internal R&D

The importance of acquiring and applying new technologies in business was one of the main factors influencing economic progress in today's global business environment (Krušinskas & Vasiliauskaitė, 2005; Zehir et al., 2010). A number of businesses showed significant effects between performance and technological investments, which indicate the most significant expenses. However, it can be assumed that higher firm performance can be expected through applying and employing technological innovation because the latest technologies hinder technological improvement as according to Young Sung and Choi (2011). On the other hand, Zehir et al. (2010) and Kruinskas and Vasiliauskait (2005) emphasized the importance of technological investment in any organization, stating that implementing cutting-edge technology or innovative processes results in increased productivity, improved quality, cost savings, increased activity outcomes, increased profit, competitive advantage, market share and simultaneously strengthen firm performance.

Studies by Loof and Heshmati (2008) and González-Benito (2007) showed that technological investment was believed to affect firm performance significantly. Their studies stated that many firms had invested a significant amount of money in technology and machinery. There are several explanations why businesses and organisations invest significant sums in technology each year. The motives are to i) improve management decision-making, ii) facilitate company processes, and iii) support strategic goals. Additionally, Zehir et al. (2010) noted that scholars and industry experts have been attempting to establish a more direct link between technology investment and firm performance due to today's firms' massive investments in technology. Despite over a decade of research on the impact of technology investments on firm performance, the studies' findings have not been clear (Thouin et al., 2008). The development of technological investment and its relationship to firm performance in Malaysia, especially manufacturing firms, has been an intriguing area of study that has received insufficient attention. There is evidence of the insufficient investigation, particularly in Malaysia, focusing on technological investment and firm performance. The prior literature on technological investment has concentrated on the relationship between information technology (IT) investment and firm performance (Zehir et al., 2010; Loof & Heshmati, 2008; González-Benito, 2007), as well as the relationship between human resource management investment and firm performance (Ferguson & Reio, 2009) and advanced manufacturing technology investment and firms' performance (Idris et al., 2008). However, technological investment and organization's performance literature still lack empirical evidence.

Technology is defined as the knowledge and processes that individuals use to meet their individual needs and desires (Wright, 2008) and as the collection of physical processes that convert inputs to outputs by the use of procedural processes and organizational preparations (Wie, 2003), while investment is defined by Piana (2004) as the creation or acquisition of productive assets. Sikander (2011), Clark et al. (1989), and Herman (1998) characterized technological investments as the mechanisms by which firms fund their research and development (R&D) activities, with the primary objective of achieving the desired return on investment (ROI). There are many types of technology investment within a company, including information technology investment, administrative technology investment, operational technology investment, and advanced manufacturing technology investment.

The study of Zehir et al. (2010) defined the use of electronic devices and programs for the processing, storage, transfer and presentation of information as information technology (IT), which provided long term benefits and can be evaluated based on its costs and benefits (Apostolopoulos & Pramataris, 1997). On the other hand, Idris et al. (2008) stated in their study that administrative technology, also known as business support tools, is used to integrate the operations of the entire organization and to apply new science or engineering discoveries to the design of operations and manufacturing processes as advanced manufacturing technology. According to the operational technology investment framework, technology is classified as technical expertise associated with equipment, a chemical process, a patent, a procedure, or a single electric or mechanical feature, as well as software code (Stock & Tatikonda, 2000).

Technological investment refers to the degree to which a manufacturing company invests in internal activities or expenses associated with research and development (R&D) (Zahra & Bogner, 1999; Kotabe & Swan, 1995) through establishing facilities and acquiring knowledge, as well as the skills necessary for the continuity of the in-house research and development. Internal R&D by a business often results in the ownership of intellectual property in the form of patents or copyrights and control of critical knowledge, which allows the business to leverage its inventions profitably. Helfat (1994) discovered that internal research and development have resulted in potential success by developing proprietary research platforms. According to some studies, China has grown significantly faster than the United States and the European Union. China is widely recognized as the second-largest contributor to internal R&D on a country-by-country basis, accounting for 20 percent of total global R&D. Pharmaceutical firms such as Pfizer or car manufacturers such as General Motors and Volkswagen usually spend the most on R&D.

Numerous studies have discovered a correlation between technological investment and the competitive market (Scherer & Huh, 1992; Spital & Bickford, 1992). Burgelman and Rosenbloom (1989) analyzed the extent to which a firm's technology strategy, as measured by internal research and development spending as a percentage of revenue, allowed the firm to respond to its competitor and become a new technological development in the industry. In a similar vein, Pegels and Thirumurthy (1996) noted in their study that the accumulation of information and technical strength through research and development activities could influence organizational success. Pavitt (1990) emphasized the importance of a company investing in fundamental research since the cost of doing so is far less than the cost of understanding the effects of such research in the future. Therefore, some companies have reinvested a significant amount of revenues back into their R&D, especially technology companies, since they have viewed it as an investment to continue growth. It can be said that technology investment is one of the most important drivers toward company growth and the rationalization of strategic decisions to gain the specified economic stability. This investment in technological resources is focused on internal R&D expenses.

2.3.2.3 Intensity of Product Upgrades

The intensity of product upgrades refers to the frequency and the number of new products being introduced (Herman 1998; Zahra & Covin, 1993). This technology strategy refers to the frequency at which the company's current goods are revised or extended. A company that excels in this strategy is extensive in terms of product updates, outpaced rivals. In order to gain market share while retaining customer loyalty, several upgrades are essentials to ensure profitability (US Industrial Outlook 1994) (Buzzell & Gale, 1987).

Upgrades are also critical for revenue generation and strengthening the competitive position of a business. Additionally, these changes act as a legitimate market warning to competitors, demonstrating the company's commitment to the industry. Finally, a diversified product offering helps a business build a positive reputation with clients, maintain its leading position, and improve performance.

Upgrading is the process of replacing a product with a higher-quality version of the same product, such as one that performs better or has a stronger feature (Anton & Biglaiser, 2013; Fudenberg & Tirole, 1998; Martin, 2011). The frequent launch of updated products has been recognized as a critical method for firms to continually refresh themselves to survive and succeed in a rapidly evolving market climate (Anton & Biglaiser, 2013; Koufteros & Marcoulides, 2006), and is particularly noticeable in the durable goods industry. For example, each month, a new cell phone model with innovative agenda, camera, or Internet functions is introduced to the market (Martin, 2011), while the automotive industry introduces new components with each new model. Other sectors, such as personal computers, home appliances (washing machines, dryers, and vacuum cleaners), CRT devices (television sets and monitors), and consumer goods, exhibit similar trends (Anton & Biglaiser, 2013).

2.3.2.4 External Technology Sources

External technology sources are characterized as the use of strategic partnerships, licensing agreements, acquisitions, and outright acquisitions of technology from third parties or external sources (Zahra & Bogner, 1999; Adler, 1989; Dowling & McGee, 1994; Kotabe & Swan, 1995; Shan, 1990). These sources enable manufacturing companies to gain access to a greater platform of technological capabilities essential for product development to overcome their weaknesses in the R&D of the manufacturing companies to boost company product development and create opportunities (Dodgson, 1993).

External sources of technology are often used to supplement and expand an organization's internal technical capabilities. They can acquire technologies from other businesses, purchase technology-based companies, enter into agreements on licensing with other businesses to acquire or sell their technologies or form technological alliances (also referred to as R&D partnerships) (Dussauge et al., 1992; McCann, 1991; Porter 1985). Dodgson (1993) opines that strategic alliances and licensing enable companies to combine their specific technological superiority with their prevailing product attributes developed by external sources. This strategy enables the rapid introduction of a diverse range of innovative products to market, the reduction of development processes for new products, and the mitigation of high-risk activities connected with new product development. External technologies can be used for defensive or offensive purposes. External technology may be used defensively to complement the shortcomings in an organization. Internally produced skills, experience, and knowledge in a company's technology must begin and manage change. On the equal ground, external technology is applied to exploit opportunities from the competition. Competitors' strategic alternatives are constrained, and their market share is eroded.

In a competitive environment, businesses can seize opportunities on the market rapidly by introducing new goods or bolstering their technological capabilities, which can quickly become extinct. While large telecommunications companies increasingly rely on external technology sources to gain cutting edge technological skills while avoiding the associated risks with creating complicated technology (Hagedroon, 1993). Outsourcing and technological collaboration reduces the required cycle to develop the technology. This enables businesses to respond to the changes in customer demand promptly. Furthermore, business function in a secure setting (aerospace industry) depends on external technology sources less frequently. Commonly, these businesses enhance their existing products and processes.

Though hostility is intended to promote external sources to acquire multiple technologies without investing heavily in risky research and development, additionally, as hostility develops as a result of major competence-destroying shifts in a market, it may increase a company's dependence on external sources for new technology, rather than solely on internal research and development (Link & Tassey, 1987). Thus, increased competition in such an environment could encourage a company to license its technology, rapidly disseminate it, and establish it as an industry standard (Hill, 1992). As a result, the organization will be able to influence the course of its industry's evolution. New ventures become more profitable than before by sharing the costs and risks of product development with alliance partners. Similarly, in markets where non-price competition is strong, businesses can bundle their product characteristics with their partners, thus raising profits.

Whereas, in the heterogeneous environment, external technology sources can be utilized (Miles et al., 1978). These sources enable the company to sustain a high level of innovation in its products and processes while also meeting the market's diverse needs. Correspondingly, to thrive in this setting, a business must have a diverse set of technological capabilities. Therefore, strategic alliances, licensing agreements, acquisitions, outright purchase of technology and other external outlets could provide the business with a broader range of technological capabilities (Hagedroon, 1993; Zahra & Bogner, 1999).

Strategic alliances, a type of inter-organizational cooperative strategy, involve pooling specific resources and expertise by cooperating organizations to accomplish common and partner-specific objectives. Gaining access to new markets, improving the speed of penetration into new markets, sharing research and development, production, and marketing costs, diversifying the product line/filling product line gaps, and acquiring new skills are reasons companies must form strategic alliances.

2.3.2.5 Product and Process Technology

This element indicates that the business will create novel products and processes and market them first (Ali, 1994). Typically, radicalism reveals itself through the novelty of the technology itself (as with technical developments or paradigm shifts) or via the novelty of the applications supplied by the technology to the user. The term product and process technology refer to the extent to which new technology is integrated into a business's plants and processes (Saleem et al., 2020; Zahra & Covin, 1993). Executives must decide on the technological portfolio's substance and breadth. The portfolio's content must be chosen by determining the combination of product and process technologies.

However, scope refers to the portfolio's diversity in process and product technologies. The internal and external technology sources of a business indicate its stress on the process and product technologies. Technology-based products are the outcome that meets the requirements of customers (Zahra, 1993; Zahra & Covin, 1994). Process technologies allow a business to produce products efficiently and cost-effectively. Market performance requires both product and process technologies (McCann,1991). Although executives recognize the significance of new product development (Ali, 1994), specific individuals cannot recognise the importance of process innovations. Fortunately, this is beginning to change (Skinner, 1992).

Process innovation has played a growing role in achieving competitive competence in the last few years. Businesses are anticipated to innovate their processes to cut costs, enhance product quality and efficiency, and manufacture and sell new items. Western businesses have shifted their emphasis to process innovation to keep pace with their global competitors, addressing a deficiency in previous resource allocations by US companies, which have historically favored product innovations (Zahra & Das, 1993).

Technological advancements in products and processes may be drastic or gradual. However, revolutionary technologies represent significant advancements in the industry. These products and processes are the outcomes of a continuous effort to extend the incremental technologies. It is evidenced in several studies that covered many sectors. Utterback (1994) suggested that the development of radical product technology could encourage high dynamism. To be more precise, the organization introduces highly advanced technology-based products early in an industry's life cycle to draw consumers and increase market share. When a dominant design arises, the competition focuses on price and product value rather than product novelty. A dominant design enables quality and product standardization by increased incremental product technology advancement.

2.3.3 Critical Review of the Literature on Technology Strategy

Many researchers have presented diverse technology strategy in the various context of studies. Zahra (1996b) distinguished six variables of technology strategy as a model that guided a new venture's decisions on developing and deploying technological resources and capabilities. The variable are; 1) pioneering posture, selecting the company's technological innovation posture and capabilities (introducing new products to the market first); 2) determining the number of products to be introduced to the market; 3) technology sourcing which is the extent of using a venture's internal and external R&D sources of technology (in-house R&D activities, licensing, strategic alliances and acquisition of the technology); 4) R&D spending on the technological level; 5) the combination of applied and basic research projects, and; 6) the venture's use of patents. The study highlighted the important roles of the technology strategy in utilizing the organization's technological resources and capabilities.

In addition to that, empirical findings of Zahra and Covin (1993) in a study on 103 manufacturing-based firms representing 28 matured industries stated that technology policy as the set of organizational decisions concerning three variables of technology strategy in their study varies widely across firms among select business strategy dimensions and firm performance. The variables covered technological posture (Oster, 1990), the level of automation of plants and facilities, the adoption of the latest technology in the production, and capital allocations for new equipment and machinery (Hayes & Wheelwright, 1984) and the intensity of the firm's product development activities (Zahra, 1991). The findings supported the strong positive relationships between technology strategy and organizational performance.

Studies by Maidique and Patch (1988) outlined a technology policy entailing six variables, namely, the type of technology, the desired level of competence (nearness to state of the art), internal versus external sources of technology, R&D investment, the timing of technology introductions, and R&D organization. The six variables of technology strategy derived from the study of Zahra et al. (1994) were the company's technological innovation posture and capabilities (the first to the market, fast follower, imitator and application), dominant technological thrust and goals of a company's, globalization of its technology strategy extension (a company engaged in a global technology strategy), technology sourcing (use of external and internal sources of technology), the nature of technological investments, the technologies offered by the company after some time and the organizational mechanisms for technological resources (technology experienced executive). Nevertheless, Narayanan (2001) categorized two types of technology strategy: the scope of technologies and technology led the company's pledge to pioneer the technological thrust and goals of the company. Various studies have reported that technology strategy is positively associated with organizational performance (Zahra & Bogner; 1999; Ali, 1994; Adler, 1989; Dowling & McGee, 1994). On the other hand, Kalay and Lynn (2015) stated that there had been no effect of technology strategy on performance.

There are a lot of studies on technology strategy in the literature (Porter, 1985: Adler et al., 1989; Bell & McNamara, 1991: West, 1992: Kerin et al., 1992; Kotabe, 1992; Dussague et al., 1993; Utterback, 1994; McGrath, 1995; Cho, 1996; Zahra, 1999; Wilbon, 1999; Husain, 2016; Parker, 2000; Zahra & Nielsen, 2002; Wilbon, 2002; Gibbons & O'Connor, 2003; Ngamkroeckioti et al., 2005; Lin & Chang, 2006; Van de Velde, 2006; Muhammad et al., 2009; Chadee & Pang, 2008; Man et al., 2009; Ghazinoory & Farazkish, 2010 and Sikander, 2011). Table 2.9 shows the previous studies on technology strategy and their research context. Some of the studies were done qualitatively and in the form of conceptual papers that proposed potential variables of technology strategy and explained the concept of technology strategy, while most were conducted quantitatively. Therefore, there is a need to empirically test the proposed variables which are covered in this study.

Table 2.9
Past Research on Technology Strategy

Author	Country	Context	Methodology	Research Design
Porter (1985)	-	Firm	Conceptual	Qualitative
Adler et al. (1989)	-	Firm	Conceptual	Qualitative
Bell and McNamara (1991)	-	High-tech ventures	Conceptual	Qualitative
Kerin et al. (1992)	-	Firm	Conceptual	Qualitative
Kotabe (1992)	-	Firm	Conceptual	Qualitative
Dussague et al. (1993)	-	Firm	Conceptual	Qualitative
Utterback (1994)	-	Firm	Conceptual	Qualitative
McGrath (1995)	-	High-technology companies	Conceptual	Qualitative
Cho (1996)	Korea	Government R&D programs in Korea	Empirical	Quantitative
Zahra (1999)	USA	176 manufacturing companies in Southeastern state	Empirical	Quantitative
Wilbon (1999)	USA	31 Computer software IPO firms	Descriptive	Quantitative/ Content analysis
Parker (2000)	Europe USA Asia Middle East Africa	78 organizations operating in the telecommunications industry	Exploratory cross-sectional	Quantitative/ Exploratory study
Li & Atuahene-Gima (2001)	China	300 new technology ventures from a sample frame of 500 firms in Beijing	Empirical	Quantitative
Zahra and Nielsen (2002)	USA	149 in 1996 and 97 in 1999 from 600 companies of 20 US based manufacturing technologies.	Exploratory longitudinal	Quantitative/ Longitudinal study
Wilbon (2002)	USA	168 high-technology firms	Exploratory cross-sectional	Exploratory study and content analysis
Gibbons and O'Connor (2003)	Ireland	359 Irish SMEs	Empirical	Quantitative
Ngamkroeckioti et al. (2005)	Thailand	SMEs in the Thai food industry	Conceptual	Qualitative study was conducted using semi-structured in-depth interviews with food expert
Lin and Chang (2006)	Taiwan	144 Taiwan Electrical and Electronic Manufactures Association	Empirical	Quantitative
Van de Velde (2006)	Europe	Corporate and university spin-offs in Flanders	Empirical	Quantitative/ Content analysis

				Experiment and survey
Lin et al. (2006)	USA	US technology enterprises	Empirical	Quantitative
Muhammad et al. (2009)	Malaysia	61 Malaysian industrial automation company	Empirical	Quantitative/ Empirical
Chadee and Pang (2008)	China	ICT firms from China, South Korea, Thailand and Philippines	Empirical	Quantitative
Man et al. (2009)	China	118 technology-based small and medium-sized enterprises	Empirical	Quantitative
Ghazinoory and Farazkish (2010)	Iran	Iranian Nano-composite companies	Exploratory cross-sectional	Qualitative and quantitative
Sikander (2011)	Malaysia	E & E manufacturing industry	Empirical	Quantitative
Althonayan and Sharif (2010)	UK	Airlines industry (International Airlines)	Empirical	Qualitative/Case study
Husain (2016)	India and United Arab Emirates (UAE)	India and Dubai companies in different sectors of industry	Empirical	Quantitative

Note. Past research on technology strategy from 1985 – 2016.

In terms of the research context, most of the studies on technology strategy involved manufacturing industries in different regions. For example, Lin and Chang (2006) studied 144 companies from Taiwan Electrical and Electronic Manufacturers Association and Zahra and Nielsen (2002) in their exploratory longitudinal study focused on 149 companies in 1996 and 97 companies in 1999 of 20 US - based manufacturing technology industries. Sikander (2011) studied Malaysian manufacturers, and Ghazinoory and Farazkish (2010) studied Iranian Nano-composite companies. Other than that, previous research on technology strategy applied manufacturing companies in developing countries (Chadee & Pang, 2008; Man et al., 2009; Gibbons & O'Connor, 2003; Ngamkroeckioti et al., 2005), manufacturing companies in developed countries (Zahra, 1999; Wilbon, 1999; Zahra & Nielsen, 2002; Lin & Chang, 2006; Althonayan & Sharif, 2010) and manufacturing companies in an underdeveloped but rich country like Iran as research contexts (Ghazinoory & Farazkish, 2010). Research focusing on manufacturing companies in Malaysia has been very limited, and this study aims at filling this contextual gap.

As shown in Table 2.9, various researchers used different methodologies, including conceptual, descriptive, empirical, exploratory cross-sectional, and exploratory longitudinal. Malhotra and Grover (1998) explained the fundamental concepts on technology strategy, descriptive as the description of technology strategy and performance measurement issues, empirical as the research's data were derived from an existing database, a review, a case study, and taxonomic or typological methodologies. While exploratory cross-sectional as the study's purpose is to increase familiarity through a survey in which data is gathered at a single moment in time, and exploratory longitudinal is the methodology for conducting surveys in which data collecting occurs at two or more periods in time within the same organization.

Based on the literature review, the qualitative studies on technology strategy identified the variables of technology strategy. However, these variables have not been empirically tested in manufacturing companies in the context of developing countries (Husain, 2016), whereas most of the quantitative studies in technology strategy have examined the relationship between various variables and organizational performance (Zahra & Nielsen, 2002). Man et al. (2009) suggested the elements of copyrights and other means of intellectual capital protection that should be considered in developing a technology strategy. It is evidence of the relevancy of the technology strategy variable concerning the copyright and patent toward organizational performance.

Moreover, Sikander (2011) suggested that more research needed to be conducted in technology strategy in a broader context and suggested considering other technology strategy variables. Therefore, by considering the suggestions from previous researchers, this study aims at examining the impact of new technology strategy integrated dimensions on organizational performance and analyzing the moderating effects of external environment factors on strengthening or weakening the relationship in the context of the Malaysian manufacturing industry as well as testing the relationship between technology strategy and organizational performance.

2.4 Technology Strategies and Organizational Performance

Several previous empirical studies were conducted on the impact of technology strategy (Ngamkroeckjoti et al., 2005; Zahra & Bogner, 2000). Most of the studies listed the organizational performance as the outcome of technology strategy. In research conducted by Zahra and Bogner (2000), organizational performance was listed as the outcome of technology strategy. Zahra (1996) pointed out that organizational performance was often associated with technology strategy. Past research revealed connections between technology strategy and organizational performance (Zahra & Bogner, 2000). Dasgupta et al. (2011) opined that organizational performance depended on the technology strategy. In brief, most of the findings in previous research showed that technology strategy contributed to organizational performance. This finding was also demonstrated in Zahra and Bogner (2000) technology strategy model, which demonstrated the relationship between technology strategy and organizational performance and between resources and the competitive environment as sources of organizational performance (Bridoux, 2004).

The impacts of technology strategy on organizational performance from the past research were summarized in Table 2.10.

From the table, organizational performance can be identified as an impact of technology strategy. Numerous performance indicators have been used to assess organizational performance, including financial and non-financial performance. The financial performance indicator was the most commonly employed to measure organizational performance and maybe the most important indicator in most situations (Ahmed & Manab, 2016; Kotha & Nair, 1995).

Table 2.10
Past Research on Organizational Performance as the Impact of Technology Strategy

Author	**Year**	**Dimensions of Organizational performance**	**Context**
Kotha & Nair	1995	Financial Performance – ROS and sales growth	25 publicly traded firms listed at Tokyo, Osaka & Nagoya Stock Exchanges
Pegels & Thirumurthy	1996	Financial performance – Annual operating income (PROF)	49 US firms across several industries
Zahra	1996	Financial performance – ROA	CEO/ or top-ranking executive of 683 manufacturing companies
Zahra & Bogner	2000	Financial performance – ROE and growth in market share (GMS)	581 US-based software ventures
Edler, Meyer-Krahmer, & Reger	2002	Financial Performance – sales revenue growth	Senior R&D/ technology officers of 438 the world's most technology-intensive corporation (Japan, North America & Western Europe)
Hashim, Wafa, & Sulaiman	2004	Financial Performance – sales, assets, equity, number of employees, ROI, ROS & ROA	748 SMEs in Malaysia
Ngamkroeckjoti, Speece & Dimmitt	2005	New product performance	Six SMEs chosen as case studies

Note. Past research on organizational performance as the impact of technology strategy from 1995 – 2005.

2.4.1 Organizational Performance as the Impact of Technology Strategy

Studies have implicitly accepted the notion that technology strategy contributes to organizational performance. Galbraith et al. (2008), as cited by Man et al. (2009), discovered that technology strategy was acknowledged concerning the intensity of the research and development investment that emphasized the extent of technological advancement when contrasted with their business rivals. In recent decades, intense development in strategic management research is to investigate the deployed strategy and implementation characteristic by technology-based corporation strategy, particularly in small and medium-sized enterprises (SMEs) industries (Bantel, 1997; Bruton & Rubarik, 2002). Technology has begun as a key component in explaining complicated strategic issues. Most researchers have identified technology as the main thrust behind the quick rate of progress in many markets. Technology can be classified into the following three types: product, process and management technologies (Chadee & Pang 2008). Accordingly, organizations have become gradually dependent on advanced technology to improve their performance (Althonayan, 2008).

In addition, the important role of strategic management of technological resources is evidenced by the achievement in the organization, especially the technology-based industries. These elements contribute to the corpus of knowledge about organizational technology management. Wilbon (1999) used content analysis to examine the relationships between technology posture, technology options, technology portfolio, intellectual property rights, and technology experience of executives and the performance of software firms that conducted initial public offerings (IPOs). He discovered that IPO investors pay a premium for technology posture and its greater weight in determining a firm's potential market. The study's findings suggested that the firm's executives made a sizable contribution to the firm's success.

Technology strategy had turned out to be gradually essential these years when the technology was divided into various segments so that the organizations can insist on collaborating with external network linkage. Lin and Chang (2006), in their Study of Computer Industry Company's Performance: The Roles of Technology Strategy and External Network using Network theory in Taiwan computer industry, studied the influential factors of companies' performance in the computer industry in Taiwan. The study used a random sampling method, and one hundred and forty-four questionnaires were collected from the Taiwan Electrical and Electronic Manufacturers Association fellows. The empirical results demonstrated that the external network could indirectly affect the organization's performance through the technology strategy.

Meanwhile, Mutuku (2011), in a mixed-mode analysis using Management theory study of Kenya Commercial Bank (KCB), found that employing Mpesa technology strategy as a key stride to enhance the steadiness of its core banking system with the expanded accessibility and upgraded effectiveness over the business gave some impact on KCB performance. According to Maina (2004), numerous organizations have utilized technology to obtain a competitive advantage over rivals. Her studies found significant positive links between 23 of the 40 possible relationships of technology strategy dimensions and the competitive performance of the telephony firms in Kenya. This study pointed out that a higher value for several technology strategy variables was associated with greater competitive performance.

In summary, the study of the technology strategy of the different industries suggested a strong correlation between financial performance and the effectiveness of the technology strategy (Roberts, 1995). Numerous articles dealing with the theory and practice of technology strategy have been published over the last 30 years, but the topic has continued to be under considerable development and debated referring to the different external environment factors.

2.5 External Environment

Strategic planning is necessary for the mission and vision of the organization. Nevertheless, the most important thing is to be realistic about the wants and needs of customers, organizations financial and non-financial capabilities, including the external environment. The external environment greatly influences the success of the technology strategy. There are giant companies in the world that have failed because of a lack of external environment analysis. For example, a company managed to market its sewing machine to the rest of the world but failed badly on the African continent, not because Africans do not need clothes. The sewing machine was massive in size, and most of the traditional Africans liked to carry items to be taken from shop to house. The strategic management of this company is inaccurate and not seen in the reality aspect of the external environment. While one of the world's leading automakers failed to make reasonable sales, its brand was excellent, the emblem placed on the car is not suitable for the Muslim community. It can be said that there is no direct sale in the East Coast state. In the Middle East, the sales of cars of this brand are very proud because the emblem has been changed. Sensitivity to the external environment is taken into account realistically. Otherwise, the so-called great strategy will be abandoned in implementation, return on investment profit and quality of life. Thus, five external environment factors are identified in the context of this research. They are measure by dysfunctional competition, institutional support, environmental turbulence, strategic alliance for product development, and political networking strategy dimensions.

Dysfunctional competition defined as the extent to which firms' competitive conduct is opportunistic, unequal, or even illegal in a sector. The tacit support of local authorities has caused widespread opportunities and illegal activities to the business participant. Furthermore, property rights remain poorly regulated due to the inadequacy of the legal structure to define and protect them. There is an increasing number of copyright and patent infringement cases, which is prevalent in unfair competition practices and the breach of contracts and agreements in Malaysia (Abd Jalil et al., 2020).

Institutional support measures the degree of government intervention through its relevant agencies such as MITI that assist companies in minimizing the negative effects of an insufficient institutional framework during the transition phase. In the process of economic transition, the market forces have been engaged by redistributive institutions in a manner in which market institutions are subordinated. Hence, government institutions may support new technology companies in market economies (Arshad et al., 2020). This support is critical for underdeveloped economies which experiencing transitional processes. Although, product innovation is an important strategy that required intensive resources to support and mitigate risks and resource constraints. This constraint is associated with a strategy in emerging technology companies. Meanwhile, the intellectual property rights of new technology companies formed as a result of unprotected product innovation consequently encourage companies to adopt high-risk and low-profit strategies. Therefore, a dysfunctional business climate relies on external resources by new technology companies are critical to their survival.

Environmental turbulence is a term that refers to the degree to which a business environment changes and is unpredictable. In a turbulent world, new technology companies often pursue a product innovation strategy because the environment forces them to compromise their normal business practice while discovering opportunities to meet the end needs of the dynamic consumer (Miller, 1987). As a result of these factors, existing research indicates that a product innovation strategy results in increased success in dynamic environments.

According to the study, strategic alliances and networking with influential individuals are critical extra organizational tools that companies may use to secure resources and influence. According to several inconsistencies' findings, new technology companies in transitional economies often develop relationships with other firms through strategic alliances while strengthening relationships with government officials to compensate for the resource limitations. Poor institutional infrastructures are no longer applicable for transitional economies. Consequently, relationship-based management skills are undeniable could be considered a viable alternative for transitional economies. Manufacturing companies often enter into cooperative agreements to produce and sell new products via collaboration with other companies (Bucklin & Sengupta, 1993;

Dowling & McGee, 1994; Shan, 1995). These partnerships referred to as strategic alliances for product development, are widely used to supplement internal product innovation efforts by new manufacturing firms in transitional economies.

However, contractual and cultural miscommunications pose a major setback for effective strategic alliances. This limitation has inefficiently utilized resources and managerial energy that depart from the firm's core strategy (Peng & Heath, 1996). Despite all challenges and difficulties, product innovation has gained an advantage from strategic alliances (Kotabe & Swan, 1995). These strategic alliances assist new manufacturing companies in acquiring the resources necessary to enhance their technological and marketing capabilities and provide reputational benefits necessary for the successful marketing of their new products.

Political networking is the process by which a business channel its resources to strengthened relationships by lobbying elected officials, financial institutions, and government bodies and regulators (Kotler, 1986). Unlike institutional support, which emphasized the relationship but instead focused on the environment. Moreover, institutional support represented the degree of support received by managers of emerging technology firms from government agencies.

Political networking uses personal contacts and favors exchanges, which has complemented the absence of institutional infrastructure. For instance, given the adequacy of institutional frameworks, it is argued that fostering political alliances is an efficient way for new manufacturing firms to acquire capital and leverage to support new initiatives. McKee et al. (1989) established that prospector firms outperformed other types of firms in terms of product innovation efforts because prospectors put a higher premium on political activism to help those efforts.

2.6 Manufacturing Industry in Malaysia

The initiation of the Industrial Revolution has given a breath of fresh air to the development of technologies as many new technologies being introduced, thus, improving productivity while reducing the cost. Technology strategy is among the commonly used strategies in improving the organizations' competitive edge in relation to quality and cost. Technology strategy is widely utilized in these many sectors such as electrical and electronic, chemicals and steel industries, automobile and so forth to produce a product cost-effectively more efficiently. It has been done in developed nations such as Europe, the United States, and Japan by implementing a technological strategy to strengthen their competitive advantage in lower costs, better quality, greater flexibility, and faster delivery (Hayes & Jaykumar, 1988; Goldhar & Jelinek, 1985; Parthasarthy & Sethi, 1992).

Malaysia's manufacturing industry has been a significant contributor to the economy and has risen quickly since 1999. Manufacturing has contributed about one-third of Malaysia Gross Domestic Product in 2007. Manufacturing sectors will continue to play a major role in the economic growth with the forecasted expansion of 6.5 percent each year. Additionally, the rate of development is predicted to quicken with the implementation of the Third Industrial Master Plan (IMP3), which begins in 2005 and runs through 2020. Eventually, it can help to improve competitive resilience among organizations. Sufficient evidence on how far technology strategy is successful requires further investigations. For that reason, the study aims to evaluate the factors influencing the success or failure of the Malaysian manufacturing industry.

2.6.1 Brief History of Malaysian Manufacturing Industry

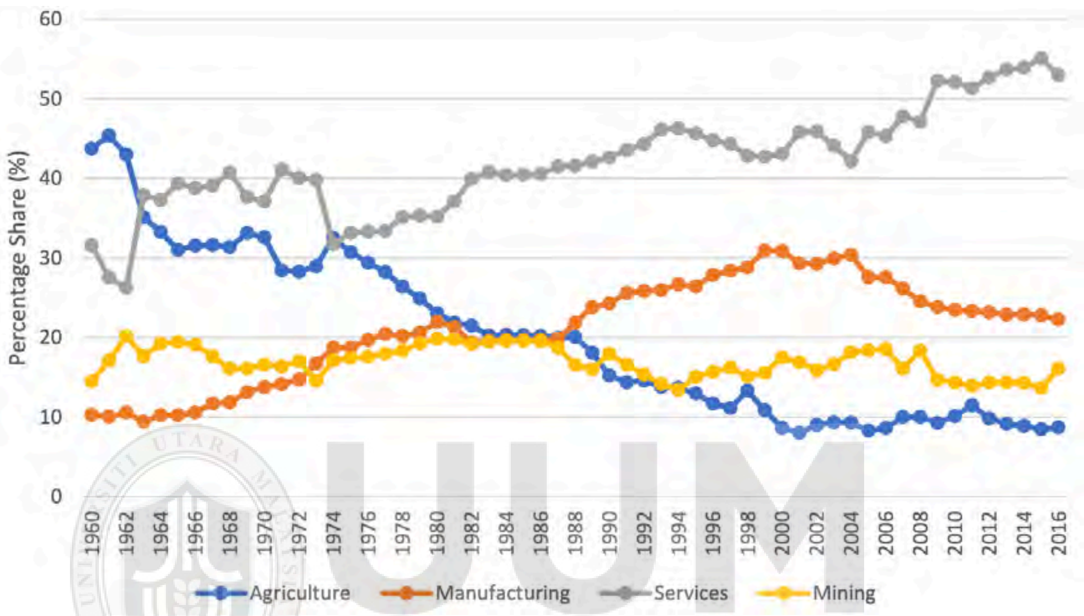

Figure 2.2
Structural Composition of Malaysia's GDP, 1960-2016
Note. World Bank

The Malaysian economy has been shrinking in terms of the industry during the last fifteen years. One thing that can be noticed is that the percentage of GDP and total employment for manufacturing has declined as of late. When real GDP went from under 30 percent in 1999, the manufacturing sector's proportion of GDP peaked close to 31 percent (Figure 2.2). By the time it reached that point, the percentage of GDP it had accounted for had dropped every year, with the industry's portion of GDP has decreased to 22 percent by 2016. Over the last four decades, the GDP contributed by the services sector has progressively climbed from 32 percent in 1974 to 53 percent in 2016. Even if there were changes in the amount of GDP that the services contributed to throughout various time periods, the growth in the proportion was significant following 2004.

Towards the end of the twentieth century, the manufacturing sector across the globe underwent a drastic transformation. These transformations have left an indelible mark on various manufacturing industries, including processes, manufacturing, technology, strategy, consumer relationships, and markets. As a result, this has brought about a positive transformation in performance measurement. Nowadays, these manufacturing industries are no longer viewed as closed systems with an emphasis on efficiency. These industries should adapt to the dynamics imposed by an increasingly challenging global economic environment. They must operate as an open system, which means that customer-centric and technology-based are the foundations of their establishment.

2.6.2 Transformation in Malaysia's Manufacturing Industry

After gaining its independence, Malaysia has transformed from an agriculture and commodity-dependent economy during the sixties to a manufactured export-driven economy, which can be noticed from its expansion in the manufacturing sector. Malaysia has recorded an astounding achievement, especially in electrical and electronic products. According to Das (1998), developing countries manufacture exportable products that create more dynamic growth effects. Its range of benefits to the economy includes steadier earnings accrued from exports, encouraging trade terms, higher investment rates and more advanced technology, which can take the Malaysian economy closer to international standards.

Malaysia's GDP demonstrates the manufacturing sector's contribution to the country's transformation. In 1980, agriculture contributed 21 percent to the economy, while manufacturing contributed 17.2 percent. In 2007, the manufacturing sector increased its contribution to GDP to a record 30.1 percent, while the agricultural sector contributed 7.6 percent to GDP in the years under review (Economic Report 1980/81 and 2007/2008). Malaysian government policy encompasses economic policies such as the National Development Policy (NDP) and the New Economic Policy (NEP) and import substitution and export-oriented industrialization strategies. These two policies have resulted in a restructuring of the industrial sector.

The electrical and electronic categories from Malaysia's manufacturing sector have been widely exported. Since 1980, the share of electrical and electronics has started to be at the top of Malaysia's manufactured exports. The increase in the share of petroleum and chemical product exports in 2008. These changes contribute to the hike in fuel prices across the globe. According to WTO Report, Malaysia ranked the world's 21st largest exporting country and 28th leading importing country globally.

Malaysia's imports and exports totalled nearly 250 percent of GDP, indicating the country's rapid trade expansion. It is self-evident that manufacturing is critical to the economy due to its contribution to gross domestic product (GDP), job growth, and cross-border trade. It has also improved slightly over the years, owing to its contribution of 7.3 percent to Malaysia's economy in the second quarter of 2014 (Bank Negara Malaysia, 2014). Between January and November 2014, the manufacturing industry achieved a 6.1 percent rise in market value, totalling RM600.1 billion. Over this time, jobs increased by 1.5 percent, or 1,030,383 people, with a corresponding increase in productivity of 4.6 percent, or RM582,421. In general, the manufacturing index increased by 5.9 percent compared to the previous year, when it increased by 3.7 percent in November 2014 (Department of Statistics, 2015). Malaysia's exports and imports combined accounted for about 250 percent of GDP. All of these figures point to Malaysia's rapid economic growth. The following subsection will address the historical context, emphasizing the essence of manufacturing sector industrial and trade policies.

2.6.3 The Growth of The Manufacturing Sector

British colonial economic policies had significantly shaped the nature and the extent of industrial development in the colonies. In Malaya, the British had emphasized the export-oriented primary commodity production (namely natural rubber and tin) and the manufacturing import that had been largely confined to the processing of raw materials for export and manufacturing of a few items for local consumption. This policy had effectively discouraged the growth of other local industries. Then, headed by Tunku Abdul Rahman, the elected government started to make amendments to the policy after its Independence. The change was aimed towards a politically stable country and the rapid economic growth to finance development programs. Then, the Pioneer Industry Ordinance was passed in 1958 to encourage import-substitution industries and provided incentives such as tax reliefs. There were two consequences of this strategy. First, it only produced an overconcentration of capital-intensive industries that could not absorb an adequate proportion.

2.6.4 Manufacturing Industry as a Source of Employment

Concerning a source of employment, the manufacturing sector has successfully contributed not less than 16.4 percent of the country's overall employment. In January 2019, the manufacturing sector employed 1,091,560 workers, a 0.3 percent increase over December 2018. Meanwhile, every year, the number of employees continued to increase by 2 percent (that was about 21,011 people) compared to 1,075,635 people who were gainfully employed in December 2018 (Department of Statistics, 2018). The aggregate real wages in the manufacturing sector witnessed a decrease of 8.9 percent from 10.1 percent, supported by lower wage growth in the export-oriented industries.

This manufacturing sector of the economy has been envisioned to continue seeing tremendous growth, even though manufacturing as a whole has seen substantial growth due to a surge in demand for domestic products and export-oriented industries. As the increase was recorded in external investment, there has been an anticipation that manufacturing industries would achieve their target on the export of product faster in the category of electric and electronic based-products, especially in demand for global semiconductor products and would achieve an improved regional trade which would boost the sector.

With the above viewpoint, Malaysia can likely benefit from the development, especially in demand for photosensitive conductors, electronic integrated circuits and semiconductor devices. Moreover, it is equally expected that domestic-oriented items would witness further expansion due to the increase in investment and domestic consumption. In a similar vein, the robust demand for construction-related material as projected in the 10th Malaysian Plan and National Key Economic Areas (NKEAs) would gain momentum. Domestic demand, particularly from the private sector, is projected to play a more prominent role in driving economic progress. To be more precise, initiatives to encourage manufacturers to shift up the value chain are projected to improve the manufacturing sector's resilience and competitiveness. In achieving these benefits, the manufacturing sector needs to ensure that staff who support organizational growth are available. Due to the increase in private and foreign investment, the government supports, and the banking system should provide strong financial support to the manufacturing sector to grow even further.

2.6.5 Malaysia Manufacturing Production

Malaysian production increased by 3.7 percent in February 2019 compared to the same month a year earlier. Between 1991 and 2019, manufacturing production in Malaysia averaged 5 percent, ranging from -44.4 percent in June 1994 to 38.5 percent in January 2000. As a result, it is necessary to address how Malaysia can revitalize its manufacturing sector.

Despite its manufacturing sector's success, Malaysia is tenacious in ensuring that this growth is sustainable and continuous, especially in attracting investments from leading foreign companies. It has done so by establishing a well-developed ecosystem in several industrial clusters. Their presence has consistently fueled the growth of local champions to promote related industries. The increased advancement of technology in both the resource-based and non-resource-based manufacturing industries has emphasized the importance of upskilling human resources and pursuing high-wage employment. This initiative also catalyzes the growth of other industries. To maintain Malaysia's role as a preferred investment destination, the government must continue to provide the necessary support, especially in infrastructure growth, research and development, and facilitation. Several partnerships between universities, public research institutes, and the private sector are currently underway. On the other hand, while most businesses believe in-house research and development is sufficient, there is still much to gain from strategic academia-industry partnerships that aim to commercialize new products and increase the number of local companies moving up the value chain technologically.

Countries such as Belgium, China, Germany, Korea, the United States of America, and Taiwan have implemented sustainable solutions by developing a Manufacturing Innovation Centre (MIC) as a platform for identifying gaps in the production of new innovative products and assisting indigenous companies in transferring knowledge. The idea of MIC has been built in developed countries throughout the world; a typical example is China, which has invested heavily in the MIC as its technology powerhouse, to boost ten new areas of growth such as robotics, medical technology, and aerospace by the year 2025. Meanwhile, Malaysia has over 60 government-owned research institutes, with over 40 of these institutes devoted to the manufacturing sector. Despite these figures, the nation has not achieved performance on a par with other globally successful MICs. Malaysia has plenty to learn from other developed countries regarding re-energizing the manufacturing sector in line with current global market trends.

2.7 Theoretical Perspectives

2.7.1 Resource-Based View (RBV)

The theoretical framework for this analysis was the resource-based view of the company. According to the resource-based view, competing firms must expend significant resources in assets, capabilities, knowledge, and organizational processes to compete effectively (Barney, 1991; Conner, 1991; Schulze, 1992; Bharadwaj, 2000). The resource-based viewpoint evolved out of the need for a company's technological resources to be compatible with the external business environment in which it operates. The resource-based perspective is concerned with an organization's ownership of unique resources and capabilities that decide its performance, as well as the highly skilled human capital that manages those resources (Berger & Di Patti, 2006; Di Zhang & Bruning, 2011; Caldeira & Ward, 2003; Penrose, 1959). Additionally, previous research has described the resource-based view as an excellent tool for emphasizing the role of environmental policy in generating a broader organizational advantage that enables firms to earn a premium profit. According to Russo and Fouts (1997), the resource-based view places a strong emphasis on performance as the primary outcome variable, and the work to adopt the resource-based view explicitly emphasized the intensity of intangible concepts. Their research concluded that a resource-based view of the firm could be more easily applied to corporate social responsibility concerns in the future.

The resource-based view illustrated by Penrose (1959), Pisano (2015) stated that each organization is endowed and could be viewed as a collection of resources (Di Zhang

& Bruning, 2011). The theory suggests that the characteristics of industry settings are not crucial to the individual organizational performance, while organizational performance illustrates the resources and capabilities of the firm by leveraging good market opportunities and fulfilling competition. By not limited to technology advancement, deregulation, high-interest rates, shorter products life cycle, new competitors, capital market pressures, inflation, lower purchasing power, high exchange rates, change in consumer preferences and tastes, high consumer expectations of product and service quality, product replacement, consumer demand, globalization and innovation. See Pisano (2015). Prahalad and Hamel (1990) stated that core competencies represent the collective learning in the organization, especially how to coordinate diverse production skills and integrate multiple streams of technologies. In addition to their research in 1996, the resource-based view claims that a firm's individual qualities associated with its previous track record, organizational culture and capabilities are essential to achieve success.

Thus, the conceptual work conducted by Barney (1991) identified four resource characteristics to be strategically important to sustain competitive advantage, namely often abbreviated as VRIO (value, rarity, inimitability and organizational). The four characteristics must be simultaneously held for the resource to be considered a strategic asset. The first characteristic value is where the resource must produce value toward firms in terms of cost or differentiation advantage. The second characteristic is a rarity, where the resource must be held in a unique strategy or plan to achieve a competitive advantage. The third characteristic is inimitability, where rivals must be economically deterred from imitating for the resource of sustained competitive advantage. The fourth characteristic is organizational appropriability, where the resource must produce a value realized by the firm (retain all the profits).

The resource-based view always favors the performance of the individual organization (firm-level). In this study context, technology strategy is perceived as resources and core competencies considered valuable, rare, inimitable, and organizationally appropriate. At the individual organization (firm-level), technology strategy allows the firm to take advantage of an opportunity and neutralizes threats in the organization's operating environment. Technology strategy is considered valuable when it offers either extrinsic or intrinsic awards, such as an existing technology that fits the company's strategy or employment. In terms of the rarity of the firm, technology strategy is rare in the condition that existing technology has been utilized for its quality to gain a competitive advantage within the organization's current and potential competition (Barney, 1991). Technology strategy inimitability cannot be replicated (such as experience) but may develop over time (David, 1986), and these characteristics may lead to success (Caldeira & Ward, 2001). In order to create a competitive advantage, the resources must be valuable, rare, inimitable and nonsubstitutable (Barney, 1991). Therefore, to sustain the competitive advantage over its competitors, the organization must develop an attribute or combination of any attribute, including access to natural resources (high-quality minerals) and a highly trained workforce. The organization could take advantage of its resources to be able to have the ability to create an entry barrier for its competitors. The contention in the resource-based view perceives that gaining a competitive edge is realize through technological and organizational competencies (Harrison, 2003; Teece et al., 1997).

Moreover, competitor superiority and performance can be achieved by dominating firm-specific resources and competencies (Barney, 1986).

Although some studies found that technology strategy is related to organizational performance, theory-based empirical testing would provide stronger support to explain the nexus between technology strategy and the performance of an organization (Ahmed & Manab, 2016; Dasgupta et al., 2011; Man et al., 2009; Galbraith et al., 2008; Bridoux, 2004; Zahra & Bogner, 2000; Zahra 1996; Kotha & Nair, 1995). This study is based on the resource-based view of TS, which stress technological resource's value as a source of competitive advantage (Wang et al., 2011; Das & Zahra, 1998). Hence, this study employs the resource-based view as the underpinning theory to clarify the linkage of technology strategy, external environment and organizational performance. The rationale of using the resource-based view as the underpinning theory of this study is because its credibility and technology strategy is the fundamental factor that influences firm strategic technological resources, which then affects organizational performance. Therefore, this theory best fits the study framework since technology strategy dimensions could be influenced by the external environment, consequently affecting organizational performance.

2.7.2 Resource Dependency Theory (RDT)

The resource dependency theory contextualizes organizations' relationships with and responses to their environments. It then postulates how the relationship manifests itself in terms of performance or competitive advantage. Pfeffer and Salancik (1978) established the Resource Dependence Theory in the 1970s. The theory is predicated on how organizations gain strength when they accumulate resources that other organizations value.

Resource dependence theory (RDT) has established itself as a prominent theory in an organizational study concerning strategic management. RDT views the corporation as an open system subject to external conditions (Pfeffer & Salancik, 1978). As Pfeffer and Salancik (1978) explain, to comprehend an organization's behavior, one must first comprehend its context before embarking on comprehending its ecology.

RDT recognizes the importance of external influences on organizational behavior, and while their context binds managers, they can reduce environmental uncertainty and dependence (Bendickson et al., 2018). The concept of power, which controls essential resources, is central to these behaviors (Ulrich & Barney, 1984). Organizations seek to diminish the authority of others over them while frequently striving to strengthen their influence over others.

With a robust sociological foundation (Weber, 2009), organizational success is characterized by resource dependency as organizations maximize their power (Kanter, 2017; Pfeffer, 2020). Organizations are considered coalitions in this perspective, modifying their structure and patterns of behavior to gain and keep necessary external resources. Acquiring external resources is accomplished by decreasing dependence on other organizations, consequently increasing others' reliance on its technological capabilities while altering its dominance toward other organizations. Another important aspect of resource dependence is that the fundamental is built upon presumptions about how organizations acquire their power. Initially, organizations are presumptively made up of insight and outsight alliances (Pfeffer & Salancik, 2015). Coalitions are created as a result of social interactions in order to influence and control behavior. Second, the environment is presumed to contain limited and valuable resources necessary for an organization's sustenance (Pfeffer, 1978). Therefore, environmental factors present a difficulty for organizations confronted with resource acquisition uncertainty. Uncertainty is a term that relates to the variety and complexity associated with purchasing raw materials from other companies. For instance, corporations reduce uncertainties in the supply chain by creating coalitions with powerful key suppliers while partnering through joint ventures with this firm (Provan et al., 1980). Thirdly, companies are believed to pursue two linked goals within their environment: (1) to gain control of resources that reduce their need on other organizations, and (2) gain control of resources that increase their need on other organizations. Attaining either goal is believed to affect the flow of information across organizations while strengthening an organization's authority (Pfeffer, 2020).

Conventionally, resource dependence theories propose that relationships among organizations are collective power interactions based on resource exchange. Organizations seek to alter their dependence connections by either reducing their reliance or increasing their reliance on other organizations.

The study of the organizational bases of power dates back to Weber's work in 1947 that covered extensive work of the previous scholar in the field of social exchange theory (Blau, 2017; Emerson, 2019) and political science (Dahl, 1957). Crozier (2009), Hickson et al. (1971) and Hinings et al. (1974) have produced recent research on the individual firm in structuring the function and process of intraorganizational.

According to Selznick (1949), organisations can develop unique engineer competencies and obtain resources and support from external players to achieve these fundamental duties. When regarded in this way, co-optation is simply an organizational effort to maximize power by reducing the organization's reliance on other companies. This increase organization's reliance on others vertically as well as horizontal integration.

2.8 Summary of the Chapter

Chapter Two is a comprehensive explanation of the literature reviews of variables used in this research. The previous results of studies in the same field are critically discussed and reported. The relevant factors to technology strategy, organizational performance, and external environment will be summarized in the framework. These variables and hypotheses development will be explained further in Chapter Three.

There are five variables of technology strategy, namely pioneer-follower posture, technological investments, intensity of product upgrades, external technology sources, and product and process technology. These technology strategy factors have been chosen as these factors have been frequently used and are essential in representing the technology strategy factors of previous research (Parker, 2000; Sikander, 2011; Zahra & Bogner, 2000; Chadee & Pang, 2008; Husain, 2016).

CHAPTER THREE

CONCEPTUAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

3.1 Introduction

This chapter discusses a conceptual framework that focuses on relationships of the three variables: technology strategy, organizational performance and external environment. The hypothesis for technology strategy and organizational performance will be established, as well as the moderating effect of the external environment.

3.2 Research Framework

Figure 3.1 displays this study's proposed conceptual framework, which derives from the literature review discussed in the previous chapter and theoretical perspectives. Technology strategy is referred to as despite the fact that the differences in the characteristics suggest that technology strategy is considered a long-term plan that leads companies to utilize the committed resources of the technology in order to gain competitive advantage possessed by the manufacturing companies or firms. The proposed research framework is described based on the findings and gaps from the literature review by incorporating five elements of technology strategy namely pioneer-follower posture, technological investments: internal research and development (R&D), the intensity of product upgrades, external technology sources, and product and process technology.

Technology strategy of the manufacturing companies or firms is the focus of the study because technology strategy is viewed as a long-term strategic plan which determines the firm's investment priorities and the preferences in technology development; for example, using technologies for the company's sustainable competitiveness (Mazlomi & Yusuff, 2011). Furthermore, technology strategy is undoubtedly a vital element to enhance the competitiveness of the manufacturing companies (Obradovic & Ebersold, 2015; Zahra et al., 1999). Based on the literature review discussed in the previous chapter, Figure 3.1 illustrates this study relationship between organizational performance, technology strategy, and the external environment. The research framework is presented schematically in the following figure.

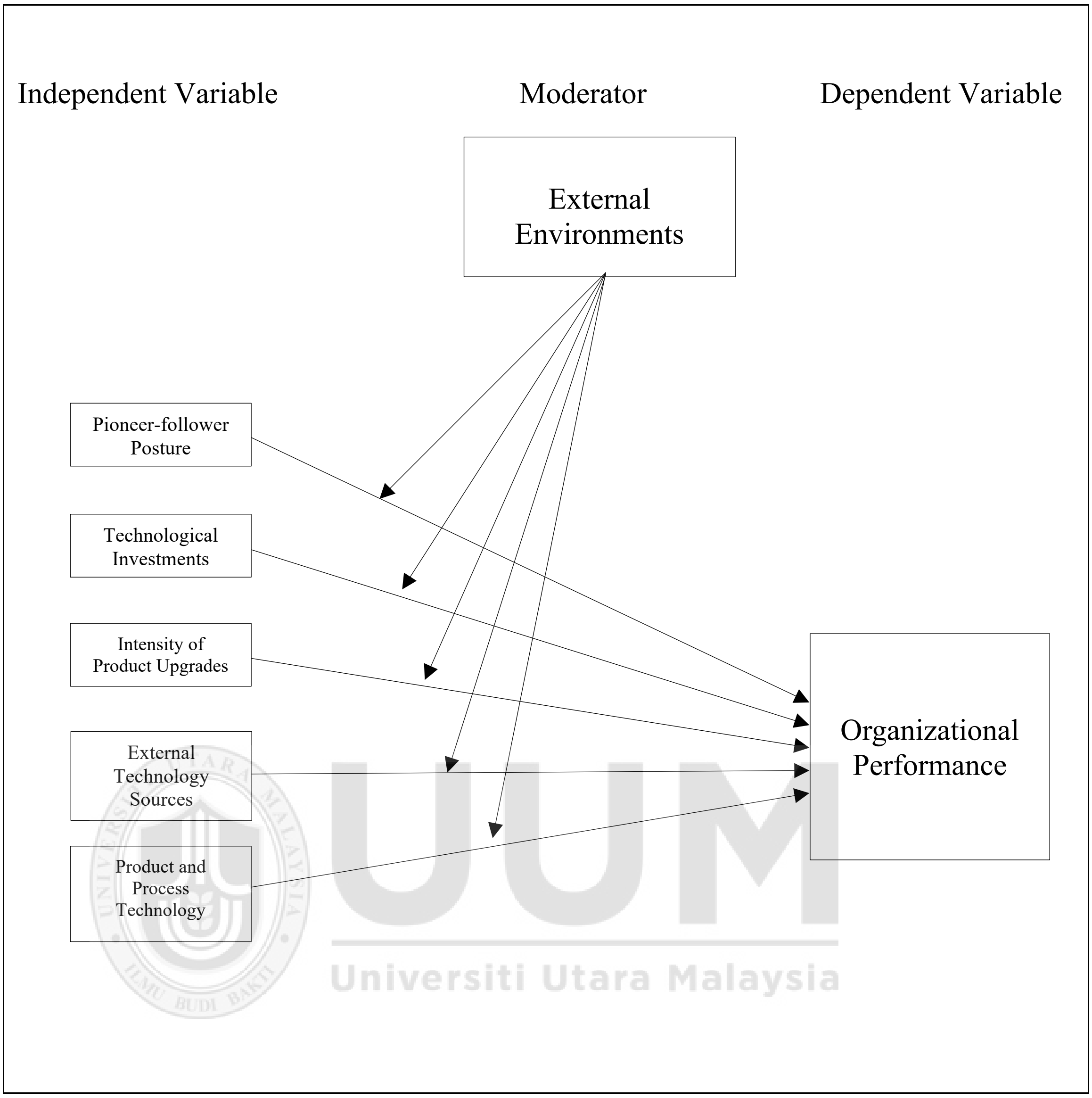

Figure 3.1
Proposed Research Framework

3.3 Hypothesis Development

The hypothesis is developed based on the theoretical framework, findings, and arguments revealed from the previous studies. This section empirically investigates the relationships of the independent variable, moderating variables, and outcome variables. Meanwhile, the moderating variables include the external environment. The dependent variable is organizational performance. Technology strategy can profoundly affect an organization's performance and survival (Zahra & Bogner, 1999).

The consideration of the technology strategy factors is retrieved from the literature review. Based on the literature, there are several factors identified as the dimensions for technology strategy. However, this study focuses on pioneer-follower posture, technological investments: internal R&D, the intensity of product upgrades, external technology sources, and product and process technology.

3.3.1 Technology Strategy and Organizational Performance

In this study, technology strategy is the independent variable, while organizational performance (financial and non-financial performance) is categorized as the dependent variable. As discussed in the previous chapter, past studies showed that organizational performance is influenced by technology strategy (Obradovic & Ebersold, 2015; Zahra et al. 1999; Mazlomi & Yusuff, 2011; Wilbon, 1999; Sikander, 2011). The previous section explained the concept of technology strategy and how technology strategy is related to organizational performance. Technology strategy has gradually become essential these past years. In early research, some technology strategy was claimed to be the critical factor in organizational performance (Lin & Chang, 2006; Hussin, 2016). However, these claims were not accompanied by rigorous supporting evidence (Sikander, 2011), especially in the manufacturing industry.

Technology strategy concepts have been studied and explored by many authors, especially its impacts on organizational performance for its survival. The study on technology strategy was initiated in 1985 and has still been an interest of the researchers. Since then, technology strategy has continued to gain attention from researchers as the subject area that has not only been better conceptualized in theory but has also been widely adopted.

In the earlier chapter, the relevant literature on technology strategy which was presented focused on studies that investigated the relationships between pioneer-follower posture, technological investments: internal research and development (R&D), the intensity of product upgrades, external technology sources, and product and process technology. The descriptions of the hypotheses for each element are mentioned in the following subsections. The literature has implicitly accepted that technology strategy has contributed to organizational performance. Organizations may benefit from the improved efficiency by increasing their processing and production capability.

3.3.1.1 Pioneer – Follower Posture and Organizational Performance

The first dimension of technology strategy in this study is pioneer – follower posture. Pioneer – follower posture is an issue that often appears in the literature on technology strategy and has become an important issue in the organization (Porter, 1985; Teece, 1986; Sikander, 2011). The features of technology posturing and its effects on organizational performance have been broadly discussed in the literature (Sikander, 2011; Muhammad et al., 2009). According to previous research on all relationships, technology posture is ultimately a critical aspect of shaping an organization's strategic posture because it strongly correlates with organizational performance. Several authors have suggested that technology posturing is essential in building a reputation for being the first in the industry to try new methods and technologies (Zahra & Covin, 1993; Oster, 1999; Adler, 1989).

Zahra and Covin (1993) stated that technology posture refers to the extent to which companies or firms would apply technology as a tool to make them competitively strong. Consequently, technology strategy should be measured on how far the companies or firms are willing to take the technical risk (Rauch et al., 2009) and how aware they are that such efforts are made. Meanwhile, technological leadership refers to high technological competencies and abilities resulting from a persistent active role in spearheading innovation. In explaining the concept of technology posture, Ansoff and Stewart (1967) and Maidique and Patch (1978) outlined three types of postures, namely technology leader, a follower, or a laggard (low cost). Companies or firms that control and apply innovation in their organization may have *a first-mover* advantage over their rival. These technological leaders can develop and manufacture new products ahead of the competition, allowing them to control the market, particularly when the technological and intellectual properties are protected through patents or other mechanisms that prevent late entrants from exploiting the technology. According to Khalil (2000), technology leaders can gain extraordinary profits by imposing a higher price for their products since there is a technological loophole between their products, customers, and competitors.

For instance, a Malaysian automated-based company that regards itself as a cost leadership company would develop faster than a traditional technology leader. Unsurprisingly, its customers facing substantial cost pressures as a result of intense global competition. Pressures from high costs are partly can be translated into a lower cost of capital investments. Therefore, automation companies that adopt a low-cost strategy eventually benefit customers while enhancing production capabilities without compromising future expansion results while enjoying higher revenue and growth.

Many studies, for example, Manu (1992), García-Villaverde et al. (2017), Wilbon (1999), Lee and Tang (2018), and Mena and Chabowski (2015), discovered an association between the pioneer-follower posture and organizational performance. See Table 3.1. The findings are consistent with the literature that argues that the maturity of product technology (which is prevailing for automation technology) and its superiority design can be easily mimic and duplicated. The distinctive features of product performance are narrowed. Consequently, this product becomes more uniform. Since pricing remains a critical component for rivalry, especially under such a price-competitive environment, cost leadership is commonly associated with the organization's success (Utterback & Abernathy, 1975; Abernathy & Utterback, 1978; Tushman & Moore, 1982).

Meanwhile, Durand and Coeurderoy (2001) did not find a link between the first movers and organizational performance. However, the longer a company or a firm delays the entry, the greater the negative effects of age on its performance. This phenomenon occurs due to the difficulty of resisting competitive erosion because pioneers and early followers drive the changes in the industry, indicating a negative relationship between pioneer – follower posture and organizational performance (Muhammad et al., 2009; Durand & Coeurderoy, 2001; Khalil, 2000; Lieberman & Montgomery, 1998). Identifying these effects should help managers and stakeholders make more effective entry decisions to sustain a firm's advantage, leading to better performance and a higher probability of survival. Thus, this study hypothesizes the relationship between pioneer – follower posture and organizational performance as follows:

H1=There is a relationship between pioneer – follower posture and the organizational performance of manufacturing companies.

Table 3.1
Pioneer – Follower Posture and Organizational Performance

#	Author	Context	Country	Methodology	Relationship Results
1.	Manu (1992)		The United States and in Europe	Empirical	Pioneers emerged as the best performers
2.	García-Villaverde et al. (2017)	224 Spanish footwear industry (16.97% response rate) from the population of 1403 firms.	Spain	Empirical	Pioneering orientation had a positive and significant effect on new product performance at t-value 2.81
3.	Muhammad et al. (2009)	61 Malaysian industrial automation company	Malaysia	Quantitative and Empirical	Technology posture had a significant negative relationship with revenue growth
4.	Durand and Coeurderoy (2001)	582 French manufacturing firms	France	Empirical	Did not find any link between the first movers and organizational performance.
5.	Wilbon (1999)	31 Computer software IPO firms	USA	Qualitative/Content analysis	Technology posture had a positive and significant impact on IPO performance
6.	Lee and Tang (2018)	147 manufacturing firms in northeastern China (response rate of 58.8%)	China	Quantitative	Technology posture had a significant relationship with firm performance
7.	Mena and Chabowski (2015)	349 SBUs in 285 different firms	List of Dun and Bradstreet	Quantitative and Empirical	Pioneering organizations set a standard in the market, this, in turn,

		Information Services		enhanced organizational performance. The findings showed that the world's most innovative companies, such as Apple and Google, that consistently offered inventive solutions that satisfied their stakeholder claims and overcame their competitors in their business model and process (Fast Company 2015).
8.	Lieberman and Montgomery (1998)		Meta-analysis	Imitators can reduce their investment costs and ultimately defeat pioneers

Note. Pioneer-follower posture and organizational performance variables used in this study and studied by different researchers

3.3.1.2 Technological Investments: Internal R&D and Organizational Performance

Stores et al. (2013), Meliciani (2000), Pakko (2002) and Vranakis and Chatzoglou (2012) stated that technological investments have positively influenced performance, but earlier researches had not been able to find the effects on performance (Lee et al., 2016; Vranakis & Chatzoglou, 2012). Roach (1991), in his study, found that computers have limited effects on workers performance. Nonetheless, numerous studies published in the last few years have discovered that technological investment has a significant positive impact on firm performance (Zehir et al., 2010; Idris et al., 2008; Heshmati & Loof, 2008; González-Benito, 2007). Technological investments have been studied at the company, industry and country levels (Spring et al., 2017; Mithas & Rust, 2016; Vranakis & Chatzoglou, 2012; Abdi, 2008; Indjikian & Siegel, 2005; Pakko, 2002; Im et al., 2001; Devaraj & Kohli, 2000). Adopting and developing new technologies via investment in physical resources, specialized plant and machinery, and information technology are critical components of performance improvement. As a result, Vranakis and Chatzoglou (2012) suggested a novel conceptual framework for examining the decision to invest in new machinery and equipment in order to increase the efficiency of manufacturing firms.

A number of studies have investigated the relationship between technological investment and organizational performance. Contradictory findings have emerged from past studies. Some studies have found a positive relationship between technological investment and organizational performance. Table 3.2 shows that three studies have reported a no relationship while four studies have reported a negative relationship.

In a study on the different national and multinational companies (MNCs) in Turkey, Zehir et al. (2010) concluded that technological investments were vital components for firm performance. Zehir et al. (2010) used factor analysis, correlation analysis and reliability tests to investigate whether there was a difference of means and correlation between the variables. They report a positive relationship between technological investment and organizational performance. Heshmati and Loof (2008) conducted a thorough empirical review of a potential two-way causal relationship between technological investment and organizational performance. Their research discovered that companies of varying sizes exhibit significant heterogeneity in their technology investment and performance behavior.

According to some studies, the relationship was dynamic and dependent on other factors. González-Benito (2007) examined the relationship between technological investment and purchasing function performance. His article argued that the impact of technological investment on purchasing performance is dependent on the purchasing function's ability to incorporate and improve advanced purchasing and supply practices. These businesses performed far better than others.

However, other studies found no significant relationship. A study on 719 companies from the Taiwanese electronics industry found no conclusive evidence for technological investment's contribution to organizational performance (Ho et al., 2011). In a study on 165 companies from 3 different industries, namely retail, consumer products and food and beverages and tobacco, Motiwalla et al. (2005) also found no impact of technological investments on company performance. Thouin et al. (2008), in their study on 914 integrated healthcare delivery systems, discovered a positive connection between information technology budgetary expenditures and information technology services outsourced with profitability. However, information technology personnel are not significantly associated with an increase in profit. Similarly, Macdonald (2006) found technology investment as measured by human capital investment (programmers), which a company employs to develop software that negatively affects the company's performance. See Table 3.3.

Table 3.2
The Reported Direction of the Relationship between Technological Investment and Organizational Performance

Positive	**No relationship**	**Negative**
Jung (2009), Ramdani (2012)	Roach (1991)	Thouin et al. (2008)
Heshmati and Loof (2008)	Ho et al. (2011)	Im et al. (2001)
Weill and Ross (2004)	Motiwalla et al. (2005)	Mithas and Rust (2016)
Bagheri et al. (2012)		Macdonald, (2006)
Kwon (2007), Hartono (2003)		
Kleis et al. (2012)		
González-Benito (2007)		
Zehir et al. (2010)		
Idris et al. (2008)		
Byrd et al. (2006)		
Indjikian and Siegel (2005)		

Table 3.3

Summary of Empirical Studies on the Relationship between Technological Investment and Organizational Performance

#	Study	Sample	A measure of Technological Investment	A measure of Organizational Performance	Methodology	Finding/ Relationship result
1.	Stores et al. (2013)	Malaysian public listed companies (PLC's)	Operation related technological investments such as plants and machineries, Administrative related technological investment such as IT for HR, Purchasing Department	ROI ROA		This paper developed a framework that explained the relationship between technological investment and firm performance.
2.	Zehir et al. (2010)		Information technology	Profitability, productivity, market share	Used primary data, factor analysis, regression analysis, correlation analysis	
3.	González-Benito (2007)	141 purchasin g managers of medium and large Spanish companies in three industrial sectors		productivity	Used cross-sectional survey, exploratory factor analysis, confirmatory factor analysis, multiple regression analysis	The finding showed that IT investment exerted a positive effect on purchasing operational performance.
4.	Bagheri et al. (2012)				Employed a survey method, regression analysis, hierarchical linear regression	
5.	Idris et al. (2008)		Production technology, planning technology, design technology, administrative technology	ROI, cost reduction	Used correlation analysis, ANOVA test	The result found strong positive correlations between investment in advanced technology with ROI.

6.	Heshmati and Loof (2008)			Financial and operational performance		The result showed evidence of a two-way causal relationship and significant heterogeneity observed between technological investment and performance behaviour by size.
7.	Vranakis and Chatzoglou (2012)		Infrastructure investment in capital in new technology and new machinery and equipment			
8.	Macdonald, (2006)	685 USDOT registered motor carriers spread over two observation years, 2002 and 2003.	Level of physical assets (computers) and human capital (programmers)	Level of firm efficiency (sales / employee)	Ordinary least squares regression (OLS) analysis, correlation analysis	The result showed that technology investment significantly affected performance. The level of physical assets that was utilized by firm positively impact performance as measured by efficiency. But the number of programmers (human capital) a company employed to develop software, had negatively affected the company's performance.
9.	Thouin et al. (2008)	914 integrated health care delivery system	IT budgetary expenditures, IT services outsourced, IT personnel	ROI, profitability	Used archival survey data, regression analysis	There was a positive connection between IT budgetary expenditures and IT services outsourced with profitability.

				IT personnel were not significantly associated with the increase in profit.
10.	Motiwalla et al. (2005)	Financial statements of 165 companies selected from retail (R), consumer products (CP), and food beverages and tobacco (FBT) extending over a period of 10 years.	ROA ROS	There was no impact on technological investments on company performance

Note. Technological investment and organizational performance variables used in this study and studied by different researchers.

Technological investment has been examined from a variety of angles. Los and Verspagen (2000) examined the spillovers and competitiveness associated with R&D, while Hall (2002) examined R&D financing. Whereas, Aboody and Lev (2001) and Jefferson et al. (2006) investigated the time lag between R&D and its benefit and how R&D contributes to the firm's potential earnings. Furthermore, Anagnostopoulou (2008) investigated the value of intangible asset expenses and research and development costs. The study by Saunders and Brynjolfsson (2016) investigated the investments in information technology-related intangible assets (Saunders & Brynjolfsson, 2016), goodwill (Chauvin & Hirschey, 1994), and patents (Hall et al., 2005). The conclusion drawn from these studies is a strong correlation between investment in intangibles and a company's valuation.

Additionally, several studies have been conducted to examine the connection between R&D investment and organizational performance. Several studies have discovered a strong correlation between research and development investment and organizational performance. According to some scholars, there was no relationship; however, others asserted a negative relationship.

Numerous volumes of empirical research have been published demonstrating the effect of R&D investment on organizational performance across various industries. Although some study has been conducted, there have been relatively few empirical studies on R&D investment in manufacturing firms. Earlier research has established a positive correlation between R&D investment and firm performance (VanderPal, 2015; Ahmed et al., 2011; Poletti Hughes, 2008; Ding et al., 2007). Ozturk and Zeren (2015) found a positive correlation between R&D investment and company performance in Turkey's manufacturing industry, highlighting the impact of technological investment on the manufacturing industry's sales growth. Similarly, VanderPal (2015) demonstrated a strong correlation between research and development expenditure and profitability.

Additionally, the findings found that R&D expenditures rose alongside increases in revenues and incomes. Other researchers discovered transparent, direct relationships between research and development investment and sales growth, benefit, and employee productivity (Selvarajah & Sheena, 2017; Zhu & Huang, 2012). In addition to these studies, Freihat and Kanakriyah (2017) reported that continuous R&D investment yields good positive performance outcomes for the company as calculated by the return on asset (ROA), return on equity (ROE), and earnings per share (EPS).

However, contradictory results from previous studies have cast doubt on this hypothesis. However, there is significant evidence that R&D investment results in improved long-term returns. Not all investors view this as a positive indicator, especially when the investment is short-term. This phenomenon is because R&D investments have historically been treated as a direct expense deducted from the company's revenues. As a result, investors can view significant R&D investments negatively if they are deemed excessive.

Additionally, businesses can increase their market share and reap monopolistic profits by investing in research, development, and innovation. According to Hall (2002), salaries and wages for highly trained engineers and scientists accounted for more than 50 percent of R&D investment. Engineers and scientists build an intangible asset (know-how) that can produce potential income. Previous research has shown that insufficient investment in R&D will reduce the level of innovation and knowledge growth, thereby lowering firms' productivity and investments in both physical and human resources (human capital) (Rogers, 2005). R&D has historically been overlooked, in part due to data access issues. Sougiannis (1994) states that results showing no significant link between R&D and beneficial outcomes could be due to small sample sizes, quality of R&D data, and insufficient statistical methods. Grabowski and Mueller (1978) demonstrated that R&D investment practices led to above-average returns in research-intensive industries.

Additionally, Wilbon (1999) discovered that R&D investment impacted the reactions of initial public offering (IPO) investors to the performance of computer software firms. Similarly, Dave et al. (2013) discovered that the differences in profit levels between companies in a particular sector were not always the effect of R&D investments. In the context of information technology, the Standard and Poor (S&P) index companies demonstrated a negative but significant relationship between R&D investment and technological performance. On the other hand, Bouaziz (2016) and Konak and Kendirli (2014), who also examined the effect of R&D spending on firm performance, found no evidence of a relationship between R&D spending and corporate performance. German Bet (2017) and Xu and Jin (2016) found no connection between organizational performance and future expected productivity, current productivity, and R&D investment. Thus, this study investigates the linkage of technological investment and organizational performance in the manufacturing industry.

H2=There is a relationship between technological investment and the organizational performance of manufacturing companies.

3.3.1.3 Intensity of Product Upgrades and Organizational Performance

The intensity of product upgrades is based on the frequency and the unit of the product being introduced (Herman, 1998; Zahra & Covin, 1993). Likewise, other studies all use the term product development intensity to refer to the frequency of new product introductory. Additionally, the intensity of product upgrades is the degree to which a company is committed to improving and extending its products than its competitors. The importance of product line expansion is measured in this study while emphasizing the improved version of the existing products. The development of the new product phase is vital for the survival and growth of contemporary businesses (Kleinschmidt, 1994; Ngamkroeckjoti et al., 2005).

This technology strategy component refers to the frequency at which the venture's current products are revised or extended. A business that performs well in this perspective is prolific in product upgrades, far outpacing its competitors in this field (Bell & McNamara, 1991; Brown & Eisenhardt, 1995; McGrath, 1994). These improvements are necessary for increasing market share, retaining customer loyalty, gaining access to distribution networks, and ensuring profitability (US Industrial Outlook 1994) (Buzzell & Gale, 1987). Upgrades are also critical for revenue generation and strengthening a company's competitive position. Additionally, these enhancements serve as a credible market alert to rivals, showing the venture's dedication to the industry. Finally, a diverse product offering strengthens the firm's reputation with customers, helps the firm retain its leadership position, and enhances performance.

Despite the significant expenses connected with these processes, the company that brings the most products to market will gain superior organizational performance in a competitive environment. Some of these products will be brand new offers, while others will be extensions or additions to existing products. Additionally, a high rate of product improvements increases the likelihood of ever receiving a good product. This continual stream of successful upgrades creates the financial flow necessary to fund the company's research and development activities. Businesses with a small number of successful products cannot sustain high organizational performance in a competitive world where few products survive as significant revenue generators due to quick imitation and spread. As a result, the financial benefits of launching a single new product in a complicated market may be temporary.

In addition, a lack of consistent hits will erode the company's negotiating power with downstream channels that sometimes assist in maintaining marginal goods. These constraints are heightened for companies that often lack established alliances or other assets to exploit in the absence of a strong product line. Additionally, if many firms compete by offering a large number of new products through upgrades, the volume of their competitive offerings can prevent all firms from realizing economic rents from this strategy. Thus, in a competitive environment, regular product upgrades and extensions are essential to capitalize on market changes and maintain a company's profitability and gross margin (Hambrick, 1983; Iansiti, 1995). Therefore:

H3=There is a relationship between the intensity of product upgrades and the organizational performance of manufacturing companies.

3.3.1.4 External Technology Sources and Organizational Performance

The increase in market competition has led to the need for the company or firm to be innovative in their venture for new product development. Firms or companies that cannot develop new products will be at a loss compared to those who can, especially if time and quality are the values that the companies or firm uphold (Langerak et al., 2004; Li & Calantone, 1998; Song & Parry, 1997). This loss was possible if companies or firms do not have the resources and abilities to be innovative (Das & Teng, 2000). This situation is further compounded by the rapid changes in technology and the growing complexity of technological development (Badawy, 2009). Alas, companies and firms can no longer independently work if they remain strong (Rigby & Zook, 2002); instead, they may need to obtain external technological support to remain relevant to cope with their deficiency (Kim, 2009). Researchers in the field of technological innovation have been carrying out studies on the impact of external technology acquisition on the organisation (Belderbos et al., 2004; Faems et al., 2005; Jones et al., 2001; Nieto & Santamarı´a, 2007; Schoenmakers & Duysters, 2006). This study is important as companies or firms are supposed to make a conscious effort in gaining knowledge from external technology sources (Vanhaverbeke et al., 2002; Cassiman & Veugelers, 2006; Tsai & Wang, 2008).

External technology sources can be defined as anything that is conducted in order to legally have the rights to use other people's technology which include the use of partnership, understanding, the acquisition of technology (Shin et al., 2019; Zahra & Bogner, 1999; Adler, 1989; Dowling & McGee, 1994; Kotabe & Swan, 1995; Shan, 1990). Using external sources will help two or more companies or firms strategically work on projects that may require the combination of technologies that enable one company or firm to complement the limitation of the other so that they can produce several new products (Dodgson, 1993).

Despite the growing interest in the usage of external technology sources, researchers have not systematically documented the contributions of these sources to technology strategy. Shaw (1993) mentioned that technological progress has prevailed through the sharing of knowledge among industry members. Henceforth, the leap in technology progress depends on networking and collaboration. There is sufficient evidence showing that a limited number of firms could develop a new product from a potential technology and process independently (Thomas, 1994). Accordingly, an increase in outsourcing that emphasises core competencies is considered the main advantage.

Nevertheless, a company or firm can decide whether to outsource their innovation projects or invest in developing new knowledge through internal research and development undertaking activities (Tsai et al., 2011). Though internal R&D was previously preferred, using the external source termed open R&D is a more recent trend (Hagedoorn, 2002). The change in the market has led companies to choose an open R&D structure that includes external sources of knowledge rather than the company very own closed R&D (Hagedoorn, 1993). The application of internal and external source knowledge can boost organizational performance (Berchicci, 2013; Cassiman & Veugelers, 2006; Hargadon & Sutton, 1997).

However, according to Zaadnoordijk (2012), the ability to use internal and external information has no significant effects on the performance of the companies. Nevertheless, some studies found that external and internal technology sources can positively influence company performance (McKelvie et al., 2018; Berchicci, 2013; Zaadnoordijk, 2012; Zahra & George, 2002). The issue remains in the manner the external technology sources can affect performance. Therefore, this research will investigate how the desire for external sources link to performance. The external source of R&D is low in cost while the internal R&D is more costly than before, but technology attain from internal R&D will be the exclusive rights of the company or firm (O'Regan & Kling, 2011).

Researchers have been looking closely into the connections between external sources and organizational performance from several perspectives. Jones et al. (2001) and Montoya et al. (2007) focus on the impacts of external technology acquisition on the market performance of the products. Meanwhile, some studies look into the relationship between performance and different variables of external acquisition, namely, mergers and acquisitions (Ahuja & Katila, 2001), technology alliances (Schoenmakers & Duysters, 2006), collaborative networks (Belderbos et al., 2004; Faems et al., 2005; Nieto & Santamarı´a, 2007), and technology licensing (Tsai & Wang, 2007). Results have been inconsistent with these studies that have recorded negative or insignificant findings (Belderbos et al., 2004; Jones et al., 2001; Tsai & Wang, 2007) as well as positive (Tsai et al., 2011; Ahuja & Katila, 2001; Nieto & Santamarı'a, 2007). The following hypothesis is proposed based on the evidence presented in this study:

H4=There is a relationship between external technology sources and the organizational performance of manufacturing companies.

3.3.1.5 Product and Process Technology and Organizational Performance

Product (manufacturing) and process technology can be defined as integrating newer technology in the companies or firm's daily business (Zahra & Covin, 1993). This study intends to determine the importance of technology in lowering manufacturing costs, manufacturing unique products, expanding production flexibility and reducing lead times. Pappas (1988) classified product and process technology as technology portfolio, which was defined as a tool in which decision is made on the importance of technology after undergoing some systematic deliberations. In other words, the outcome of company investment in technology combining with existing technology is commonly defined as a technology portfolio (Malekzadeh et al., 1989). On this basis, the technology portfolio is crucial as it outlines the internal technological strength of the companies or the firms, which is beneficial not only in product development but also in establishing a competitive edge over rival companies. Firms or companies with a wide range of technological strengths are more likely to develop new products and resist competition from emerging business entrants (Burgelman & Rosenbloom, 1989). For that reason, to measure the technology portfolio, observation should be made on the firm's focus on product development.

According to Zahra and Covin (1993), manufacturing operations, human resources, and strategic decisions are influenced by the product line. The size of the product lines, to a certain extent, depends on how active product development strategies. Zahra and Covin (1993) found evidence that supports the idea that product line breadth is directly associated with the aggressiveness of the new product development strategy. A firm with a broader technology portfolio is more likely to have more products to be shown, justifying the more opportunities it would have. However, for a smaller firm, quickly introducing products would enable them to be noticeable than their rivals (Acs & Audretsch, 1990). The timing and recentness of the portfolio have a massive impact on research and development (R&D) performance and revenues from new products (Roberts, 1995). Diversification of the products enables them to attain profits from joint venture products and the core product lines, which increases their investor appeal. However, having a broader portfolio will be challenging to manage, expensive and risky to pursue. Nevertheless, according to de Azevedo Rezende et al. (2019) and

Roberts (1995), it can enhance financial performance. Based on these arguments, this study proposes the following hypothesis:

H5 = There is a relationship between the product and process technology and the organizational performance of manufacturing companies.

3.4 The Moderating Role of External Environments in Influencing Technology Strategies on Organizational Performance.

The external environments, a third variable or a moderating variable in the framework that moderates the relationship between technology strategy and organizational performance, includes dysfunctional competition, institutional support, environmental turbulence, strategic alliance for product development, and political networking strategy. Baron and Kenny (1986) stated that the moderating variable is a variable that modifies or affects the direction and strength of a causal relationship between technology strategy and organizational performance. A moderating effect is an interaction that indicates the impact of one variable is subject to the level (Frazier et al., 2004). Hence, the differential effect of these variables as a function of the moderator is analyzed. The external environments (which is classified into five distinct environments) acts as a moderator in linking technological strategy and the performance of an organization.

The investigation of the impact of the external environment on technology strategy and organizational performance remains a great topic of interest for academicians and companies, especially during globalization. For instance, some researchers highlight the impact of competitive market environment moderators, namely dynamism (the rate and consistency of change within an industry), price hostility (the level of competition within industry against lower costs and prices), non-price hostility (a focus on product quality and service), and heterogeneity (the variety of consumer segments within the new venture's industry) on the efficacy of technology strategy toward new venture performance (Zahra & Bogner, 2000; Zahra, 1999) while giving less emphasis on other factors. Limited empirical evidence in this area of studies, especially on how little is known about how the external environment (dysfunctional competition, institutional support, environmental turbulence, strategic alliance for product development, and political networking strategy) may moderate the impact of technology strategy on organizational performance.

Zahra and Bogner (2000) found new product radicality that has a significant negative interaction with price hostility while external technology sources have a strong association with performance and insignificance of growth of market share (GMS) in situations of non-price hostility. The study also suggested that in order to have a successful performance, a formal technology strategy should be obtained. Furthermore, if the technological choices suit the external environments, the company or firm can achieve superior performance. Dess and Beard (1984), Li and Atuahene-Gima (2001), and Zahra and Bogner (1999) assert that managers' perceptions of the external environment have a moderating effect on the relationship between strategy and firm performance. In particular, the external environment (price hostility, market dynamism, market heterogeneity) moderates the interaction between technology strategy and the performance of the hi-tech companies, both positively and negatively.

A hostile environment, a subset of the external environment, is a negative element to the firm's operation. A hostile environment refers to the lack of certainty and security in the environment, which may be traced to having excessive rivalry, poor supply conditions, and severe industry changes. Hostile environments are, therefore, competitors', market and product-related uncertainty, and rigorous regulation (Zahra & Bogner, 1999; Zahra & Garvis, 2000; Dess & Beard, 1984; Werner et al., 1996) should be a matter of concern to the business context of Malaysia. Abdullah and Abdul Jalil (2006) acknowledged that some manufacturing industries had high barriers to entry due to their capital-intensive nature.

Li and Atuahene-Gima (2001) noted that dysfunctional competition, which refers to unhealthy competitive behaviour, can be found among competing firms in the market. Consequently, these companies or firms are drawn to display opportunist, unjust and illegal behaviour. Due to this, the competing companies or firms may appear inept despite having technological strength or even wishes to pursue their technology strategy.

On the positive note, the government would most likely support companies or firms which focus on the advancement of technology so that they can minimize negative consequences (due to the lack of institutional infrastructure) (Li & Atuahene-Gima, 2001) as well as reduce its risks and limitations (Guo, 1997). Among the institutional supports include providing science parks and information, advisory, financial support and financial services (Choi et al., 2021; Peter et al., 2018; Lai & Shyu, 2003; Storey & Tether, 1998). Li and Atuahene-Gima (2001) explained that assistance from government institutions is vital to ensure the technology strategy of the companies or firms is effective. According to Choi et al. (2021) the influence of government support is particularly positive in the technology and export sectors. Therefore, this study posits that the effects of technology strategy on the organizational performance of the manufacturing companies will positively be improved if they believe they receive an adequate level of institutional support.

Resource dependence theory (RDT) states that individuals in the organization are responsible for perceiving, interpreting, and evaluating the environment. The condition of the environment is important since what the managers perceive is often regarded as valid and often leads to a specific important decision (Daft, 1992; Hall, 1991). According to Burns and Stalker (1994), preliminary information-gathering activities differ in their importance depending on the level of perceived environmental uncertainty. On a similar note, the ability needed to reach outstanding performance depends on the intensity of environmental disturbance. The effects of rapid technological transition and extreme market changes can be seen in high-technological companies or firms. According to the resource-based theory, the advantage of the firms over others can diminish (Barney, 1991; Peteraf, 1993; Reed & Defillippi, 1990; Eisenhardt & Martin, 2000). A company may not be able to effectively transform its resources due to a change in technology that potentially leads to a turbulent environment. When this happens, what used to be the resources may instead become a liability. Similarly, Leonard-Barton (1992) also concurred with the idea.

Meanwhile, the contingent theory argues that adequate alignment of organization design variables concerning exogenous context variables can influence business performance (Burns & Stalker, 1994; Lawrence & Lorsch, 1967). Brush and Artz

(1999), Eisenhardt and Martin (2000) and Nee (1992) found that patterns of effective capability differ according to market dynamism or a competitive environment. The change in its ability will help it suit the business environment (Zajac et al., 2000), influencing dynamic capability development. However, managers in high-tech firms in China significantly focuses on technological capability. Nevertheless, there have been few studies focusing on the impact of technological ability on business empirical research.

This study has identified two types of environmental turbulence which has been emphasized and studied as follows: technological turbulence and market turbulence (Boyd et al., 1993; Milliken, 1987; Houston & Franklin, 1986). Technological turbulence can be referred to as the perfection that interferes with one's ability to predict and interpret accurately and understand the feature of the technological environment (Milliken, 1987) entirely. Using technological innovation enables one to respond effectively and up-to-date with technological trends by improving technological ability. With solid technological ability, companies or firms can create better customer value to perform better while ensuring survival amid technologically turbulent environments. On the contrary, companies or firms in a stable technological environment cannot enhance their technological capability unless the focus includes improved performance on other capability dimensions (marketing capability). A company or firm that has to deal with a high degree of technological turbulence may consider other options, including outsourcing, to improve product innovativeness. Furthermore, outsourcing the technology will enable companies or firms to improve their potentials (Venkatesan, 1992; Zahra et al., 2005), thus improving products and organizational performance.

Meanwhile, the changes in the customers' nature and preferences and the intense competition among competitors indicate market turbulence. Some companies or firms may constantly launch products to meet the market and customers' needs. The main challenge in market turbulence is not keeping abreast with technological trends instead of seeking technological innovation. However, due to market uncertainty, investment in technology may not bear the desired outcomes.

Therefore, based on the relationships in the above model and the objectives and literature review in this study, the following hypotheses are developed to test the moderating effects of external environments on a technology strategy that affects the organizational performance of manufacturing companies in Malaysia. Therefore, this study predicts that:

H6= External environments significantly moderate the relationship between pioneer – follower posture and the organizational performance of manufacturing companies.

H7= External environments significantly moderate the relationship between technological investment and the organizational performance of manufacturing companies.

H8= External environments significantly moderate the relationship between the intensity of product upgrades and the organizational performance of manufacturing companies.

H9= External environments significantly moderate the relationship between external technology sources and the organizational performance of manufacturing companies.

H10= External environments significantly moderate the relationship between product and process technology and the organizational performance of manufacturing companies.

3.5 Summary of the Chapter

The purpose of this study is to investigate the association between technology strategy, external conditions, and organizational performance. This chapter focused on the conceptual framework and hypothesis development consistent with the research objectives and research questions presented in Chapter One. Next, the research methodology will be explained in the following chapter containing important subheadings such as research design, population and sampling, data collection, validation, instruments validation and data collection process.

CHAPTER FOUR

RESEARCH METHODOLOGY

4.1 Introduction

This chapter contains the research design and methodology used in this study. This chapter describes the research design. Following will be a description of the population studied and the method used to determine the sample size, sources of data collection, including the related validity and reliability data and instruments and measurements used in the framework. Finally, this chapter will discuss the data analysis method, data collection procedures and data analysis.

4.2 Research Design

Zikmund et al. (2013) define research design as a blueprint that outlines the techniques and processes for collecting and evaluating the necessary data. This study aims to determine whether the external environments positively impact the relationship between technology strategy and organizational performance among Malaysian manufacturing firms. The philosophical perspective adopted in this study is a positivist research framework, which employs deductive reasoning, to begin with, the formulation of the hypothesis and ends with empirical findings in testing the developed hypotheses (Sekaran & Bougie, 2016). According to Miller (2000), positivist research aims to test hypotheses in a study by statistically analyzing the data gathered to forecast the occurrence of a particular phenomenon. Finally, considering potential constraints and prejudices, quantitative analysis is the best approach since its ability to address the question remains widely applied, and it is an acceptable method for this study.

Hence, it is suggested that the most appropriate research design for this study will be a quantitative study that employs exhaustive literature review from previous studies, and previous studies have suggested conducting a quantitative survey to determine issues and gaps in this area. Previous studies have reported the importance of the quantitative study to understand the situation related to technology strategy among manufacturing companies before developing a thorough investigating model (Kumar, 2011; Sekaran & Bougie, 2016). In meeting the objectives of the study and aligned with positivist philosophical preference, a quantitative approach is selected as this method allows for the examination of the relationship between the predictor variable (technology strategy) and the criterion variable (organizational performance) as moderated by external environment and organization characteristics. Generability of observation is based on an appropriate quantitative method enabling the analysis of collected data from a population sample (Amaratunga et al., 2002).

This context will use a descriptive study and cross-sectional research design in data collection to test the hypotheses based on empirical data. In order to further investigate the nature of the problems more explicitly, a descriptive study was carried out to elaborate the dilemma of a particular problem from a limited existing knowledge on the issue (Zikmund et al., 2013; Sekaran, 2003). On the other hand, social science research frequently uses a cross-sectional research design (Kumar, 2011) and the consistency of the issue, problem and situation thus continue to exist at a specific point in time that could be discovered in this study. In addition, to establish the variance among groups or how two or more factors interact through hypothesis testing (Sekaran & Bougie, 2016). Hence, hypothesis testing was carried out to verify that the nature of the relationship among factors was investigated and described (Zikmund et al., 2013; Sekaran, 2003).

This analysis aims to describe the relationship through hypotheses testing to determine the interaction between the construct by employing PLS-SEM. A descriptive study was carried out to understand whether technology strategy influences organizational performance.

This research is about technology strategy, and during the past 30 years, much more information has become available on technology strategy. The researcher hypothesized that technology strategy could be objectively described and quantified and that a survey method would be used to evaluate this analysis. A survey research approach is beneficial for attaining specific statistical information, the simplest and least expensive, providing complex quantitative data (Whitfield & Strauss, 1998; Delamont, 2004). Additionally, respondent's high-level perspective privacy could lead to sincere and valid responses, whereas the high degree of standardization and convenience of the survey method is mainly required from data analysis to achieve generalization (Ghauri & Grønhaug, 2005).

4.2.1 Purpose of Research

The empirical analysis aims to apply Resource-Based View (RBV) and Resource Dependency Theory (RDT) in assessing the moderating effect of external environment to explain variances in the relationship between technology strategy, as measured by the composite dimensions of pioneer-follower posture, technological investments: internal R&D, the intensity of product upgrades, external technology sources, as well as product and process technology, and organizational performance (financial and non-financial) for the manufacturing industry in Malaysia.

The way manufacturing companies' experiences technology strategy varies from across countries to unique external environments influences organizational performance. Previous studies have examined the relationship between technology strategy and organizational performance in American, European, African, Middle Eastern and other Asian manufacturing industries (Lin & Chang, 2006; Zahra & Nielsen, 2002; Sikander, 2011; Ghazinoory & Farazkish, 2010; Chadee & Pang, 2008; Man et al., 2009; Gibbons & O'Connor, 2003; Ngamkroeckioti et al., 2005; Zahra, 1999; Wilbon, 1999; Althonayan & Sharif, 2010). However, these studies did not investigate this relationship in manufacturing companies in Malaysia. Moreover, the external environments may have a different influence that affects the relationship between technology strategy and organizational performance because of their different risk orientation, relative capacities and past performance histories. With many companies struggling to balance their technology and business strategy, the gap in the literature calls for a better understanding of the how external environment moderate the relationship between technology strategy and organizational performance. With the number of external environment factors such as strategic technological changes, policymakers and the labor market and human resource development need to understand how these factors affect the technology strategy and organizational performance. A better understanding of the consequences the external environments have on manufacturing companies will enable organizational leaders to be better informed of the necessity of policies and benefits designed to enhance the manufacturing industry to benefit from the global changes, especially in Industrial Revolution 4.0.

4.2.2 Time Dimension of Study

This study utilizes the cross-sectional design where data was accumulated in one shot at one point of time intentionally to answer the research question (Sekaran & Bougie, 2016). Saunders et al. (2007) called this design a snapshot time horizon. A cross-sectional design is preferred for this study because the data was sufficiently accumulated once over time.

4.2.3 Research Design Strategies

This study used a quantitative explanatory design to examine the moderating effect of the external environments on the relationship between technology strategy and organizational performance for manufacturing companies in Malaysia. Briefly, the implementation of this quantitative approach can be categorized into two levels. The first level applied descriptive study to document technology strategy, external environment and organizational performance. The second level is the causal relationship study, also called explanatory study, among the critical independent, moderating and dependent variables under investigation.

In order to accomplish the aforementioned objectives of this study, surveys were administered to collect primary data. Survey strategy or survey approach is a broad term used in business and management research that refers to a technique that enables the researcher to collect quantitatively and analyze it using descriptive and inferential statistics (Sekaran & Bougie, 2013; Saunders et al., 2007). Typically, questionnaires are the most widely used tool for obtaining data from a large population cost-effectively (Saunders et al., 2007). Furthermore, it is commonly used for descriptive analysis or, as previously mentioned, a correlational study that aids in discovering relationships between various variables. As a result, this chapter will define the unit of analysis, population sampling, respondents, a reliable and accurate survey instrument, data collection, and analysis techniques for this study's survey data.

4.2.4 Unit of Analysis

The unit of analysis refers to the level of aggregation of the data collected, which is determined by specific research scenarios with a different unit of analysis, such as persons, dyads, communities, nations, and organizations (Sekaran & Bougie, 2013). The study intends to use an organization as the unit of analysis. The respondents who are at the managerial level of the manufacturing companies, including executives, CEOs, upper-level managers, the technology managers, senior managers or other management levels with a strategic-decision making the responsibility for their firms were expected to complete the questionnaire due to their experience with their companies' technology management and strategy issues (Vida et al., 2000). In addition, this respondent involves strategic decisions and policy formulation for their companies (Nanayakkara et al., 2017). The respondent was assumed to have knowledge and experience relating to the policy formulation and involvement with the issue under investigation.

4.3 Populations and Sampling

4.3.1 Population Sampling

The term population sampling involved collecting individuals, activities, and items of study from whom the study intends to derive conclusions using sample statistics (Sekaran & Bougie, 2013). Thus, the target population of this study comprises Malaysian manufacturers located in the Northern Region of Malaysia under The Northern Corridor Economic Region (NCER) development plan. NCER was developed to spur economic growth in Peninsular Malaysia's Northern Region, including Perlis, Penang, Kedah, and Perak. NCER was founded in 2007 to capitalize on the diverse economic and social advantages of selected areas in the four northern states, with a particular emphasis on three priority sectors: agriculture, manufacturing, and services. Penang is a key manufacturing hub in Malaysia, with Dell, Intel, and AMD all operating manufacturing facilities there. The sample of this study was extracted based on listed companies from the directory of the Federation of Malaysian Manufacturers (FMM) before the outbreak of COVID19 pandemic. Federation of Malaysian Manufacturers Malaysian Industries Directory 2019 is now in its 50th year of publication. The FMM Directory, widely regarded as the most powerful and most widely used platform for business communications with over 2400 manufacturers, effectively promotes Malaysian goods and services, expanding their presence and sales globally. It is a formal and credible database for manufacturers, and it can be used as a very reliable source of sampling to avoid sampling bias.

The manufacturing companies were chosen primarily due to their importance to the Malaysian economy (Perlis, Penang, Kedah, and northern Perak contributed more than 20 percent of its GDP). Additionally, manufacturing sectors are considered to be the most vulnerable to globalization danger. Manufacturing firms are often subjected to global developments, most notably the Industrial Revolution 4.0 (IR4.0). These businesses are the primary exporters of their goods, and as a result, they are highly vulnerable to technological changes. This research is limited to Malaysian manufacturing firms due to the manufacturing sector's enormous effect on the country's economy. The study's manufacturer division comprises manufacturers from a variety of different industries. To varying degrees, these companies have successfully embraced emerging technologies (Council on Competitiveness, 1991). The manufacturing companies that comprised the sampling frame were drawn from various manufacturing sectors, as detailed in Table 4.1.

Table 4.1
Malaysia's Manufacturing Sector

	Manufacturing sectors
1	Manufacture of food products, beverages and tobacco
2	Textile, wearing apparel, leather and footwear
3	Wood, furniture, paper products and printing
4	Petroleum, chemical, rubber and plastic
5	Non-metallic mineral products, basic metal and fabricated metal products, machinery and equipment
6	Electrical, electronic, computing machinery parts
7	Transport equipment and other manufacturers
8	Other manufacturing activities not elsewhere classified and recycling

Note. Federation of Malaysian Manufacturers (FMM) directory 2019.

4.3.2 Sampling Method

The sample for this study was drawn from a population of 354 manufacturing firms as detailed in Appendix A, and it was drawn from the Northern Region of Peninsular Malaysia, which includes the states of Perlis, Penang, Kedah, and Perak. This analysis used 354 manufacturing firms as a sampling frame. According to Kumar et al. (2013), a sampling frame is a comprehensive description of the population from which the sample is drawn. Additionally, all respondents to the sampling frame have a high probability of being chosen. Before selecting probability sampling, it is usually necessary to define the sampling frame (Ali Memon et al., 2017). The sampling frame of manufacturing firms was drawn from the directory of FMM.

Therefore, a total sample size of 181 was computed for a population of 340 to 360 to allow statistical inferences at the 95 percent confidence level based on the Krejcie and Morgan (1970) table was a minimum sample (see Appendix B). Furthermore, according to Cohen et al. (2017), to determine sample size, consider the significant level of 0.05 with the sampling error of 5 percent and the reliability level of 95 percent. Alternatively, to help Krejcie and Morgan's approach, G*Power analysis was used to evaluate the sample size, as it is one of the most common software packages. G*Power was introduced as an independent power analysis software to statistically tests in social and behavioral science. Thus, with an alpha of 0.05 and a power of 0.95, the estimated sample size needed for this effect size (using G*Power 3.1 or another software package) is approximately N = 180. As a result, it can be concluded that the total sample size for the Krejcie and Morgan methods combined with G*Power analysis is roughly equal and will undoubtedly be more than sufficient for the study's primary objective.

Following that, given the presence criteria developed for sample selection, respondents were chosen using a probability sampling design suitable for use after identifying the sampling frame. In order to achieve robustness, the analysis employs a probability sampling design to ensure that the data are representable according to a valid sampling procedure.

Probability sampling would be used in this study because it ensures that respondents (top management and higher-ranking officers) from the larger population have a fair probability of being included, that selection is based solely on chance, and that there is less likelihood of bias in the survey (Cohen et al., 2017). Thus, a simple random sampling technique was used to determine the manufacturing companies included in the survey. The most basic application of this technique is the least biased and most generalizable (Kumar et al., 2013; Sekaran, 2003). The research randomizer program was used to produce the study's random numbers. It randomly selected 181 manufacturing companies from a total sample size of 354 using this program. Due to the low response rate for unit analysis within an organization, as shown in previous studies (Nanayakkara et al., 2017; Man et al., 2009; Zahra, 1996), the researcher chose to use PLS-SEM with sample sizes ranging from 30 to 100, rather than CB-SEM with sample sizes ranging from 200 to 800 (Sarstedt et al., 2014).

4.4 Sources of Data Collection

This study used primary data in examining a relationship between constructs within the research framework. The primary sources of instruments to measure the key variables are in Table 4.2:

Table 4.2
Sources of Data Collection

Variables	Variable Measured	Sources of Data	No. of Items	Cronbach's alpha
IV	Technology Strategy	Questionnaire adapted from Sikander (2011), Zahra and Covin (1993), Oster (1999), Adler (1989), Maidique and Patch (1988), Dvir et al. (1993), Clark et al. (1989), Miller (1988), Herman (1998), Cooper (1987), Li and Atuahene-Gima (2001), Zahra (1991; 1993), Hills (1989); Hayes and Wheelwright (1984).	37	0.70 – 0.84
MV	External Environment	Questionnaire adapted from Li and Atuahene-Gima (2001), Sheng et al. (2011), Miller (1987), Bucklin and Sengupta (1993) and Li and Zhang (2007).	22	0.50 – 0.86
DV	Organizational Performance	Questionnaire adapted from Fullerton and Wempe (2009), Jusoh (2010), Abidin et al. (2014), Muhammad et al. (2009), Kaplan and Norton (1996), Laursen and Salter (2006), Dossi and Patelli (2010), Ahmad and Zabri (2016), Parker (2000), Zahra and Covin (1993), Lin	22	0.88 – 0.91

	and Chang (2006), Zahra (1996) and Hoque (2004).	

Note. Sources of data collection based on literature review.

4.5 Validity and Reliability

Validation of content is critical to ensuring that questionnaires are developed in a manner that is suitable for measuring the subject. Thus, Hardesty and Bearden (2004) performed face and content validity tests to ensure the modified instruments from previous studies were accurate and could be used interchangeably by researchers. Additionally, content validity can be determined following the pre-testing and pilot-testing processes.

4.5.1 Face Validity

Face validity was used to adjust the measurement items through interviews with experts from the selected manufacturing firms, including top management, COOs, senior directors, general manager, and two academicians from higher learning institutions. They were selected for their extensive experience, breadth of expertise, and willingness to evaluate the things within each construct and accept them following the decision. Following the constructive interview and discussion with experts, the number of items was changed and updated to ensure that each relationship was appropriate for this report. As a result, to ensure that the evaluation instruments accurately represent the proposed measure (Hardesty & Bearden, 2004).

4.5.2 Content Validity

The term content validity refers to the degree to which an instrument accurately calculates the desired construct (Kumar et al., 2013). As a result, the researcher chose to nominate and choose seven Subject Matter Experts (SMEs) in various positions, as shown in Table 4.3, to conduct the pre-test. Pre-testing is a critical phase before completing a questionnaire; it ensures that the questions are transparent and that respondents can comprehend how they are planned and predicted (Sekaran, 2003). Two academicians will be tasked with reviewing each item's wording, the comprehension of the questions, the order of the questions, and the specific guidance to all respondents (Kumar et al., 2013). At the same time, another five manufacturing industry experts will be asked for their expert opinion on the chosen variables and their appropriate content and decide the question's acceptance or removal. The experts will be tasked with validating, examining, and making any necessary modifications to each question from the instruments and enhancing understanding among potential respondents.

Table 4.3

Subject Matter Experts (SMEs)

No	Backgrounds and Qualifications	Experts
	Practitioners	
1.	Chief Operating Officer SilTerra Malaysia Sdn. Bhd. Master of Business Administration, Universiti Utara Malaysia	Kader Ibrahim
2.	Factory Manager Hitachi Cable (Johor) Sdn. Bhd. Bachelor of Science	Chai Seang Ee
3.	Senior Director Human Resources for South East Asia ON Semiconductor Master of Business Administration (Business Administration and General Management), Universiti Kebangsaan Malaysia	Kamaldin Nordin
4.	Chief Executive Officer TasBlock (M) Sdn Bhd Master of Architecture, Southern California Institute of Architecture	Nor Hasima Hj Hassan
5.	Deputy General Manager Rensoon Ceramics Sdn Bhd Bachelor of Science	Elson Eng Kam Sek
	Academicians	
6.	Associate Professor Dr., Universiti Teknologi MARA (UiTM Perlis) PhD (Accounting) Universiti Utara Malaysia	Azrul Abdullah
7.	Senior Lecturer, Universiti Malaysia Perlis Master of Business Administration, University of Central Missouri, USA and Bachelor of Science (Business Administration and Computer Science), Indiana State University, USA	Tengku Suriani Tengku Yaacob

As a result, this research will employ Lawshe’s method for establishing content validity since, as Ayre and Scally (2014) note, this proven method has been widely used by scholars to develop content validity in various sectors, including manufacturing. Lawshe developed a Content Validity Ratio (CVR) to scale or calculate the content validity of each item to be evaluated by an expert. Three scales are used to classify items as *essential, useful but not essential,* or *not necessary* (Lawshe, 1975). Appendix D1 and Appendix D2 detail the questionnaire’s validation.

CVR determines if an item is relevant to or unrelated to the content validity, with the CVR value ranging from +1 to -1. According to Lawshe (1975), the minimum CVR value can be calculated using the four characteristics or indicators mentioned in Table 4.4. Additionally, it can assist in determining which items are retained or rejected.

Table 4.4
The Characteristics Minimum Values of CVR

No	Characteristics	Results of CVR
1	If fewer than half say essential	CVR is negative
2	If half say essential and half do not	CVR is zero
3	If all say essential	CVR is 1.00
4	If more than half say essential	CVR is in the middle of 0 and 0.99

As a result, if five SMEs are chosen for content validity, the minimum value of CVR, according to Lawshe's method, must be 0.62. The CVR is calculated using the formula:

$$CVR = (Ne - N/2)/(N-1)$$

Notes:
Ne = number of SMEs indicating "essential"
N = total number of SMEs

4.5.2.1 Result of Content Validity Ratio (CVR)

All responses from SMEs are pooled to determine the essential quantities for each item to establish content validity. The item column for each question is shown in Appendix C, while the number represents the SMEs that validated the questionnaire. The result indicates that the result met the minimum requirements of Lawshe's scale, with more than half rating it as *essential*, as opposed to U rating it as *useful but not essential* and N rating it as *not necessary*.

The following formula has been used to justify the conclusion:

$$CVR = (Ne - N/2)/(N-1)$$

$$= (486 - 7/2) / (7-1)$$

$$= 80.4 * 0.80$$

0.80 suggests that the CVR is between 0 and 0.99, indicating that the SMEs approved the item suggested after validating the judgments. Certain items, however, must be omitted because SMEs determined that they were not suitable to ask potential respondents.

4.5.2.2 Summary of Reviewers' Comments

After validating the questionnaire, Table 4.5 summarises the SMEs' comments and feedback about the proposed questionnaire using Lawshe's method. SMEs made the following remarks.

Table 4.5
Summary of Recommendations from Reviewers

Subject Matter Experts (SMEs)	Comments
SME 1	• The dysfunctional competition and strategic alliance for product development items need to be restructured, focusing on external environments for Malaysian manufacturing companies.
SME 2	• In technology strategy contexts, the technological investment and external technology sources items seem to be less relevant for multinational corporations (MNCs) than for local private companies.
SME 4	• It is prudent to merge questions 16 and 17. • The following questions should be removed: 18, 19, 20 and 21.

SME 6	• It is recommended that the survey code number and the company name in section A not be included in the study. • It is also recommended that the product name be placed at the top of section A. • Some of the sentences in section A, specifically questions 3, 4, and 15, should be revised more concisely.
SME 7	• The financial performance and non-financial performance elements in section E should be updated to ensure that the correct items are classified when assessing organizational performance. • For instance, item NF3 focuses on the quality of product performance to assess the total quality management's performance. While NF4 aims to quantify operational performance by focusing on material and labour efficiency or productivity. Whereas, the objective of NF6's emphasis on employee development and training is to assess human resource efficiency. • Along with NF7, NF8, NF9, NF10, NF11, NF12, NF13, and NF14 all require revision.

Note. Author

Thus, it can be inferred that this questionnaire contains only five parts, with some items omitted to avoid potential sensitivity issues. However, the number of questions has been limited to ensure that respondents can complete the questionnaire in a reasonable amount of time. In this case, the number of items has been finalized into several sections: Section A contains four items, Section B contains thirteen items, Section C contains thirty-three items, Section D contains twenty-two items, and Section E contains ten items.

4.6 Measurement of Variables

Measurement is central to business research, and two primary processes were typically applied: conceptualization and operationalization (Kumar et al., 2013). To begin, variables are specified conceptually (as constructs), and the second step refers to operational definitions, which specify how variables will be calculated (Kumar et al., 2013). Following that, the operationalization considers three variables: dependent, moderating, and independent.

After being tested to fit the organization's current patterns for further data analysis, the items in this questionnaire were adapted and compiled from existing sources. These items were included in this analysis because Cronbach's alpha values in previous studies indicated reliable results. In addition, a survey will be used to determine relationships between variables based on the proposed conceptual framework, and the questionnaire was created after detailed reviews of prior literature, as previously mentioned.

4.6.1 Technology strategy

Technology strategy in this study was defined as even though the differences in the characteristics suggest that technology strategy is considered a long-term plan that leads companies to utilize the committed resources toward technology to achieve competitive advantage possessed by the manufacturing companies. A six-item scale was used to assess variables related to technology strategy. As a result, technology strategy is operationalized by using five content dimensions of technology strategy extracted from previous research to direct the selection process of the following technology strategy variables in measuring specific dimensions. The variables are as follows: pioneer-follower posture, technological investments, the intensity of product upgrades, external technology sources, and product and process technology.

4.6.1.1 Pioneer – Follower Posture

The pioneer – follower posture describes a company's preference for using technology to position itself (Sikander, 2011) strategically. Therefore, measuring this variable's dimension concerning a company's propensity to embrace technical risk (Rauch et al., 2009) and the extent to build reputation is considered a conscious determination. Burgelman et al. (1996) and Song et al. (2013) opined that technological leadership is a relative advantage in possessing technological competencies and capabilities. As a result, this commitment enables companies to gain a pioneering role in developing technology in contrast to a more conservative monitoring role. However, a company could become a pioneer in technological change in its respective industry or choose to remain a follower of its competitors (Song et al., 2013). Pioneering and followership represent the conventional cycle of technological postures considering the extremes of diverse follower positions (Kerin et al., 1992).

Respondents were asked to score their willingness to use technology to strategically position themselves on a six-point Likert scale ranging from low to high for each statement. This aspect demonstrated the company's dedication to creating and implementing revolutionary technologies. Additionally, it implied a company's substantial use of cutting-edge technology in expanding its market reach. A low score showed a strong desire to keep up with technological advancements.

4.6.1.2 Technological Investments: Internal R&D

This measurement of technological investments: internal R&D indicates the degree to which companies fund their R&D activities and the primary objective of achieving the desired ROI (Sikander, 2011; Clark et al., 1989; Herman 1998). A study by Vranakis and Chatzoglou (2012) proposes a new conceptual framework for exploring why manufacturing firms invest in new machinery and equipment to increase their efficiency.

4.6.1.3 Intensity of Product Upgrades

The intensity of product upgrades refers to the frequency and the number of new products being introduced (Herman, 1998). As mentioned by Miller (1988), Clark et al. (1989), and Dvir et al. (1993), the term product development intensity refers to the quantity and rate at which new products are introduced. This study measures the importance of product line expansion, emphasizing an improved version of the existing products. Kleinschmidt (1994) and Ngamkroeckjoti et al. (2005) also mentioned that new product development (NPD) is vital for the survival and growth of contemporary companies. The frequent launch of updated products has been recognized as a critical method for firms to constantly refresh themselves to survive and succeed in a rapidly evolving market climate (Anton & Biglaiser, 2013; Koufteros & Marcoulides, 2006), and is especially noticeable in the durable goods industry.

4.6.1.4 External Technology Sources

External technology sources define as the application of strategic alliances, licensing agreements, acquisitions and outright purchase of technology from the third party or external sources (Zahra & Bogner, 1999; Kotabe & Swan, 1995; Dowling & McGee, 1994; Shan, 1990; Adler, 1989). These sources enable manufacturing companies to gain access to a more incredible platform of technological capabilities essential for product development to overcome their weaknesses in the R&D of the manufacturing companies. As a result, it boosted company product development and created opportunities (Dodgson, 1993). Dodgson (1993) opined that strategic alliances and licensing enable companies to combine their specific technological superiority with their prevailing product attributes developed by external sources. This strategy swiftly introduces a variety of new products in the market.

4.6.1.5 Product and Process Technology

Product and process technology define the degree to which new technology is integrated into the firm's (Zahra & Covin, 1993). This study measures the importance a company places on using technology to manufacture unique products, gain low manufacturing costs, develop production flexibility while reducing lead times. Ensminger et al. (2004) point out that technical success is generally accepted as successful implementation.

4.6.1.6 Technology Strategy of Dimensions and Items

This section determines the core constructs of dimensions and items of technology strategy in the manufacturing industry. Technology strategy played a crucial role in making manufacturing companies improve their competitive advantage (Montiel Campos et al., 2009). Five dimensions of technology strategy were selected in this study. These dimensions are pioneer – follower posture, technological investments: internal R&D, the intensity of product upgrades, external technology sources, and product and process technology. Additionally, these five dimensions include all facets of an entity that enhance organizational performance.

The pioneer – follower posture or technology posture was assessed in this study using an instrument adapted from Ettlie and Bridges (1982) and previously used by Sikander (2011), Zahra & Covin (1993), Oster (1999), Adler (1989), and Maidique and Patch (1988). This measurement consists of nine items in a six-point Likert scale ranging from low to high for each statement. The scale has a Cronbach's coefficient alpha of 0.79. The technological investments factor in this study reflected a firm's investment in internal research and development, fundamental research. The measurement of technological investments: internal R&D was adapted Lefebvre et al. (1992) and McCann (1991). Furthermore, this instrument was also used by Herman (1998), Dowling and McGee (1994), and Kotabe and Swan (1995). The items for technological investments: internal R&D consist of eight items. The scale has a Cronbach's coefficient alpha of 0.81. The instrument used for the measurement of the intensity of product upgrades was adapted from Sikander (2011), Zahra and Covin (1993), Dvir et al. (1993), Clark et al. (1989), Miller (1988); Herman (1998), Cooper (1987), Li & Atuahene-Gima (2001) consist of six items.

External technology sources are often used to supplement and expand an organization's internal technical capabilities. They can obtain technology from other companies, buy technology companies, conclude licensing arrangements with others to buy or sell their innovative product while building their technology partnerships (Dussauge et al. 1992; McCann 1991; Porter 1985). External technological sources measure constructs adapted from Zahra and Bogner (1999) as these are established items with a high-reliability score. Items for external technology sources of four items in a six-point Likert scale. The scale has a Cronbach's coefficient alpha of 0.84. Whereas the instrument for product and process technology was adapted from Zahra and Covin (1993), Miller (1988), Zahra (1991), Zahra (1993), Hills (1989), Hayes and Wheelwright (1984) consist of six items and was also used by Sikander (2011). The tested items indicated that Cronbach's alpha was accepted with the range 0.70 and above. Table 4.6 illustrated the dimensions and items of technology strategy based on pioneer – follower posture, technological investments: internal R&D, the intensity of product upgrades, external technology sources, and product and process technology.

Table 4.6
Dimensions and Items of Technology Strategy

Independent Variables	Adapted Items	Sources
Pioneer-Follower Posture	1. Pursuing high technical risk, break-through technologies. 2. Having reputation for technological innovation. 3. Striving for dominance in key technologies. 4. Building a reputation for being first in the industry to try new methods and technologies. 5. Being an industry leader in innovation efforts. 6. Being an early industry entrant regarding innovation efforts. 7. Being first in discovering new technologies. 8. Being first in introducing new innovative products. 9. Being first in introducing low-cost products.	Ettlie and Bridges (1982); Sikander (2011); Zahra and Covin (1993); Oster (1999); Adler (1989); Maidique and Patch (1988)
Technological Investments: Internal R&D	1. Maintaining high level of R&D investment in relation to sales revenue. 2. Ensuring R&D investments provide predefined return (estimated profit). 3. Acquiring external funding for R&D projects. 4. Average annual spending on R&D as a percent of company sales (past 3 years in 2015, 2016 and 2017). 5. Has one of the largest R&D groups in the industry. 6. Has one of the most productive R&D groups in the industry. 7. Spends more on R&D than the competition. 8. Spends more on R&D than the industry average.	Lefebvre et al. (1992); McCann (1991); Herman (1998); Dowling and McGee (1994); Kotabe and Swan (1995)
Intensity of Product Upgrades	1. Reducing product development cycle time. 2. Increasing total number of products offered. 3. Continuously improving existing products. 4. Emphasis on new product development. 5. Increased the rate of new product introductions to the market. 6. Number of new products offered.	Sikander (2011); Zahra and Covin (1993); Dvir et al. (1993); Clark et al. (1989); Miller (1988); Herman (1998); Cooper (1987); Li and

		Atuahene-Gima (2001)
External Technology Sources	1. Uses joint ventures for R&D. 2. Is heavily engaged in strategic alliances. 3. Collaborates with universities and research centers in R&D. 4. Contracts out a major portion of its R&D activities.	Zahra and Bogner (1999)
Product and Process Technology	1. Unique products manufacturing capability (use of technology to manufacture unique products). 2. Use of technology to achieve low manufacturing cost. 3. Use of technology in improving production flexibility and reduce lead-times. 4. Level of automation of plants and facilities. 5. Using the latest technology in production (up-to-date technological infrastructure). 6. Capital investment in new equipment and machinery.	Sikander (2011); Zahra and Covin (1993); Miller (1988); Zahra (1991; 1993); Hills (1989); Hayes and Wheelwright (1984)

Note. Sources and items for questionnaire construct based on literature review.

4.6.2 Organizational Performance Construct and Dimensions

This dimension of the questionnaire corresponds to the dependent variable's measurement. It is intended to elicit data about an organization's performance. Financial and non-financial dimensions are used as one of the leading performance indicators for manufacturing firms. Both financial and non-financial indicators, as well as multidimensional performance measures, have been commonly used by previous researchers to assess organizational performance in manufacturing firms, as they play a significant role in the activity and development context, which contributes to firm performance see Ahmad and Zabri (2016), Dossi and Patelli (2010), Said et al. (2003), Neely et al. (2001), and Kaplan and Norton (1996).

Non-financial performance indicators are now widely used in manufacturing firms, with the majority of the measures listed being used by more than 80 percent of corresponding firms (Abdel-Maksoud et al., 2005). This indicator explains why conventional performance metrics alone do not seem to accurately represent the effectiveness of operating organisations in today's fast-paced, complex, and competitive world (Jusoh, 2010). Advanced technology adoption is correlated with a greater emphasis on non-financial success indicators in manufacturing firms (Fullerton & McWatters, 2002; Abdel-Maksoud et al., 2005). Non-financial measures broaden the scope of regulation by eliminating shortsighted measurements, and their inclusion enables knowledge sharing by supplementing traditional performance assessment instruments (Dossi & Patelli, 2010). Non-financial performance indicators included innovation performance and a variety of organizational non-financial performance indicators (Kaplan & Norton, 1996; Laursen & Salter, 2006; Dossi & Patelli, 2010; Ahmad & Zabri, 2016).

Organizational success is often characterized conceptually in terms of the following elements: social system and the ability to manipulate environments with limited resources. However, it also places a premium on achieving organizational objectives effectively through available resources (Georgopoulos & Tannenbaum, 1957; Yuchtman & Seashore, 1967; Lusthaus & Adrien, 1998; Saeidi et al., 2014; Asat et al., 2015). Thus, organizational performance was described in this study as the extent to which efficient and successful resource utilization is considered to be a determinant of an organization's success.

Hence, for this research, the operationalization of organizational performance is based on a total of ten items adapted from McDougall et al. (1994) and used in a variety of studies, including those by Kaplan and Norton (1996), Laursen and Salter (2006), Fullerton and Wempe (2009), Muhammad et al. (2009), Jusoh (2010), Dossi and

Patelli (2010), Abidin et al. (2014), Pegels and Thirumurth (2016). The tested items indicated that Cronbach's efficient alpha was 0.88, which classically considered sufficient. There are benefits to using a well-tested and robust instrument that has been commonly used in previous research. However, in light of the study's objective, this instrument has been refined by including two items: the number of new product launches and the time required to bring a product to market. Interval scales on a six-point Likert-type scale was used to assess organizational efficiency in this analysis, with one denoting low and six denoting high. Respondents were asked to evaluate their organization's use of the defined performance indicators compared to competitors over the last three years. The dimensions and items of organizational performance in Table 4.7 are classified as financial and non-financial.

Table 4.7
Dimensions and Items of Organizational Performance

Dependent Variables	**Adapted Items**	**Sources**
Organizational Performance	1. Organizational performance measured by return on assets (ROA). 2. Organizational performance measured by return on equity (ROE). 3. Organizational performance measured by return on sales (ROS). 4. Organizational performance measured by return on investment (ROI). 5. Organization's market shares in its main products and markets. 6. Growth of sales in its main products and markets. 7. Organization's profitability better than its competitor for the last three years. 8. Number of new product launches. 9. Time to market launches. 10. Process improvements and re-engineering.	McDougall et al., (1994); Fullerton & Wempe (2009); Jusoh (2010); Abidin et al. (2014); Muhammad et al. (2009); Kaplan & Norton (1996); Laursen & Salter (2006); Dossi & Patelli (2010); Ahmad & Zabri (2016); Parker (2000); Hoque (2004)

Note. Sources and items for questionnaire construct based on literature review.

4.6.3 External Environment Construct and Dimensions

The external environments have been proposed in Chapter Two as moderating variables which contain numbers of dimension. As discussed in Chapter Two, the external environments are described in this study as the conditions, causes, or events that occur in the market environment in which a firm operates and presents a variety of unique challenges to the firm's success (Hashim, 2005). Section D of the questionnaire was structured to elicit details about the external environment, including dysfunctional competition, institutional support, environmental turbulence, strategic alliance for product development, and political networking strategy dimensions. The external environment factor indicates the industry's rate of change, the unpredictability of consumer and competitor conduct, and industry changes. An instrument developed by Li and Atuahene-Gima (2001), Sheng et al. (2011), Miller (1987), Bucklin and Sengupta (1993) and, Li and Zhang (2007) were adapted and improved to measure the external environment. A total of 22 items are used to operationalize the external environments factor. The scales used in their analysis were upgraded to a 6-Likert scale from a 5-Likert scale. Table 4.8 shows the measurement items for the external environments in this line.

The dysfunctional competition was measured based on the instrument adapted from Li and Atuahene-Gima (2001). Furthermore, this instrument was also used by Sheng et al. (2011). The items used to determine dysfunctional competition include four items that reflect the degree to which the industry has been subjected to competition over the last three years. The Cronbach's efficient alpha for the dysfunctional competition is 0.71.

The institutional support instrument was adapted from Li and Atuahene-Gima (2001). The institutional support items consist of four components that reflect how the government and its agencies have aided the industry over the last three years. The Cronbach's efficient alpha for the dysfunctional competition is 0.71.

Environmental turbulence is the increased frequency and severity of changes in the external market environment, allowing for more significant uncertainty (Duncan, 1972). The instrument used to measure environmental turbulence in this study was adapted from Miller (1987) and was used to describe the manufacturing company's environment over three years. Cronbach's alpha for the measured item was 0.50. The items for environmental turbulence consist of four items.

Strategic alliance for product development refers to an expression of inter-organizational cooperative strategies involving the pooling of specific resources and expertise through cooperating organisations to accomplish both shared and unique objectives (Varadarajan & Cunningham, 1995). Gaining access to new markets; improving the speed of penetration into new markets; sharing research and development, production, and marketing costs; diversifying the product line/filling product line gaps; and acquiring new skills are reasons companies can form strategic alliances. The measurement of strategic alliance for product development items was adapted from Bucklin and Sengupta (1993) to reflect the degree to which a company has engaged in strategic alliance for product development over the last three years. The scale of 0.86 indicates that Cronbach's alpha is acceptable. The measurement for strategic alliances for product development consists of six items.

Finally, Li and Zhang (2007) adapted items of political networking strategy to demonstrate the degree to which senior management has dealt with political networking strategy. The scale of 0.86 indicates that Cronbach's alpha is acceptable. The items for political networking consist of four items. Table 4.8 summarized the external environment's dimensions and items focused on the dysfunctional competition, institutional support, environmental turbulence, strategic alliance for product development, and political networking strategy.

Table 4.8
Dimensions and Items of External Environment

Moderator Variables	Adapted Items	Sources
External Environments;		
Dysfunctional competition	1. Unlawful competitive practices such as illegal copying of new products. 2. Counterfeiting of your firm's own products and trademarks by other firms. 3. Ineffective market competitive laws to protect your firm's intellectual property. 4. Increased unfair competitive practices by other firms in the industry.	Li and Atuahene-Gima (2001); Sheng et al. (2011)
Institutional support	1. Implemented policies and programs that have been beneficial to your firm's operations. 2. Provided needed technology information and technical support to your firm. 3. Played a significant role in provididng financial support for your firm. 4. Helped your firm to obtain licenses for imports of technology, manufacturing and other equipment.	Li and Atuahene-Gima (2001)
Environmental turbulence	1. Actions of local and foreign competitors have been highly unpredictable. 2. Market demand and consumer tastes have been unpredictable. 3. It has been difficult to forecast how technologies will change in this industry. 4. Product market conditions have been changing very fast.	Miller (1987)
Strategic alliance for	1. Entered into cooperative agreements with other firms to design and manufacture new products.	Bucklin and Sengupta (1993)

product development	2. Collaborated with other firms to market new products. 3. Joined with other firms to introduce new products. 4. Jointly promoted new product lines with other firms. 5. Jointly distributed and provided support services for new products with other firms. 6. Established cooperative agreements with other firms and institutions for R&D.	
Political networking strategy	1. Spent much effort in cultivating personal connections with officials of government and its agencies. 2. Maintained good relationships with officials of state banks and other government financial agencies. 3. Devoted substantial resources to maintain good relationships with officials of governments and their agencies. 4. Spent a lot of money on building relations with the top officials in government.	Li and Zhang (2007)

Note. Sources and items for questionnaire construct based on literature review.

4.7 Design of the Research Instruments

The principal instrument produced was a survey questionnaire (see Appendix E). A set of questionnaires were developed based on a literature review from the previous research for data collection. The items in the questionnaire were based on a literature review. The questionnaire was prepared in dual language which is English (see Appendix E3) and Bahasa Melayu (see Appendix E4). The questionnaire will be submitted to the university's language centre. The questionnaire comprises five sections. The study collects data on the respondents in five parts. Section A is an individual's profile. Section B consists of the organization's profile. Section C includes 33 items on technology strategy. Elements of technology strategy of manufacturing companies are looked at from the aspects of pioneer – follower posture (9 items), technological investments: internal R&D (8 items), the intensity of product upgrades (6 items), external technology sources (4 items), and product and process technology (6 items). Section D consists of items on the external environment such as dysfunctional competition (4 items), institutional support (4 items), environmental turbulence (4 items), strategic alliance for product development (6 items) and political networking strategy (4 items). Finally, Section E consists of organizational performance (10 items). See Table 4.9.

Table 4.9
Components in the Questionnaire

Section	Topic covered
A	*Individual's Profile*
B	*Organization's Profile*
C	*Technology Strategy*
	Pioneer-Follower Posture
	Technological Investments: Internal R&D
	Intensity of Product Upgrades
	External Technology Sources
	Product and Process Technology
D	*External Environment*
	Dysfunctional Competition
	Institutional Support
	Environmental Turbulence
	Strategic Alliance for Product Development
	Political Networking Strategy
E	*Organizational Performance*
	Financial Performance
	Non-Financial Performance

Note. Full questionnaire in Appendix E.

4.7.1 Development of the Survey Questionnaire

A structured questionnaire was used as the principal survey instrument. The aim of creating a structured questionnaire for this study was to collect quantifiable data. The survey questionnaire consisted of five sections. Section A comprises questions regarding the general characteristics. Section B comprises questions regarding the organization profile. Section C included questions focused on technology strategy dimensions. Section D contained questions on the external environments. Section F contained questions on the performance of the organization. Appendix E presents the content of the questionnaire and the relevant sources.

Along with yes/no questions and rating questions, the survey questionnaire included Likert scaled questions, which have a high probability of eliciting responses that accurately represent respondents' opinions (Burns & Bush 2002; Zikmund 2000; Wong 1999). Six Likert scales will be used in this analysis. Sekaran (2000) and Malhotra (1999) prove that a six-point scale is as good as many different options, since lengthening the scale does not always boost the reliability of the ratings (Elmore & Beggs, 1975, cited in AbHamid, 2006) and may result in increased uncertainty among the survey participants (Aaker et al. 2000; Hair et al. 2003). As a result, a six Likert closed rating scale will be used where applicable in this study.

The majority of manufacturing firms in Malaysia operate in English, the country's primary official language. However, Malay is Malaysia's national language. As a result, the survey questionnaire was translated into Malay to incorporate the words associated with technology strategy in Malay.

4.8 Data Analysis Method

This section discusses the data analysis technique to test the variables. The Statistical Package for Social Science (SPSS 24) and Partial Least Square – Structural Equation Modeling (PLS-SEM) will be used to analyze the data in this study. SPSS will be used to identify any errors or abnormalities after conducting data screening and data cleaning. Treatment on missing data, outlier detections and cross-loading will be performed. Subsequently, the initial stage was a series of descriptive statistics analyses (frequency counts, means and standard deviation) to look at the profiles of the respondents. Smart PLS software will be used for inferential statistics in order to answer the research questions. The analysis performed in this study is shown in Table 4.10. Table 4.11, on the other hand, displayed the research objective, hypothesis, and data analysis.

Table 4.10
Data Analysis

Research Objectives	**Analysis**	**Software**	**Purpose**
	Descriptive analysis	SPSS	Missing value, outlier detection and cross-loading. Description of sample characteristics.
	Analysis of measurement scale	SMART PLS	Verify the construct's validity (discriminant and convergent validity (AVE and Composite Reliability).
RO1, RO2, RO3, RO4 and RO5	Relationship between constructs	SMART PLS	Test the relationship between constructs to determine if any/all of the constructs have a significant relationship.
RO6	Moderation	SMART PLS	Analyze how external environments influence the relationship between technology strategy and organizational performance.

Table 4.11
Objective of the Research, Hypothesis and Data Analysis

	Research Objective	**Research Hypothesis**	**Data Analysis**
RO1	To examine the relationship between pioneer – follower posture and organizational performance in manufacturing companies.	H1= There is a relationship between pioneer – follower posture and organizational performance of manufacturing companies.	Structural model of PLS-SEM using Smart PLS 3
RO2	To examine the relationship between technological investments (internal R&D) and organizational performance in manufacturing companies.	H2= There is a relationship between technological investment (internal R&D) and organizational performance of manufacturing companies.	Structural model of PLS-SEM using Smart PLS 3
RO3	To investigate the relationship between the	H3= There is a relationship between the intensity of product upgrades	Structural model of PLS-

	intensity of product upgrades and organizational performance in manufacturing companies.	and organizational performance of manufacturing companies.	SEM using Smart PLS 3
RO4	To investigate the relationship between external technology sources and organizational performance in manufacturing companies.	H4= There is a relationship between external technology sources and organizational performance of manufacturing companies.	Structural model of PLS-SEM using Smart PLS 3
RO5	To assess the relationship between product and process technology and organizational performance in manufacturing companies.	H5= There is a relationship between product and process technology and organizational performance of manufacturing companies.	Structural model of PLS-SEM using Smart PLS 3
RO6	To analyze the moderating effect of external environments on the relationship between technology strategies and organizational performance in manufacturing companies.	H6= External environments significantly moderate the relationship between pioneer – follower posture and the organizational performance of manufacturing companies. H7= External environments significantly moderate the relationship between technological investment and the organizational performance of manufacturing companies. H8= External environments significantly moderate the relationship between the intensity of product upgrades and the organizational performance of manufacturing companies. H9= External environments significantly moderate the relationship between external technology sources and the organizational performance of manufacturing companies. H10= External environments significantly moderate the relationship between product and process technology and the organizational performance of manufacturing companies.	Structural model of PLS-SEM using Smart PLS 3

4.8.1 Data Entry Errors

The most frequent cause of errors were data entry errors, which usually occurred when data was entered into SPSS (Page and Meyer, 2000). Thus, it has been proposed that data checking be used to identify errors before continuing with descriptive and inferential statistics research. Data validation seriously should be taken since it involves data obtained from primary sources (Page & Meyer, 2000).

4.8.2 Missing Value

The most common issue in social science research is missing value or data caused by data errors. Additionally, Page and Meyer (2000) and Hair et al. (2014) have outlined many possible explanations for missing values, including response not needed, difficulty in answering, uncertainty in answering, reluctance to answer, and finally, unknown or respondent have no idea. As a result, it is critical to implement a procedure for dealing with missing data (Kumar et al., 2013). According to Hair et al. (2014), two approaches to handling missing data are recommended: mean replacement and casewise deletion. Meanwhile, Kumar et al. (2013) suggested three deletion strategies: listwise deletion, pairwise deletion, and value replacement.

4.8.3 Treatment of Outliers

The next move is to examine the existence of outliers. Outliers were instances when extreme scores on a particular question led to a higher result or where extreme scores or answers on all questions are present (Hair et al., 2014; Kumar et al., 2013). As a result, Kumar et al. (2013) recommended that the data set be tested for both univariate and multivariate outliers to eliminate any biased performance. However, the decision to remove or include outliers from data analysis is context-dependent. Hair et al. (2014) proposes simply deleting them from the data set if outliers are found.

4.8.4 Test of Multicollinearity

Multicollinearity is the final step in the data screening and cleaning process. Multicollinearity is a statistical phenomenon identified by Kumar et al. (2013) and Sekaran and Bougie (2013). It occurs when two or more independent variables in a multiple regression model are strongly correlated. According to Sekaran and Bougie (2013), the simplest way to determine multicollinearity is to perform a correlation matrix search on the independent variables. If the correlations are greater than 0.70, this is regarded as the first indicator of significant multicollinearity. Additionally, as discussed in the following section, calculating tolerance values and the variance inflation factor (VIF) can be used to detect multicollinearity.

4.9 Descriptive Statistics and Inferential Statistics

According to Kumar et al. (2013), data analysis has two primary goals: descriptive statistics and inferential statistics. According to Sekaran and Bougie (2013), descriptive analysis was characterized as determining the maximum, minimum, means, standard deviations, and variance of each variable. In a nutshell, it aims to organize and summarize results (Kumar et al., 2013). However, inferential statistics determine relationships between variables by using various significance tests, such as univariate or bivariate analysis (Sekaran & Bougie, 2013; Kumar et al., 2013; Gupta & Gupta, 2012). As such, it aims to test hypotheses and then to conclude an inference based on the outcome. On the other hand, descriptive statistics can deal with frequency distribution as well as the respondent's profile (Kumar et al., 2013). While inferential analysis is emphasized through the method of generalization (Gupta & Gupta, 2012), it is concerned with statistical testing hypotheses and the relationship between sample statistics and population parameters (Kumar et al., 2013).

4.9.1 Partial Least Square (PLS)

SEM is rapidly gaining popularity in business and social sciences (Henseler et al., 2016). Although technology strategy researchers appear to be slow to adopt SEM as a statistical tool, their use has steadily increased in recent years, especially in articles published in strategic technology management systems (STMS) research journals and empirical research (Zahra & Covin, 2000). As a result, this study's review will be carried out using the SmartPLS software framework. Ringle, Wende, and Will created this well-known app launched in 2005 (Wong, 2013). Currently, this software is widely used by researchers worldwide due to its open access, user-friendly interface, and comprehensive reporting (Wong, 2013).

According to Henseler et al. (2016), PLS is the most evolved variance-based SEM tool capable of describing the variance of endogenous constructs. Additionally, the ability of PLS-SEM to solve challenging modelling issues has attracted considerable attention from scholars, particularly in the social sciences (Hair Jr et al., 2014). Nonetheless, several arguments have been given to support PLS-SEM usage to gain academic recognition. Three critical explanations for this are non-normal data, small sample numbers, and formatively constructed structures (Hair Jr et al., 2014). Meanwhile, Roy et al. (2012) identified three critical motivations for employing the PLS technique. To begin, scholars permit the examination of formative latent variables independently. Second, there are trade-offs in sample size, data normality assumptions, and residual distributions; and third, the development of new PLS-based applications such as SPADPLS, Visual PLS, SmartPLS, and PLS Graph has been encouraged. This software increases one's comprehension and awareness of all matters and conditions of PLS (Miranda et al., 2012).

However, the primary reason for using PLS analysis is that it can estimate complex model setups or multiple measurement items, like mediating, moderating, or hierarchical component models (Hair et al., 2014). There are three explanations for using PLS-SEM as a statistical analysis method. It consists of three components: (1) PLS-SEM is capable of measuring both formative and reflective latent (unobservable) variables; (2) PLS-SEM reduces the assumption of multivariate normality; and (3) PLS-SEM is capable of capturing sample sizes that are too small, According to Hair et al. (2017), the minimal sample size should ensure that the statistical approach produces robust findings and that the model is generable. As a result, a PLS path model comprises two sub models, the first of which is referred to as the inner model or structural model. The relationships (paths) between the constructs are depicted in this model. While the second model is referred to as the outer model, they are often referred to as measurement models. It illustrates the connections between the constructs and the predictor variables (Hair et al., 2017; Wong, 2013).

SEM terminology - When designing latent variables in SEM, which are typically used in CB-SEM and PLS-SEM, each variable has its distinct expression. The independent variable (IV) is referred to as exogenous, whereas the dependent variable (DV) is referred to as endogenous. Moreover, the intervening variable is a mediator, and the moderator is referred to as a moderator. The SEM terminology will be summarized in the sense of PLS-SEM, one of the methods for estimating relationships (Hair et al., 2017), as shown in Table 4.12 below.

Table 4.12
SEM Terminology for Studied Variables

Variable	Variable measured
DV Endogenous	Organizational Performance
IV Exogenous	Pioneer-follower posture Technological Investment: Internal R&D Intensity of product Upgrades External Technology Sources Product and Process Technology
MV Moderator	External Environments

4.9.1.1 Measurement Model

The first stage in performing a PLS analysis is evaluating the measurement model, sometimes referred to as the outer model. It shows that it must be related to reflective and formative outer models for the measurement model to meet specific requirements for reliability and validity (Rigdon et al., 2015). Similarly, Henseler et al. (2012) described a measurement model as explicitly associated with reflective and formative measurement and analysis's reliability and validity measures. Therefore, it is critical to understand the difference between reflective and formative models to begin the analysis. According to Hair et al. (2014), a reflective measurement model has relationships between the latent variable and its indicators. By comparison, formative measurement models have associations between the variables and the latent variable.

4.9.1.2 Structural Model

The following move is to assess the structural model. The structural model, or inner model, denotes the causal relationships between the constructs and calculates the path coefficients (which relate to the intensity of the relationship between independent and dependent variables) (Sang et al., 2010). Following the completion of measurement models in this analysis, structural models must be performed to investigate the standardized path coefficients between variables. Combining measurement models and structural models is essential to create a more detailed structural equation model (Urbach & Ahleman, 2010). A structural model is a recursive form without a loop in the path model, and it must be constructed as a casual chain (Chin & Dibbern, 2010).

4.10 Data Collection Procedures

The data collection process entails the following stages:

- **The initial stage**

  The initial stage will concentrate on developing questionnaires based on existing literature. After establishing the questionnaire's content validity, it will be refined and updated based on responses from SMEs, which include academic and industry experts.

- **Step two**

  This stage will see the questionnaire distributed to manufacturing companies' top management levels, such as chief executive officer, chief operating officer, human resource director, general manager, or any other managerial level recognized by the Federation of Malaysian Manufacturers (FMM). The office's formal address, telephone number, and email address were collected from the Federation of Malaysian Manufacturers (FMM). All of the specifics are critical to ensuring that the data collection process goes smoothly.

- **Step three**

  Due to the high probability of non-responses due to failure to answer the questions, it is reasonable to follow up with respondents via phone call or email.

- **Step four**

  The fourth stage is critical because it allows the researcher to investigate the moderating impact of the external environment on the technology strategy and organizational performance of Malaysian manufacturing firms. The following section will perform data analysis using SPSS for descriptive statistics and Smart PLS for inferential statistics.

4.10 Summary of the Chapter

This chapter discussed the analysis methods used in the present study. As a result, chapter four justified and described the research design and methods, population sampling and the different approaches to the analysis. The purpose of this study is to investigate the moderating effect of the external environment on the relationship between technology strategy and organizational performance in Malaysian manufacturing companies. To evaluate the empirical data-based theories, descriptive analysis and cross-sectional research design will be used. The study objectives were accomplished by the use of quantitative data collection and analysis methods. In other words, by using a quantitative method research design strategy, the outcome has further strengthened the validity and reliability of this study. The following two chapters will discuss the findings of this report.

CHAPTER FIVE

FINDINGS AND ANALYSIS

5.1 Introduction

This chapter discusses the data analysis results in detail and summarises the study's findings. Path modelling employs SmartPLS 3.3 software. The collected data were checked and analysed using the Statistical Package for Social Sciences (SPSS) version 24 software. Additionally, SPSS was also used to run the descriptive statistical analysis. Thus, this section has been arranged accordingly. This chapter begins with the analysis of the data collection and data preparation in sections 5.2 and 5.3.

Moreover, to describe the demographic profile and descriptive analysis in sections 5.4 and 5.5. Following section 5.6 is to verify the measurement model for all constructs, and section 5.7 summarises the proposed theoretical model. Subsequently, the structural model and hypotheses testing validation, which includes direct and indirect relationship and moderating, are explained in section 5.8, and a summary of this chapter is provided in section 5.12.

5.2 Data Collection and Responses

This study's targeted population consists of 354 manufacturing companies based on the established directory of Malaysian Industries' 50th edition from the Federation of Malaysian Manufacturers (FMM). This current directory was taken from FMM, and it was officially published on 1st January 2019. A sample size table from Krejcie and

Morgan (1970) was referred to in terms of determining the sample size. The sample size for a population of 354 in 181 respondents with a sampling error of 5 percent. The manufacturing companies were randomly selected using randomizer software. The researcher tried to contact these 181 manufacturing companies. Questionnaires were distributed through email (as email is the medium of communication) and posted mail together with a QR code that linked the questionnaire to the established manufacturing companies in the northern region. An official letter enclosed with a questionnaire has been submitted highest-ranked ranked officers that include chief executive officers (CEOs) and highest-ranked executives. They are the most knowledgeable about their companies' technological decisions (Zahra & Covin, 1993; Zahra & Das, 1993), their environments (Keats & Hitt, 1998), and organizational performance. Multiple phone reminder calls (Traina et al., 2005) and short messaging service (SMS) (Sekaran, 2003) were sent to respondents who had not completed their surveys four weeks after they were emailed the questionnaire to boost response rates (Dillman, 2011).

Accordingly, within the six months of data collection activities has been carried out, an accumulated number of 108 questionnaires have been collected. This data collection activity gives a response rate of 60 percent based on Jobber's (1989) definition of response rate. Among these 108 questionnaires, 12 questionnaires were unusable because a significant part of those questionnaires was not completed by the participants and multivariate outliers that may affect the quality of the results (Tabachnick & Fidell, 2007). The remaining 96 usable questionnaires were analysed throughout this study. These usable questionnaires accounted for 53 percent of valid responses (see Table 5.1). It was deemed satisfactory by Sekaran and Bougie (2016), who stated that a 30 percent response rate is an adequate response rate for surveys as a method of research, and Cycyota and Harrison (2002), who have empirically surveyed the response rate of top management and executives and found that on average it is evidenced that 31 percent to 35 percent is the mean value that commonly found in several studies. The higher ranked in the organization hierarchy, the harder it will take to get the response from these respondents (Anseel et al., 2010). This response rate is common in survey studies, especially if the organization was chosen as the unit of analysis (Hadid et al., 2016). Studies on board of directors and top management team members would better produce a precision, credible and reliable result that emphasizes corporate strategies development than studies that focus on middle management (Mellahi & Harris, 2015). Other issues on surveys, such as incorrect response scales and inappropriate questions, also contributed to a lower response rate (Ulhassan et al., 2014). Thus, this study achieved a response rate of 53 percent, which is considered sufficient that exceeds the threshold of 31 percent to 35 percent of several studies in the field of business and management in the past.

Table 5.1
Data Collection and Responses

Response	**Frequency/Rate**
No. of distributed questionnaires	181
Returned questionnaires	108
Returned and usable questionnaires	96
Returned and excluded questionnaires	12
Questionnaires not returned	73
Response rate	60%
Valid response rate	53%

5.3 Data Preparation and Screening

Data screening is a crucial process that employs various methods in helping the researcher to identify any potential violations of the fundamental principles underlying the application of multivariate data analysis techniques, such as errors or missing data. Hence, initial data screening detects outliers and multicollinearity that requires some cleaning techniques to ensure its reliability, usability and trustworthiness. Therefore, it helps the researcher better understand the data collected for further analysis because any error could lead to data reliability issues such as violating normality and linearity, leading to homoscedasticity assumption.

In this study, every questionnaire returned was assigned with the serial number at the top of each questionnaire. This serial number prevent confusion and redundancy on respondent that returns questionnaire late. To systematically manage the questionnaire, the serial number was assigned to track and trace each questionnaire before the data were transferred into the SPSS software accordingly. All 108 questionnaires were checked thoroughly, and it was found that 12 questionnaires are incomplete and discarded. Since these respondents were either deliberately or accidentally failed to respond to one or more questions. Consequently, these questionnaires will not be used for this analysis. Therefore, a total of 96 remaining questionnaires have proceeded for the analysis of this study.

5.3.1. Data Coding and Detection of Entry Error

Coding is a vital process to code all the responses before or after the data collected, and it is an easier way to enter into a database (Hair et al., 2007). Coding aims to make it simple to identify items. As a consequence, every item on the questionnaire was assigned a number to facilitate data entry. The number and the unique name of the variable are used to determine the coding. This study employs a 6-point Likert scale, and it has been coded with 6 or 1 from high to strongly agree and low to strongly disagree. Following that, the code will be entered into a Microsoft Office Excel document that contains all of the questionnaire's constructs: organizational performance containing financial and non-financial are labelled as OP_F1 – OP_F7 and OP_NF1 – OP_NF3, respectively. Technology strategies are labelled accordingly: pioneer-follower posture as TS_PFP1 – TS_PFP9, technological investments: internal R&D as TS_TI10 – TS_TI17, the intensity of product upgrades TS_IPU18 – TS_IPU23, external technology sources as TS_ETS24 – TS_ETS27, and product and process technology as TS_PPT28 – TS_PPT33.

Consequently, external environments comprise dysfunctional competition, institutional support, environmental turbulence, strategic alliance for product development and political networking strategy are labelled separately as TCE_DC1 – TCE_DC4, TCE_IS1 – TCE_IS4, TCE_ET1 – TCE_ET4, TCE_SA1 – TCE_SA6 and TCE_PN1 – TCE_PN4. See Table 5.2 of data coding. Fortunately, no error has been found after keyed-in the data to check frequency. Moreover, questionnaire screening has been performed, and it was confirmed that no error was detected.

Table 5.2
Data Coding

Variables	**Code of items**
Technology strategy	TS_PFP1 – TS_PFP9
	TS_TI10 – TS_TI17
	TS_IPU18 – TS_IPU23
	TS_ETS24 – TS_ETS27
	TS_PPT28 – TS_PPT33
External environments	TCE_DC1 – TCE_DC4
	TCE_IS1 – TCE_IS4
	TCE_ET1 – TCE_ET4
	TCE_SA1 – TCE_SA6
	TCE_PN1 – TCE_PN4
Organizational performance	OP_F1 – OP_F7
	OP_NF1 – OP_NF3

5.3.2 Analysis of Missing Data

One of the most pervasive problems in data analysis is missing data (Tabachnick & Fidell, 2007). In light of the impact of missing data, the researcher took preventative steps beginning with the data collection process to reduce their frequency. The returned questionnaires have been rapidly checked from the beginning to the end to ensure all questions were adequately answered. The data transformed into the SPSS software. A preliminary round of descriptive statistics was performed whether or not any data was missing from this report. Unfortunately, the missing value was found for twelve respondents after the process of key–in the data was conducted. This kind of occurrence always happens when a respondent refused to answer certain items in the questionnaire (Hair et al., 2014). Therefore, the missing data had been treated by using SPSS and were removed for further analysis. This phenomenon is consistent with Hair et al. (2010) guideline that any case with > 50 percent missing data be omitted to the degree that the sample data remain adequate. Additionally, a method for dealing with missing data entails dropping the missing case. Missing data is appearance when the inconsequential missing value of 1 is revealed in the statistical information (Tabachnick & Fiddel, 2007).

For this purpose, SPSS was used to treat the value of replaced data to further analyse in the Smart-PLS. Similarly, data inspection and replacement are crucial since PLS-SEM is highly sensitive to missing data, signalling that it was evaluated well (Maiyaki & Moktar, 2011). Additionally, PLS software ignores data with missing values. Therefore, only 96 questionnaires were used in the following step of analysis using PLS software.

5.3.3 Analysis of Outliers

Another critical stage in data screening is the evaluation and handling of outliers. These findings imply that high case scores are likely to have a significant detrimental influence on outcomes (Maiyaki & Moktar, 2011). Outlier cases typically respond to a particular question or extreme responses to all questions (Hair et al., 2017). High or low-value extremes, a construct or a unique mixture of values across numerous constructs, differentiate the study from other approaches (Bryn, 2010). An outlier is a case in which the values are well above or below most other cases.

The outliers can be detected using a boxplot, which is particularly useful for identifying skewness and outliers (Zikmund et al., 2013). IBM SPSS defines as outliers if the following conditions have been made. Firstly, the value exceeds 1.5 box lengths from the edge of the box. Secondly, an asterisk (*) is assigned on extreme points that exceed three box lengths from the edge of the box. Several techniques have been proposed in dealing with outliers, either to correct data entry errors with mean values if missing value less than 5 percent or throw it out only the uncommon respondent from the data set (Hair et al., 2010; Hair et al., 2014).

The researcher found no extreme points in this study, but there are six outliers for the case 25, 36, 87 and 89 in three variables: intensity of product upgrades, product and process technology, and organizational performance, as illustrated in Figure 5.1. Therefore, the researcher had decided to replace with mean values for these three variables to 4.1684 (intensity of product upgrades), 4.0035 (product and process technology) and 4.2894 (organizational performance) for the data of 25, 36, 87 and 89.

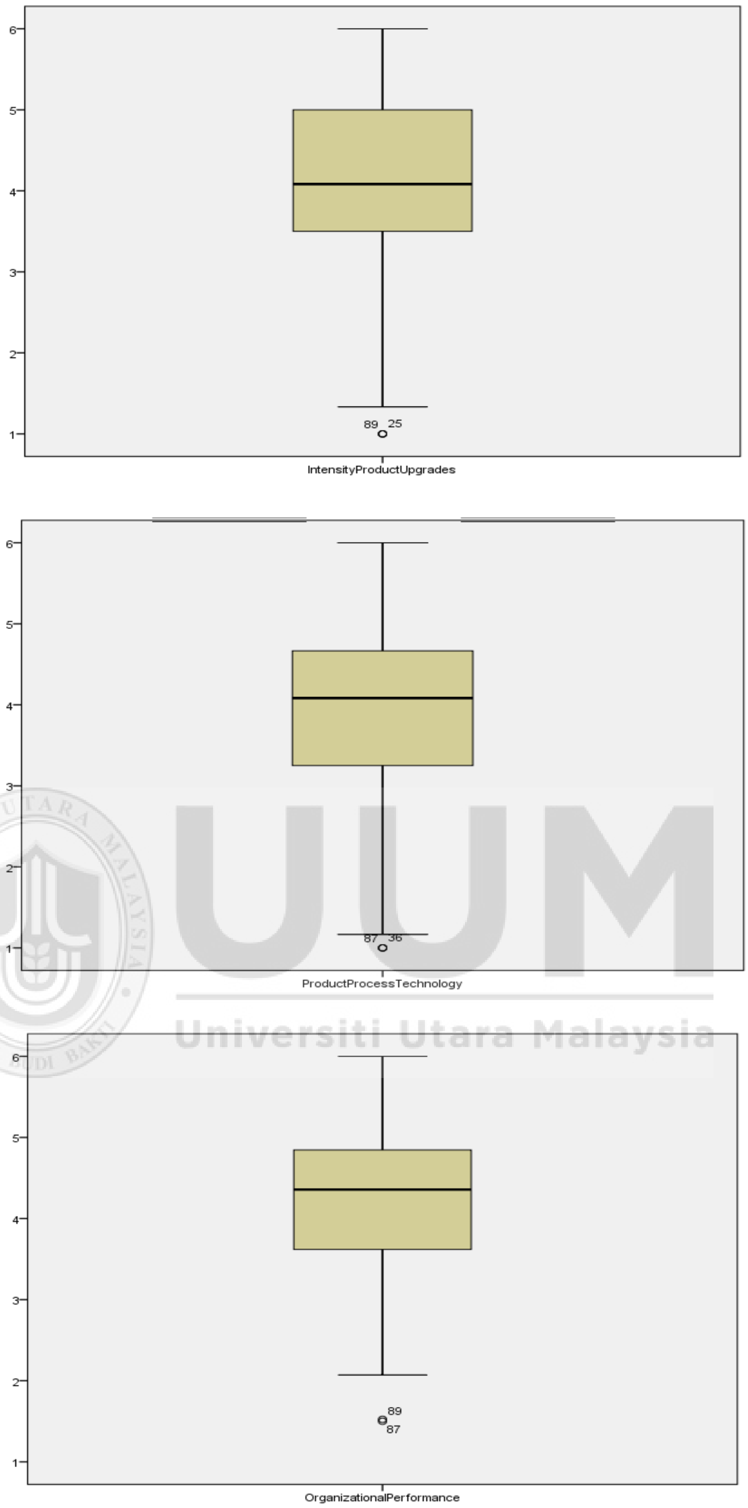

Figure 5.1
Boxplot of Outliers

5.3.4 Normality Test

Often time in research, it is essential to know if the distribution is normal. Moreover, this study observed most statistical procedures to fulfil the assumption of normality. Parametric statistical analysis is the best indication that the study conforms to the normality assumption. Studies are considered as within the parametric domain when the data distribution is normal. However, there are instances where the presumption of normality is violated, and as an outcome, result interpretation and inference can introduce biases or, in extreme cases, render the study invalid. As a result, these critical measures must be thoroughly tested to ensure that this presumption is met before conducting any further applicable statistical procedures. Fundamentally, there are three widely accepted rules of thumb for determining the validity of the normality assumption. The most convenient way is to use graphical techniques. The normal quantile-quantile plot (Q-Q plot) is another often-used technique for diagnosing data normality. Although the histogram, box plot, and stem-and-leaf plot are frequently used to verify the normality assumption.

In addition, other formal methods go beyond graphical methods that used numerical methods and formal normality tests to produce robust and conclusive evidence before making any conclusive decision about the normality of the data. The numerical methods include the skewness and kurtosis coefficients by considering a normal distribution. At the same time, the normality test is a more formal procedure that verifies whether the data follows a normal distribution. The Shapiro-Wilk and Kolmogorov-Smirnov tests are the two most frequently used normality tests available in statistical software.

Pearson (1895) attempted to develop techniques for detecting deviations from normality by focusing on the skewness and kurtosis coefficients (Althouse et al., 1998). Normality tests vary in their focus on the skewness and kurtosis values of the normal distribution. A linear relationship exists between the variable's distribution or characteristic function, and the standard normal variable Z. Skewness measures a distribution's asymmetry, while kurtosis measures its peakiness. In order to identify a normal distribution is when both skewness and kurtosis is zero (Hair Jr et al., 2014; Tabachnick & Fidell, 2013). Any values are considered normal if skewness and kurtosis are within +/- 1.96. Thus, the needed value has been extracted using SPSS, and it can be seen from the result of the skewness, and kurtosis analysis revealed that the computed z-values demonstrated in Table 5.3. The skewness and kurtosis measurement of normality should be as close to zero as possible in SPSS output. In reality, however, data are often skewed and kurtotic. All z-values are within +/- 1.96. In this study, organizational performance should be approximately normally distributed for each category of the independent variable. In conclusion, the data are a little skewed and kurtotic regarding skewness and kurtosis, but it does not differ significantly from normality. Therefore, it can be assumed that the data are approximately normally distributed in terms of skewness and kurtosis.

Table 5.3
Skewness and Kurtosis Analysis

	N	Mean	SD	Skewness			Kurtosis		
				S	**SE**	**z-value**	**S**	**SE**	**z-value**
Pioneer-Follower Posture	96	3.8565	1.16120	-.247	.246	-1.004	-.543	.488	-1.113
Technological Investments	96	3.1628	1.22624	-.108	.246	-0.440	-.450	.488	-0.922
Intensity Product Upgrades	96	4.1649	1.10488	-.472	.246	-1.920	-.012	.488	-0.025
External Technology Sources	96	2.9661	1.27971	.267	.246	1.085	-.915	.488	-1.875
Product Process Technology	96	4.0035	1.08848	-.305	.246	-1.240	.055	.488	0.113
External Environment	96	3.2936	0.86198	.306	.246	1.244	-.206	.488	-0.422
Organizational Performance	96	4.2833	0.81830	-.298	.246	-1.211	-.167	.488	-0.342
Valid N (listwise)	96								

The results of two well-known normality tests, the Kolmogorov-Smirnov test and the Shapiro-Wilk Test (Hair et al., 2017), are presented in Table 5.4 to ensure that the data are not abnormally out of normal. Normality tests compare the data set to the null hypothesis, stating that the data originate from a normally distributed population. Non-significant results mean that it is rational to behave as if the data set is normally distributed (or sufficiently close to it). The Shapiro-Wilk Test is more appropriate for small sample sizes (< 50 samples) but can also handle sample sizes as large as 2000.

Kolmogorov-Smirnov statistic assesses the normality of the distribution of scores. Table 5.4 shows non-statistical significant findings for pioneer-follower posture, intensity product upgrades, product process technology, external environment and organizational performance, but technological investments and external technology sources show statistical significant findings. Normality is shown by a non-significant result (**Sig.** value ≥ 0.05). So, pioneer-follower posture, intensity product upgrades, product process technology, external environment and organizational performance are normally distributed, but technological investments and external technology sources are not normally distributed.

Originally, the Shapiro and Wilk (1965) test needed a sample size of less than 50. This test was the first to detect deviations from normality caused by skewness, kurtosis, or both (Althouse et al., 1998). Due to its superior power properties have become the preferred test (Mendes & Pala, 2003). Therefore, this study uses the Shapiro-Wilk test as numerical means of assessing normality. Generally, the rule of thumb to indicate a normal distribution is if the **Sig.** value of the Shapiro-Wilk Test is greater than 0.05. Then the data is considered normal. If it is below 0.05, the data significantly deviate from a normal distribution. The null hypothesis for this test of normality is that the data are normally distributed. The null hypothesis is rejected if the p-value is below 0.05.

According to the Shapiro-Wilk's test ($p > 0.05$) (Shapiro & Wilk, 1965; Razali & Wah, 2011), as numerical means of assessing normality and a visual examination of the histograms, Q-Q plots and boxplots are normal. This finding indicates that organizational performance was normally distributed for the respective independent variable. The skewness of -0.247 (Standard Error = 0.246) and a kurtosis of -0.543 (Standard Error = 0.488) for pioneer-follower posture, skewness of -0.305 (Standard

Error = 0.246) and a kurtosis of 0.055 (Standard Error = 0.488) for product process technology, skewness of 0.306 (Standard Error = 0.246) and a kurtosis of -0.206 (Standard Error = 0.488) for external environment and skewness of -0.298 (Standard Error = 0.246) and a kurtosis of -0.167 (Standard Error = 0.488) for organizational performance are normally distributed but for technological investments, intensity product upgrades, and external technology sources are not normally distributed. Therefore, it is recommended to use PLS-SEM as a statistical tool for further analysis, as pointed out by Henseler et al. (2016). Fundamentally, the PLS technique does not require the assumption of normality to be fulfilled to use the SEM technique.

Table 5.4
Tests of Normality

	Kolmogorov-Smirnov[a]			**Shapiro-Wilk**		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Pioneer-Follower Posture	.079	96	.162	.982	96	.206
Technological Investments	.093	96	.040	.968	96	.020
Intensity Product Upgrades	.077	96	.188	.971	96	.031
External Technology Sources	.111	96	.005	.958	96	.004
Product Process Technology	.072	96	.200*	.981	96	.172
External Environment	.082	96	.115	.986	96	.405
Organizational Performance	.078	96	.185	.987	96	.472

*. This is a lower bound of the true significance.
[a]. Lilliefors Significance Correction
*. The distribution which the data was sampled from is not significantly different from normal.

5.3.5 Test of Multicollinearity

Multicollinearity is a condition that occurs when the independent variables are extremely interrelated, indicating a high value of r = 0.90 or greater (Tabachnick & Fidell, 2007). When two or more of the above constructs are excessively interrelated, they enclose unnecessary details and thus are not needed in the same analysis. Consequently, these cause an increase in the size of error terms while weakening the analysis (Maiyaki & Moktar, 2011). However, there are instances where the multicollinearity problem persists. This problem can be fixed by removing the offending variables. Hence, multicollinearity can be easily detected by analyzing the correlation matrix using SPSS, and a correlation value of r = 0.90 or above indicates the presence of multicollinearity (Hair et al., 2010). This study evidenced that all the highlighted values range between 0.328 to 0.718, which is less than 0.90 as in Table 5.5. Therefore, all variables will be retained, and it shows that the subject of multicollinearity does not exist in this study.

Table 5.5
Correlation among Variables

	PFP	**TI**	**IPU**	**ETS**	**PPT**	**EE**	**OP**
PFP	1.000	0.706	0.718	0.450	0.617	0.459	0.636
TI	**0.706**	1.000	0.607	0.483	0.478	0.381	0.520
IPU	**0.718**	**0.607**	1.000	0.342	0.573	0.446	0.644
ETS	**0.450**	**0.483**	**0.342**	1.000	0.328	0.549	0.391
PPT	**0.617**	**0.478**	**0.573**	**0.328**	1.000	0.472	0.362
EE	**0.459**	**0.381**	**0.446**	**0.549**	**0.472**	1.000	0.519
OP	**0.636**	**0.520**	**0.644**	**0.391**	**0.362**	**0.519**	1.000

Note: PFP, Pioneer-Follower Posture; TI, Technological Investments; IPU, The Intensity of Product Upgrades; ETS, External Technology Sources; PPT, Product and Process Technology; EE, External Environments; OP, Organizational Performance

Furthermore, SPSS also performed for collinearity diagnostics to pick up on problems with multicollinearity that may not be evident in the correlation matrix. Additionally, the Variance Inflation Factor (VIF) and the Tolerance level were investigated. The general rule of the cut-off points for determining the presence of multicollinearity indicate by VIF value exceed 10 or Tolerance value of less than 0.10 (Pallant, 2013; Hair et al., 2010). VIF is measured by the inverse of the Tolerance value (1 divided by Tolerance). The values above 10 indicate the existence of multicollinearity. Whereas, Tolerance value less than 0.10 (very small) indicates the tendency of multiple correlations among variables is high, consequently suggesting a greater chance of multicollinearity. Collinearity diagnostics of Table 5.6 demonstrate that tolerance ranges between 0.108 and 0.689 are significantly greater than 0.10. Similarly, a VIF range of 1.452 - 9.233 is acceptable since the value is 10 (Tabachnick & Fidell, 2007), indicating that multicollinearity is not a significant issue (Yong & Pearce, 2013). As a result, it is concluded that there is no issue of exogenous variable multicollinearity.

Table 5.6
Tolerance Level and VIF Value

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	1.465	.088		16.666	.000		
	Pioneer-Follower Posture	.148	.037	.211	3.993	.000	.137	7.306
	Technological Investments Intensity	.088	.029	.132	3.069	.003	.206	4.861
	Product Upgrades	.288	.044	.389	6.566	.000	.108	9.233
	External Technology Sources	.087	.032	.136	2.740	.007	.155	6.453
	Product Process Technology	.122	.036	.162	3.403	.001	.167	5.970
	External Environment	.006	.022	.007	.290	.772	.689	1.452

a. Dependent Variable: Organizational Performance

5.3.6 Non-Response Bias

Non-response bias is defined as a researcher's expectation of making a mistake when estimating a sample feature due to the under-representation of specific categories of survey respondents due to non-response (Berg, 2002). When there is a considerable disparity between survey responses and non-responses, the problem of non-response bias occurs (Lambert & Harrington, 1990). According to Singer (2006), a survey estimate is not always biassed if the response rate is below a certain threshold. There is no response rate, on the other hand, at which it is never biassed. There is a risk of bias regardless of the magnitude of the non-response bias, which must be investigated.

(Pearl & Fairley, 1985; Sheikh & Mattingly, 1981). It is vital to undertake a non-response bias analysis for this report because this condition will jeopardise the survey's validity.

Henceforth, Table 5.7 shows that two categories of respondents were categorised into primary independent samples according to an early and late response to questionnaires regarding seven study constructs. The constructs are as follows Pioneer – Follower Posture, Technological Investments, The Intensity of Product Upgrades, External Technology Sources, Product and Process Technology, External Environments and Organizational Performance. The most popular and normal method for testing for the bias in the non-responses in this study. The independent samples t-test compares those who responded from all the respondents to the distributed questionnaires during the period earlier than the end of September 2019 (early responses) to the individual who filled out questionnaires after September 2019 (late responses). Table 5.7 shows that on average denoted with the mean that indicates a significant variation in the responses, which can be seen in the given standard deviation for the early and late answers are distinctly diverse.

The organizational performance scores of early responses and late answers respondents were compared using an independent samples t-test. Table 5.8 presents the results of Levene's test for equality of variances. In this study given in the table below, a significance level for Levene's test is between 0.058 to 0.933. This result is larger than the cut-off of 0.05. This finding means that the assumption of equal variances has not been violated; therefore, Equal variances assumed is referred.

Table 5.8 indicates that there is no statistically significant difference between respondents who responded early and those who responded late based on Pioneer-Follower Posture (t -0.649, $p < 0.518$), Technological Investments (t -0.224, $p < 0.823$), Intensity of Product Upgrades (t 0.260, $p < 0.795$), External Technology Sources (t -1.748, $p < 0.084$), Product and Process Technology (t -0.250, $p < 0.804$), External Environment (t -0.304, $p < 0.762$) and Organizational Performance (t 0.051, $p < 0.959$). Based on the output obtained, the value exceeds the minimum threshold of 0.05. This value indicates that both responses show no statistically significant difference in the mean. The early responses respondent was not significantly different from late responses respondent. Therefore, it is viable to conclude that there are similarities between early and late respondents, hence no non-response bias dilemma.

Table 5.7
Group Descriptive Statistics for Early and Late Respondents

Variables	**Response Bias**	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
Organizational Performance	Early responses	49	4.2357	0.94950	0.13564
	Late responses	47	4.2266	0.76101	0.11100
Pioneer-Follower Posture	Early responses	49	3.7800	1.16501	0.16643
	Late responses	47	3.9362	1.19328	0.17406
Technological Investments	Early responses	49	3.1352	1.20595	0.17228
	Late responses	47	3.1915	1.25943	0.18371
Intensity of Product Upgrades	Early responses	49	4.1973	1.07242	0.15320
	Late responses	47	4.1383	1.14805	0.16746
External Technology Sources	Early responses	49	2.7449	1.23479	0.17640
	Late responses	47	3.1968	1.29792	0.18932
Product and Process Technology	Early responses	49	3.9763	1.02628	0.14661
	Late responses	47	4.0320	1.16025	0.16924
External Environment	Early responses	49	3.2776	0.84415	0.12059
	Late responses	47	3.3312	0.88440	0.12900

Table 5.8
Independent Samples T-Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Organizational Performance	Equal variances assumed	3.671	.058	.051	94	.959	.00907	.17608	-.34055	.35868
	Equal variances not assumed			.052	91.158	.959	.00907	.17527	-.33909	.35722
Pioneer-Follower Posture	Equal variances assumed	.007	.933	-.649	94	.518	-.15612	.24070	-.63404	.32179
	Equal variances not assumed			-.648	93.591	.518	-.15612	.24082	-.63431	.32206
Technological Investments	Equal variances assumed	.015	.904	-.224	94	.823	-.05629	.25162	-.55588	.44331
	Equal variances not assumed			-.223	93.319	.824	-.05629	.25185	-.55639	.44382
Intensity of Product Upgrades	Equal variances assumed	.008	.927	.260	94	.795	.05898	.22664	-.39102	.50898
	Equal variances not assumed			.260	92.875	.796	.05898	.22697	-.39174	.50970
External Technology Sources	Equal variances assumed	.272	.604	-1.748	94	.084	-.45191	.25849	-.96516	.06133
	Equal variances not assumed			-1.746	93.213	.084	-.45191	.25877	-.96575	.06193
Product Process Technology	Equal variances assumed	.146	.703	-.250	94	.804	-.05573	.22334	-.49917	.38771
	Equal variances not assumed			-.249	91.542	.804	-.05573	.22391	-.50047	.38901
External Environment	Equal variances assumed	.240	.625	-.304	94	.762	-.05365	.17642	-.40394	.29663
	Equal variances not assumed			-.304	93.268	.762	-.05365	.17659	-.40432	.29701

5.3.7 Common Method Variance

Common method variance (CMV), or so-called common method bias, usually occurs when responses systematically vary due to similarities in measurement methods derived from a single source data collection which could result in inflated relationships between variables (Green et al., 2016; Fuller et al., 2016; Conway & Lance, 2010). The issue of CMV can be problematic when a single factor appears from the factor analysis or one general account for the majority of the covariance among the measures (Podsakoff et al., 2003). Although the questionnaire of this study was adapted from several sources, it seems that this study using the standard type of scale for all constructs and items that will make things the same, which also have been addressed by Chang et al. (2010) and Podsakoff et al. (2003). Therefore, CMV is expected to happen in this study and might threaten the validity of the result. Consequently, to avoid any problems in the future, it is essential to identify any issues related to CMV.

Typically, it can be avoided if not using the measurement from the same person, similar item context and characteristics (Podsakoff et al., 2003). A few procedural remedies reduce CMV by the following four techniques; i) Separating independent variable and dependent variable data collection in different timing (physical separation). This technique could help the respondent to focus on what they are answering at that particular time; ii) Whereas, asking respondent something in between the independent variable and dependent variable first before asking dependent variable (psychological separation); iii) Employing different scale for the independent variable and dependent variable because standardization of the scale will make things the same and; iv) Not grouping items in the questionnaire by giving a header for the context and respondent will answer more consistently.

Harman's single factor test was conducted (Yeap et al., 2016) using SPSS to evaluate the number of biases inherent in the variance proportion distribution of items. Harman's approach was used to examine unrotated factor solution by taking all items in exploratory factor analysis (EFA), including dependent variable and check for unrotated first factor should be less than 50 percent (Podsakoff & Organ, 1986) on all the observed indicators (including dependent variable). The result had discovered that unrotated the first factor is 41.65 percent, which is less than the threshold level of 50 percent of total variance explained. This finding implies that CMV is not an issue in this study.

5.4 Demographic Profile of the Respondents

Table 5.9 summarizes the profiles of respondents in this study. 96 complete questionnaires were analyzed. This response rate of 53 percent is considered satisfactory since the researcher comes from a culturally similar environment and observes that responding to email and mail questionnaires is not widely accepted among manufacturing companies in Malaysia. The response rate was relatively high compared with other studies involving Malaysian companies (Mohamad & Wheeler, 1996). Demographic data in this study explain gender, types of company and position in the respondents' company.

Table 5.9
Profile of Respondents

Characteristics	Background Information	Frequency	Percentage
Gender	Male	71	74
	Female	25	26
Types of company	Multinational companies (MNCs)	22	22.9
	Joint venture (JV)	9	9.4
	Locally – owned (LO)	56	58.3
	Purely foreign – owned company (FO)	9	9.4
Position	CEOs	7	7.3
	Division or Group General Manager	12	12.5
	R&D/Technology Manager	7	7.3
	Financial Officer	13	13.5
	Strategist or Planner	9	9.4
	Human Resource Manager	5	5.2
	Managing Director	8	8.3
	Deputy Managing Director	2	2.1
	Factory Manager	11	11.5
	Others	22	22.9

96 usable responses were collected, with 71 (74 percent) male and 25 (26 percent) female respondents. There is slightly more male than female in this study. Manufacturing companies were categorised into the types of company as follows (MNCs, JV, LO and FO); thus, a critical study of how different types of businesses apply technology strategy and how this can be linked to organizational performance should be conducted. This knowledge is considered helpful because it is common for companies classified as MNCs to employ a technology strategy consistent with their parent company's culture. It was discovered that 67.7 percent of manufacturing companies surveyed were predominantly locally-owned, comprising 56 companies and 9 joint ventures. Whereas 22.9 percent are MNCs and 9.4 percent are purely foreign companies. This phenomenon means that the majority of the type of companies are locally – owned company which is 56 manufacturing companies.

Analysing senior manager's responses involved in strategic decision-making within manufacturing companies is the objective of the survey. While involvement by the CEO would have been perfect, replies from different levels of management were appropriate because they are a part of the team that participates in the associated decision-making process. Moreover, evidence indicates that a very large sample across diverse organisations shows that R&D managers at all levels were rated as less effective leaders than non-R&D managers. R&D executives were examined separately, and they too were rated as less effective than their non-R&D counterparts (Gritzo et al., 2017). The survey sampled CEOs/GMs/MDs/Senior Managers of manufacturing companies. Although the study was directed at CEOs, 13.5 percent (13) of respondents were Financial officers, 12.5 percent (12) were Division or Group General Managers, 11.5 percent (11) were Factory managers, 9.4 percent (9) were Strategist/planner, 8.3 percent (8) were Managing Directors, 7.3 percent (7) R&D/technology managers, 7.3 percent (7) were CEOs, 5.2 percent (5) were Human Resource managers, 4.2 percent (4) were Production managers, 3.1 percent (3) were Sales managers, 3.1 percent (3) were Senior managers, 2.1 percent (2) were Deputy Managing Directors, 2.1 percent (2) were Business Development managers, 2.1 percent (2) were Operation managers, 2.1 percent (2) were Purchasing managers, 2.1 percent (2) were Programmer, 2.1 percent (2) were Senior engineer, 1 percent (1) were Quality managers, 1 percent (1) Engineering manager and 1 percent (1) were Service manager. Therefore, these respondents predominantly consist of Financial Officers (13.5 percent). This study improves on a previous study by Sikander (2011) and Edler et al. (2002), which involved only senior R&D Managers in a STEM benchmarking study in Western Europe, North America, Japan, and Malaysia technology-intensive companies.

Table 5.10
Grouping According to Position Titles

	Frequency	Percentage
Group 1 Senior executive management		
CEOs	7	7.3
Division or Group General Manager	12	12.5
Managing Director	8	8.3
Total	**27**	**28.1**
Group 2 Second level management		
Deputy Managing Director	2	2.1
Factory Manager	11	11.5
Total	**13**	**13.6**
Group 3 Functional management		
R&D/Technology Manager	7	7.3
Financial Officer	13	13.5
Strategist or Planner	9	9.4
Human Resource Manager	5	5.2
Business Development Manager	2	2.1
Engineering manager	1	1
Operation manager	2	2.1
Production manager	4	4.2
Programmer	1	1
Purchasing manager	2	2.1
Quality manager	1	1
Sales manager	3	3.1
Senior engineer	2	2.1
Senior manager	3	3.1
Service manager	1	1
Total	**56**	**58.3**

Table 5.10 demonstrates that most of the respondents belonged to Group 3 functional management, and within this group, Financial Officers are predominant.

5.4.1 Organization Background

Table 5.11 shows the business background of the respondents involved in this study. The majority of the manufacturing companies surveyed (74 percent) employed between 50 and 3000 employees. Only five manufacturing companies reported having more than 3000 employees, while twenty manufacturing companies reported having fewer than 20 employees. Table 5.11 shows the distribution of employees by firm size.

According to the data, 33.3 percent of the manufacturing companies surveyed have been in the electrical, electronic, computing machinery parts industry, 20.8 percent were non-metallic mineral products, basic metal and fabricated metal products, machinery and equipment, and 11.5 percent were petroleum, chemical, rubber and plastic. The data for this survey was derived from the Federation of Malaysian Manufacturers (FMM) Directory (2019) for the entire industry.

A total of 100 percent of all respondents stated that their company engages in research and development. Whereas, 30 percent of respondents indicated that their R&D department had less than 5 employees, and 24 percent indicated that their R&D department had between 5 to 10 employees. Additionally, the findings show that the proportion of engineers with field experience of more than 5 years was relatively high (62 percent). Additionally, 31 percent of respondents reported that their average sales turnover was between RM101 million and RM500 million. Only 8.3 percent of respondents recorded turnover between RM501 million and RM1000 million. Only one respondent stated that their business produced USD8 billion in turnover.

Table 5.11
Organization Background

Organization Background	Background Information	Frequency	Percentage (%)
Number of employees	< 50	20	20.8
	50 – 300	40	41.7
	301 – 1000	20	20.8
	1001 – 3000	11	11.5
	More than 3000	5	5.2
Main industry	Manufacture of food products, beverages and tobacco	10	10.4
	Textile, wearing apparel, leather and footwear	0	0
	Wood, furniture, paper products and printing	5	5.2
	Petroleum, chemical, rubber and plastic	11	11.5
	Non-metallic mineral products, basic metal and fabricated metal products, machinery and equipment	20	20.8
	Electrical, electronic, computing machinery parts	32	33.3
	Transport equipment and other manufacturers	8	8.3
	Other manufacturing activities	10	10.4
Number of workers in R&D Department	< 5	30	31.3
	Between 5 and 10	24	25.0
	Between 11 and 20	13	13.5
	More than 21	29	30.2
A engineers in R&D Department having field/R&D experience	1 – 3 years	28	29.2
	3 – 5 years	6	6.3
	More than 5 years	62	64.6
Average sales turnover	< RM25 million	25	26.0
	Between RM25 million and RM100 million	24	25.0
	Between RM101 million and RM500 million	30	31.3

	Between RM501 million and RM1000 million	8	8.3
	Between RM1001 million and RM2000 million	4	4.2
	> RM2000 million	1	1
	Between RM3 billion and RM4 billion	1	1
	RM1 billion	2	2.1
	USD8 billion	1	1

The aforementioned research showed the following characteristics of the sample used in this study. It was slightly more males (74 percent) in this study; it consisted of 28.1 percent Senior executive management (CEOs, Division or Group General Manager, Managing Director), 13.6 percent Second level management (Deputy Managing Director, Factory Manager) and 58.3 percent Functional management; most (79.2 percent) companies have more than 50 workers; and about 31.3 percent of the companies had average sales turnover between RM101 million and RM500 million. These characteristics reflected the Malaysian industrial environment as a whole in early 2020. Those responses came from top management, senior executive management, second-level managers, and functional managers, which gave the researchers confidence indicated answers to strategy-related variables were genuine.

5.5 Descriptive Analysis of Construct

Descriptive analysis was performed for this study in evaluating the basic statistical description of constructs used. Descriptive statistics, namely mean, standard deviation, minimum and maximum, were conducted for all constructs such as independent, moderating and dependent. Thus, Table 5.12 shows the results of all statistical values measured through a six-point scale.

Table 5.12
Descriptive Analysis of Constructs

Constructs	N	Mean	Std. Deviation	Minimum	Maximum
Pioneer-Follower Posture	96	3.8565	1.17533	1.00	6.00
Technological Investment	96	3.1628	1.22624	1.00	6.00
The Intensity of Product Upgrades	96	4.1649	1.10488	1.00	6.00
External Technology Sources	96	2.9661	1.27971	1.00	6.00
Product and Process Technology	96	4.0035	1.08848	1.00	6.00
External Environments	96	3.2936	.86198	1.00	6.00
Organizational Performance	96	4.2833	.81830	2.00	6.00

Results of the statistical values reveal that the mean value of pioneer – follower posture is 3.8565, technological investment: internal R&D is 3.1628, the intensity of product upgrades is 4.1684, external technology sources is 2.9661, product and process technology is 4.0035, external environments are 3.2936, and organizational performance is 4.2833. The organizational performance, which has reached the highest mean among other constructs, shows that the efficiency to focus on organisation's profit by focusing on the number of the new product to be launched, focus on the time to market launch and focus on improvement and re-engineering process are essential which most of the respondents are responded to a high level.

The second highest mean is achieved in the intensity of product upgrades shows that manufacturing companies have placed a significant concern on the frequency and the number of new products being introduced in the market. The third highest mean scored by these manufacturing companies is product and process technology. The variable emphasises the extent to which new technology is incorporated into the manufacturing plants and processes of the company. Consequently, the pioneer – follower posture has fallen at the fourth-highest mean that emphasises the company's inclination to use technology to position itself strategically. Next, the fifth-highest mean is external environments signifying how the manufacturing companies will grab all the opportunities and avoid threats to maximise organizational performance. Technological investment is the sixth-highest mean that emphasises the extent to the methods by which companies are sponsoring their R&D activities while focusing on achieving the desired ROI. Finally, external technology sources variable generated as the lowest mean values, which indicate the extent to which the manufacturing companies use strategic collaboration, licensing, takeover, and outright acquisitions of technology from third parties or external sources.

5.6 Assessment of Models

This study employed Partial Least Squares Structural Equation Modeling (PLS-SEM) method to analyse using SmartPLS as suggested by several past studies (Hair et al., 2016; Sarstedt et al., 2014; Hair et al., 2013) to develop a framework for technology strategy by focusing on the constructs that clarified its effect on the exogenous variables in this analysis. Additionally, SmartPLS incorporates techniques for bootstrapping and blindfolding. Bootstrapping is a method that is carried out on 96 responses out of 500 samples. In order to determine the intensity of the relationship between the hypotheses, this study employed blindfolding procedure to verify the significance level of loadings and the path coefficients. According to Hair et al. (2016), who suggested evaluating and reporting techniques were adopted from a guideline. Hence, this procedures are mainly categorised into measurement model and structural model. The bootstrapping procedure was conducted for the hypothesis testing. On the equal weight, the structural model analysis determined the effect size of the construct and its predictive relevance to the study.

Each criterion evaluate the reflective measurement models while addressing the structural model see Table 5.13.

Table 5.13
Systematic Evaluation of PLS-SEM Results

Model	**Criterion**
Evaluation of the Measurement Models (Reflective Measurement Models)	• Ascertaining internal consistency reliability (Cronbach's alpha, composite reliability) • Ascertaining convergent validity (indicator reliability, average variance extracted, AVE) • Ascertaining discriminant validity
Evaluation of the Structural Model	• Coefficients of determination (R^2) • Predictive relevance (Q^2) • Size and significance of path coefficients • f^2 effect sizes • q^2 effect sizes

Note. Hair et al., 2017

5.7 Assessment of Measurement Model (Outer Model)

It is crucial to meet the criteria of reflective measurement models, which are their reliability and validity. Reliability tests the consistency a measuring instrument measures the concept it is measuring, whereas validity tests how well the instrument measures its intended measure. Those assessments are (1) indicator reliability, (2) composite reliability to evaluate internal consistency, and (3) validity to evaluate convergent validity and discriminant validity. The Fornell-Larcker criteria, cross-loadings, and, most importantly, the heterotrait-monotrait (HTMT) correlation ratio may all be used to assess discriminant validity. The general guidelines for assessing reflective measurement models were summarised in Table 5.14.

Table 5.14

Rules of Thumb for Evaluating Reflective Measurement Models

Types	Description
Indicator reliability	The indicator's outer loadings should be 0.70 or higher. Indicators with outer loadings between 0.4 and 0.7 should be considered for removal only if the deletion leads to an increase in composite reliability and AVE above the suggested threshold value. Outer loading is < 0.40 Delete the reflective indicator but consider its impact on content validity. Outer loading is ≥ 0.40 but < 0.70 Analyze the impact of indicator deletion on internal consistency reliability. Outer loading is ≥ 0.70 Retain the reflective indicator.
Internal consistency reliability	Composite reliability values of 0.60 to 0.70 are acceptable. Values between 0.70 and 0.90 regarded as satisfactory. Values below 0.60 indicate a lack of internal consistency reliability. Consider Cronbach's alpha as the lower bound and composite reliability as the upper bound of internal consistency reliability.
Convergent validity	The AVE should be higher than 0.5
Discriminant validity	Use the HTMT criterion to assess discriminant validity. The confidence interval of the HTMT statistic should not include the value 1 for all combinations of constructs. According to the traditional discriminant validity assessment methods, an indicator's outer loadings on a construct should be higher than all its cross-loadings with other constructs. The square root of the AVE of each construct should be higher than its highest correlation with any other construct (Fornell-Larcker criterion).

Note. Hair et al. (2017)

5.7.1 Indicator Reliability

The first step in reflective measurement models (outer model) involves examining how well the indicators (measures) load on the theoretically defined specific reflective constructs. Examining the outer model ensures that the survey items measure the constructs they are designed to measure, thus ensuring that the survey instrument is reliable. To determine indicator reliability, the researcher looked at their loadings to their respective constructs. Hair et al. (2017) suggested that the items can be retained if loadings range between 0.40 to 0.70. On the other hand, the loading considered satisfactory and significant if the item at least 0.7 (indicating that the construct explains more than 50 percent of the indicator's variance while confirming acceptable item reliability) and 0.5 level respectively (Wai Yee et al., 2016). However, the indicators with outer loadings between 0.4 and 0.7 should be considered for removal only if the deletion leads to an increase in composite reliability and AVE above the suggested threshold value (Hair et al., 2017). Hence, this study concurred that it is viable to use the rule of thumb suggested by Hair et al. (2017) with outer loading 0.5, which is considered significant.

The result of this study shows that only one outer loading was below the threshold of 0.4. Whereas the remaining outer loadings were above 0.5 and range between 0.546 and 0.920. These outer loadings can be categorized as significant loadings (moderate to strong). Nevertheless, it was noticed that AVE of the external environments below 0.5 indicates some of the outer loadings with low value must be terminated. The SmartPLS shows that 12 indicators were deleted from the model due to the low loadings ranging from 0.509 to 0.593. Indirectly, the AVE of the external environments had increased to 0.509. The result of outer loadings is presented in Table 5.15.

5.7.2 Internal Consistency Reliability

The subsequent step to assess the internal consistency reliability of the constructs is based on Cronbach Alpha (CA), composite reliability (CR) and rho values (Rho_A). Cronbach's alpha provides an estimate of the reliability based on the intercorrelations of the observed indicator variables. George and Mallery (2003) provide the following rules of thumb: *"_ > 0.9 – Excellent, _ > 0.8 – Good, _ > 0 .7 – Acceptable, _ > 0.6 – Questionable, _ > .5 – Poor, and _ < .5 – Unacceptable" (p. 231)*. Cronbach's alpha of 0.8 is acceptable. Cronbach's alpha indicates a high value while showing the scale's components have good internal consistency. For improved internal consistency of the data, composite reliability should be approved at 0.70 and above (Fornell & Larcker, 1981; Gefen et al., 2000; Hair et al., 2011). Composite reliability values of 0.60 to 0.70 are acceptable. While the values between 0.70 and 0.90 regarded as satisfactory. However, the latest study shows that Rho_A is a good measure of indicator reliability to look at unidimensionality because it much more accurate measure for the Cronbach Alpha (Imran et al., 2018). Rho-A estimates the squared correlation of the PLS construct score with real construct score and reliability coefficient value, and Rho ≥ 0.70.

Therefore, using SmartPLS standard algorism, the Cronbach alpha, composite reliability, and Rho_A of each variable are met the criterion that exceeded the minimum threshold value of 0.70. Table 5.15 shows the result of convergent validity, which include composite reliability of seven variables. Additionally, the composite reliability values vary between 0.914 and 0.956. According to Hair et al. (2017), composite reliability of 0.80 or greater is considered satisfactory. This study has achieved all threshold values of Cronbach's alpha, composite reliability and Rho_A. Thus the researcher concluded that the measurements of the items are reliable.

5.7.3 Constructs Validity

Construct validity of a measure is determined by how well the results obtained from its use match the theory that the test is based on (Sekaran & Bougie, 2010). Convergent and discriminant validity may be used to evaluate construct validity (Hair et al., 2017). The loadings and cross-loadings must be inspected to determine any issues with any of the items. Significantly, a cut-off value of 0.50 is chosen for loading (Hair et al., 2010). All items have a high load on that construct and a low load on the other constructs, indicating that the construct is valid.

5.7.3.1 Convergent Validity

Convergent validity measures the extent of the items, as suggested by Hair et al. (2013). It examines composite reliability, factor loadings and average variance extracted (AVE). The ideal value proposed by Hair et al. (2017) is 0.70 or higher, and any items below 0.70 should be analysed by the impact of an indicator deletion on internal consistency reliability. According to Hair et al. (2010), in order to obtain an acceptable level of convergent validity, it is required that factor loading of all the items $\geq$ 0.50, 0.60, 0.70 and average variance extracted (AVE) of constructs $\geq$ 0.50 value (Fornell & Larcker, 1981; Chin, 1998).

The results of this analysis indicate that all items meet the recommended value of 0.50 (Hair et al., 2010). This study obtained the AVE values exceeding (> 0.50), which is considered as high loadings on their respective constructs, which indicate an adequate convergent validity for this study (Chin, 1998). The composite reliability values indicate that all constructs are within the recommended range of 0.914 to 0.956, which means that convergent conclusions are reached. The average variance extracted (AVE) measures the variance captured by the indicators relative to measurement error. AVE has achieved the value of 0.50 and above (Bagozzi & Yi, 1988), and Table 5.15 depicting the outcome obtained from the measurement model.

Table 5.15
Results Summary of Measurement Model

Latent Variable	Items	Loadings[a]	AVE[b]	CR[c]	Rho_A	CA[d]
Pioneer-Follower Posture	PFP1	0.720	0.757	0.961	0.960	0.953
	PFP2	0.887				
	PFP3	0.909				
	PFP4	0.888				
	PFP5	0.881				
	PFP6	0.888				
	PFP7	0.903				
	PFP8	0.870				
Technological Investment	TI10	0.874	0.729	0.955	0.948	0.946
	TI11	0.822				
	TI12	0.709				
	TI13	0.868				
	TI14	0.874				
	TI15	0.904				
	TI16	0.871				
	TI17	0.891				
The Intensity of Product Upgrades	IPU18	0.827	0.782	0.956	0.805	0.802
	IPU20	0.864				
External Technology Sources	ETS24	0.917	0.741	0.920	0.803	0.802
	ETS25	0.910				
Product and Process Technology	PPT28	0.763	0.718	0.938	0.914	0.898
	PPT29	0.866				
	PPT30	0.855				
	PPT31	0.881				
	PPT33	0.893				
External Environments	TCE_DC1	0.695	0.509	0.919	0.913	0.903
	TCE_DC2	0.755				
	TCE_DC3	0.745				
	TCE_DC4	0.759				
	TCE_ET4	0.625				
	TCE_PN1	0.547				
	TCE_SA2	0.765				
	TCE_SA3	0.757				
	TCE_SA4	0.735				
	TCE_SA5	0.694				
	TCE_SA6	0.737				
Organizational Performance	OP_F1	0.729	0.543	0.914	0.895	0.894
	OP_F2	0.713				
	OP_F3	0.699				
	OP_F4	0.766				

OP_F5	0.777
OP_F6	0.715
OP_NF1	0.700
OP_NF2	0.758
OP_NF3	0.769

Note. Items removed: indicator items are below 0.6.

a. All Item Loadings > 0.5 indicates Indicator Reliability (Hulland, 1999)
b. All Average Variance Extracted (AVE) > 0.5 as indicates Convergent Reliability (Bagozzi & Yi, 1988; Fornell & Larcker, 1981)
c. All Composite Reliability (CR) > 0.7 indicates Internal Consistency (Gefen et al., 2000)
d. All Cronbach's Alpha > 0.7 indicates Indicator Reliability (Nunnally, 1978)

5.7.3.2 Discriminant Validity

The discriminant validity also called vertical collinearity. Discriminant validity testing has been conducted to validate the extent of the construct is genuinely unidentical to other constructs by employing empirical standards (Hair et al., 2014). In other words, discriminant validity testing also refers to the extent to which items uniquely different constructs or measuring distinct concepts. This testing is assessed by checking the correlations between measures of potentially overlapping constructs (MacKenzie et al., 2011). This study used three tests of discriminant analysis, cross-loading values, Fornell-Larcker and Heterotrait-Monotrait (HTMTinference) to measure the model's items.

According to Hair et al. (2014), the construct should be loaded strongly by the items. This evidence from the standardised loading estimates minimum of 0.05. This study exhibits a higher level of cross-loading that exceeds 0.7, which is considered an ideal value on the other constructs see Table 5.16. As anticipated, all items loaded onto their constructs well and suggesting no cross-loadings existed among items.

Second, the average variance shared between each construct, and its measures should be greater than the variance shared between the construct and other constructs (Compeau et al., 1999). Table 5.17 shows the discriminant validity of the constructs in which the squared correlations for each construct are less than the average variance extracted by the indicators measuring that construct, indicating adequate discriminant validity. As can be observed, the square root of all AVE values was greater than latent variable correlations (LVC). In summary, the measurement model exhibited convergent validity and discriminant validity. According to Hair et al. (2013), discrimination is lawful if the measured variable load exceeds a cross load value of at least 0.10. The findings of this study led to the sufficiency of discrimination validity.

Furthermore, previous researchers have proved discriminant validity's improved performance via a Monte Carlo simulation analysis (Henseler et al., 2015). As a result, Heterotrait-Monotrait (HTMT) testing has been carried out further to determine the discriminant validity analysis of this model. There are two ways of using the alternative approach of Heterotrait-Monotrait (HTMT) ratio of correlations to assess discriminant validity. (1) criterion – the HTMT value needs to be greater than HTMT.85, the value of 0.85 (Kline, 2011) or HTMT.90, the value of 0.90 (Gold et al., 2001), there is a lack of discriminant validity, and if the HTMT score is less than 0.85, discriminant validity between two constructs is attained (Kline, 2015; Gold & Arvind, 2001). (2) statistical test or referred to as HTMTinference – test the null hypothesis (H0: HTMT < 1) versus (H1: HTMT ≥ 1) (Henseler et al., 2015), HTMT95%

Confidence Interval contains the value 1 (for example, H0 holds means lack of discriminant validity which is not good).

Cross-loadings and the HTMT ratio were used to assess the model's external consistency in accordance with the discriminant validity criterion. Fornell and Larcker (1981) suggest that the AVE of the latent variable should be ≥ the squared correlations between the latent variables. The HTMT was devised to compensate for the insensitivity of the Fornell and Larcker (1981) and cross-loading criterion; HTMT values around 1 suggest a lack of discriminant validity (Henseler et al., 2015). The HTMT index is calculated as the average of heterotrait-heteromethod correlations divided by the average monotrait-heteromethod correlations. All HTMT index values should be < 0.90 to indicate discriminant validity (Henseler et al., 2015).

Table 5.16
Cross Loadings for Measurement Model

	EE	ETS	IPU	OP	PFP	PPT	TI
TCE_DC1	**0.695**	0.183	0.246	0.316	0.298	0.287	0.330
TCE_DC2	**0.755**	0.263	0.249	0.373	0.330	0.340	0.345
TCE_DC3	**0.745**	0.211	0.188	0.307	0.257	0.300	0.280
TCE_DC4	**0.759**	0.299	0.321	0.396	0.335	0.382	0.363
TCE_ET4	**0.625**	0.491	0.469	0.552	0.477	0.509	0.485
TCE_PN1	**0.547**	0.213	0.283	0.277	0.228	0.236	0.265
TCE_SA2	**0.765**	0.282	0.276	0.332	0.269	0.309	0.281
TCE_SA3	**0.757**	0.250	0.303	0.310	0.243	0.271	0.272
TCE_SA4	**0.735**	0.334	0.272	0.325	0.259	0.296	0.309
TCE_SA5	**0.694**	0.282	0.269	0.304	0.239	0.250	0.272
TCE_SA6	**0.737**	0.385	0.337	0.447	0.390	0.414	0.409
ETS24	0.391	**0.917**	0.639	0.743	0.719	0.671	0.607
ETS25	0.398	**0.910**	0.651	0.717	0.691	0.691	0.654
IPU18	0.417	0.651	**0.907**	0.720	0.667	0.685	0.627
IPU20	0.369	0.639	**0.920**	0.773	0.721	0.765	0.674
OP_F1	0.420	0.612	0.593	**0.729**	0.675	0.672	0.644
OP_F2	0.447	0.577	0.565	**0.713**	0.659	0.646	0.627
OP_F3	0.312	0.472	0.598	**0.699**	0.685	0.660	0.661
OP_F4	0.357	0.553	0.677	**0.766**	0.697	0.748	0.657
OP_F5	0.417	0.586	0.608	**0.777**	0.727	0.677	0.677
OP_F6	0.356	0.572	0.619	**0.715**	0.647	0.659	0.639
OP_NF1	0.362	0.560	0.505	**0.700**	0.685	0.625	0.641
OP_NF2	0.432	0.678	0.609	**0.758**	0.734	0.684	0.656
OP_NF3	0.405	0.682	0.643	**0.769**	0.708	0.709	0.651
PFP1	0.253	0.517	0.553	0.612	**0.720**	0.506	0.576
PFP2	0.376	0.656	0.633	0.776	**0.887**	0.697	0.692
PFP3	0.390	0.641	0.669	0.833	**0.909**	0.744	0.772
PFP4	0.487	0.694	0.694	0.861	**0.888**	0.794	0.763
PFP5	0.470	0.803	0.786	0.956	**0.957**	0.904	0.841
PFP6	0.361	0.721	0.707	0.866	**0.888**	0.780	0.746
PFP7	0.419	0.666	0.631	0.795	**0.903**	0.712	0.723
PFP8	0.315	0.627	0.581	0.769	**0.870**	0.688	0.695
PPT28	0.265	0.549	0.610	0.643	0.599	**0.770**	0.552
PPT29	0.432	0.598	0.634	0.710	0.655	**0.872**	0.650
PPT30	0.409	0.541	0.631	0.693	0.630	**0.856**	0.627
PPT31	0.396	0.619	0.670	0.780	0.682	**0.858**	0.670
PPT33	0.495	0.777	0.770	0.965	0.928	**0.966**	0.862
TI10	0.323	0.621	0.559	0.760	0.738	0.677	**0.874**
TI11	0.397	0.648	0.651	0.803	0.764	0.714	**0.822**
TI12	0.366	0.563	0.642	0.692	0.639	0.621	**0.709**

TI13	0.455	0.664	0.672	0.821	0.791	0.749	**0.868**
TI14	0.410	0.529	0.521	0.719	0.694	0.639	**0.874**
TI15	0.418	0.556	0.614	0.781	0.746	0.725	**0.904**
TI16	0.483	0.579	0.589	0.711	0.665	0.713	**0.871**
TI17	0.439	0.524	0.603	0.714	0.676	0.699	**0.891**

Note. ETS – External Technology Sources; EE – External Environments; IPU – The Intensity of Product Upgrades; OP – Organizational Performance; PFP – Pioneer-Follower Posture; PPT – Product and Process Technology; TI – Technological Investments

Table 5.17

Discriminant Validity (Fornell-Larcker Criterion)

	EE	**ETS**	**IPU**	**OP**	**PFP**	**PPT**	**TI**	**Convergent Validity met?**
External Environment	**[0.713]**							Yes
External Technology Sources	0.432	**[0.914]**						Yes
Intensity of Product Upgrades	0.429	0.706	**[0.913]**					Yes
Organizational Performance	0.528	0.799	0.818	**[0.837]**				Yes
Pioneer-Follower Posture	0.448	0.772	0.761	0.738	**[0.870]**			Yes
Product and Process Technology	0.483	0.745	0.795	0.818	0.848	**[0.843]**		Yes
Technological Investment	0.482	0.689	0.713	0.783	0.841	0.814	**[0.854]**	Yes

* The diagonal are the square root of the AVE of the latent variables and indicates the highest in any column or row.

Note. ETS – External Technology Sources; EE – External Environments; IPU – The Intensity of Product Upgrades; OP – Organizational Performance; PFP – Pioneer-Follower Posture; PPT – Product and Process Technology; TI – Technological Investments

Table 5.18
Discriminant Validity (Heterotrait-Monotrait Ratio ($HTMT_{inference}$) Criterion

	EE	ETS	IPU	OP	PFP	PPT	TI
External Environment							
External Technology Sources	0.478 CI$_{.900}$[0.320; 0.652]						
Intensity of Product Upgrades	0.483 CI$_{.900}$[0.291; 0.624]	0.881 CI$_{.900}$[0.761; 0.819]					
Organizational Performance	0.559 CI$_{.900}$[0.402; 0.688]	0.945 CI$_{.900}$[0.858; 0.942]	0.965 CI$_{.900}$[0.903; 0.933]				
Pioneer-Follower Posture	0.451 CI$_{.900}$[0.275; 0.606]	0.876 CI$_{.900}$[0.764; 0.979]	0.864 CI$_{.900}$[0.773; 0.948]	0.908 CI$_{.900}$[0.907; 0.977]			
Product and Process Technology	0.498 CI$_{.900}$[0.316; 0.638]	0.862 CI$_{.900}$[0.763; 0.968]	0.925 CI$_{.900}$[0.839; 0.907]	0.903 CI$_{.900}$[0.956; 0.964]	0.885 CI$_{.900}$[0.806; 0.939]		
Technological Investment	0.499 CI$_{.900}$[0.330; 0.629]	0.790 CI$_{.900}$[0.669; 0.909]	0.816 CI$_{.900}$[0.722; 0.898]	0.958 CI$_{.900}$[0.906; 0.912]	0.878 CI$_{.900}$[0.810; 0.930]	0.864 CI$_{.900}$[0.779 ;0.924]	

Note. ETS – External Technology Sources; EE – External Environments; IPU – The Intensity of Product Upgrades; OP – Organizational Performance; PFP – Pioneer-Follower Posture; PPT – Product and Process Technology; TI – Technological Investments

The third analysis to assess discriminant validity for this study is $HTMT_{inference}$. Table 5.18 shows there is discriminant validity between the external environments and pioneer-follower posture. It shows a correlation of 0.451, which is a very low correlation between that these two are two separate related variables, and that shows good discriminant validity. The study ensures that HTMT of the latent variable is very discriminant, and there is no confusion between the latent variable by the respondent. In other words, the lower the value of HTMT is, the better, as suggested by Henseler et al. (2014). $HTMT_{inference}$ score range between -1 to 1 $(-1<HTMT<1)$ indicates the two constructs are distinct from one another. As indicated in Table 5.18, the $HTMT_{inference}$ does not indicate discriminant validity problems in this study. Therefore, it can be concluded that the measures' discriminant validity is also established.

This study confirmed all constructs and completed the assessment of the measuring model. The subsequent section addresses the structural model examination.

5.8 Structural Model (Inner Model)

The second phase of the structural model analysis has been assessed. The purpose is to examine the hypothesized relationships between latent variables and the proposed model's significance level (Hair et al., 2014). This section will concentrate on the assessment of the structural model. The structural model results should be addressed after the confirmation regarding the reliability and validity of the construct measures. In Figure 5.2, there is a six-step theory behind what to do for the structural model. The first step is to look at the collinearity issues (Step 1). This step is to ensure that there is no multicollinearity between the latent variables.

The next step involves examining the structural model and focuses on the significance and relevance of the path coefficients (Step 2) and the model's explanatory power (the R^2 values) (variance explained) (Step 3), the effect size (f^2) (Step 4) as well as its predictive relevance (Q^2) (Step 5) (Roldán & Sánchez-Franco, 2012; Hair et al., 2014), and the q^2 effect size (Step 6). Model fit testing for PLS-SEM using metrics such as standardized root means squared residual (SRMR) (Henseler et al., 2016). The result of these criteria has been discussed further in the following section. Table 5.19 illustrates a systematic approach to evaluating the effects of structural models.

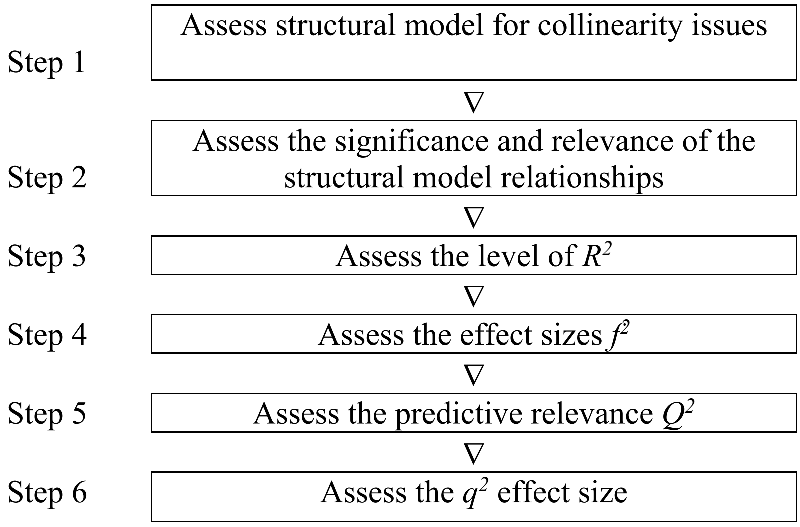

Figure 5.2
Structural Model Assessment Procedure

Table 5.19
Rules of Thumb for Structural Model Evaluation

Criterion	**Description**
Assess structural model for collinearity issues	Examine each set of predictors in the structural model for collinearity. Each predictor construct's tolerance (VIF) value should be higher than 0.20 (lower than 5). Otherwise, consider eliminating constructs, merging predictors into a single construct, or creating higher-order constructs to treat collinearity problems.
Estimates for path coefficients	Use bootstrapping to assess the significance of path coefficients. The minimum number of bootstrap samples must be at least as large as the number of valid observations but should be 5000. Critical t-values for a two-tailed test are 1.65 (significance level = 10%), 1.96 (significance level = 5%), and 2.57 (significance level = 1%). Alternatively, examine the p-value, which should be lower than 0.10 (significance level = 10%), 0.05 (significance level = 5%), or 0.01 (significance level = 1%). In applications, usually assume a 5% significance level.
Bootstrapping	Bootstrap confidence intervals provide additional information on the stability of path coefficient estimates. Use the percentile method for constructing confidence intervals. When models are not complex (i.e., fewer than four constructs) and the sample size is small, use double bootstrapping. However, the running time can be extensive.
R^2 of endogenous latent variables	PLS-SEM aims at maximizing the R^2 values of the endogenous latent variables in the path model. While the exact interpretation of the R^2 value depends on the particular model and research discipline, in general, R^2 values of 0.75, 0.50, or 0.25 for the endogenous construct can be described as respectively substantial, moderate, or weak.

	Use the R^2_{adj} when comparing models with different exogenous constructs and/or different numbers of observations.
Effect size f^2	The effect size f^2 allows assessing an exogenous construct's contribution to an endogenous latent variable's R^2 value. f^2 values of 0.02, 0.15 and 0.35 can be viewed as a gauge for whether a predictor latent variable has a weak, medium or large effect at the structural level.
Predictive relevance Q^2	Use blindfolding to obtain cross-validated redundancy measures for each endogenous construct. Make sure the number of observations used in the model estimation divided by the omission distance (*D*) is not an integer. Choose *D* values between 5 and 10. The resulting Q^2 values larger than 0 indicate that the exogenous constructs have predictive relevance for the endogenous construct under consideration.
Effect size q^2	The effect size q^2 allows assessing an exogenous construct's contribution to an endogenous latent variable's Q^2 value. As a relative measure of predictive relevance, q^2 values of 0.02, 0.15, and 0.35, respectively, indicate that an exogenous construct has a small, medium, or large predictive relevance for a certain endogenous construct.
Theory testing	For theory testing, consider using SRMR, RMStheta, or the exact fit test. Apart from conceptual concerns, these measures' behaviours have not been researched in a PLS-SEM context in-depth, and threshold values have not been derived yet. Following a conservative approach, and SRMR (RMStheta) value of less than 0.08 (0.12) indicates a good fit. Do not use the GoF to determine model fit.

Note. Hair et al., (2017)

5.8.1 Assess Structural Model for Collinearity Issues (Step 1)

In order to assess collinearity, tolerance and VIF values of the predictor constructs need to be applied (the same measures as those used to evaluate formative measurement models). Each set of predictor constructs was evaluated independently for each component of the structural model. Tolerance values < 0.20 (VIF values > 5) in the predictor constructs indicate crucial levels of collinearity in the PLS-SEM. The VIF values for all variables (endogenous (OP), exogenous (predictor) constructs) are shown in Table 5.20 (external technology sources, intensity of product upgrades, pioneer-follower posture, product and process technology and technological investments). As shown in Table 5.20, all VIF values are significantly less than the conventional threshold of 5. This finding demonstrates that no collinearity exists between the predictor constructs in this study.

Table 5.20

Result of Collinearity Test - Inner Variance Inflation Factor (VIF) Values

Constructs	ETS	EE	IPU	OP	PFP	PPT	TI
ETS				2.797			
EE				1.360			
IPU				3.064			
OP							
PFP				4.415			
PPT				4.992			
TI				4.002			

Note. ETS – External Technology Sources; EE – External Environments; IPU – The Intensity of Product Upgrades; OP – Organizational Performance; PFP – Pioneer – Follower Posture; PPT – Product and Process Technology; TI – Technological Investments

5.8.2 Assessment of Structural Model Path Coefficients (Assess the significance and relevance of the structural model relationships) (Step 2)

Direct Effects

In PLS analysis, the next step is to generate a model from the inner model. The hypothesis of direct effects needs to be tested and analyzed using path coefficients or Beta (β) (the path coefficient for the measurement model was determined by loadings). Path coefficient is used to measure the extent of the relationship strength between the variables. The path loadings between constructs were analyzed to determine their significance using calculated T-statistics. Path coefficient's rule of thumb can be identified if the value close to +1 specifies a strong positive relationship or otherwise for negative values. In contrast, it considers a weak relationship if the value nearer to 0 and sometimes indicates a non-significant relationship if very low values (Hair et al., 2014). There is variation in the path coefficients range between -1 and +1. Higher absolute values confirmed that there is a stronger (predictive) relationship between the constructs. Table 5.21 explains the path coefficient in detail. Significant values for t-values with two tails that are frequently used are 1.65 (significance level = 10 percent), 1.96 (significance level = 5 percent), and 2.57 (significance level = 1 percent) (Ramayah, 2014).

This study determined the significance level for loadings and path coefficients employing a bootstrapping procedure. Bootstrapping (hypothesis testing) estimates the spread, shape and bias of the sampling distribution of the population from which the sample under study is drawn. The SmartPLS assumed that the data set is not normal, so creating a bootstrap will help enhance sampling distribution to approaches normality, and that is why bootstrapping is good in SmartPLS because it helps overcome the problem of non-normality. The observed samples are treated as if they represent the population. Bootstrap creates a large, pre-specified number of samples, and every time sampling happens in bootstrap, the same number of cases as the original sample will be analyzed (n bootstrap>n samples) (Chin, 1998). Bootstrapping analysis is used to evaluate the direct effects of all the hypothesized relationships represented by statistical testing of the hypotheses. If t 0.05 > 1.96 (for a 2-tailed test), the hypothesis is supported (Peng & Lai, 2012). Hair et al. (2017) suggests assessing β and the corresponding t-values through a bootstrapping procedure with a resample of 500. This study ensures that the test for significance of all data has been performed using 500 bootstrapped samples. See Figure 5.3.

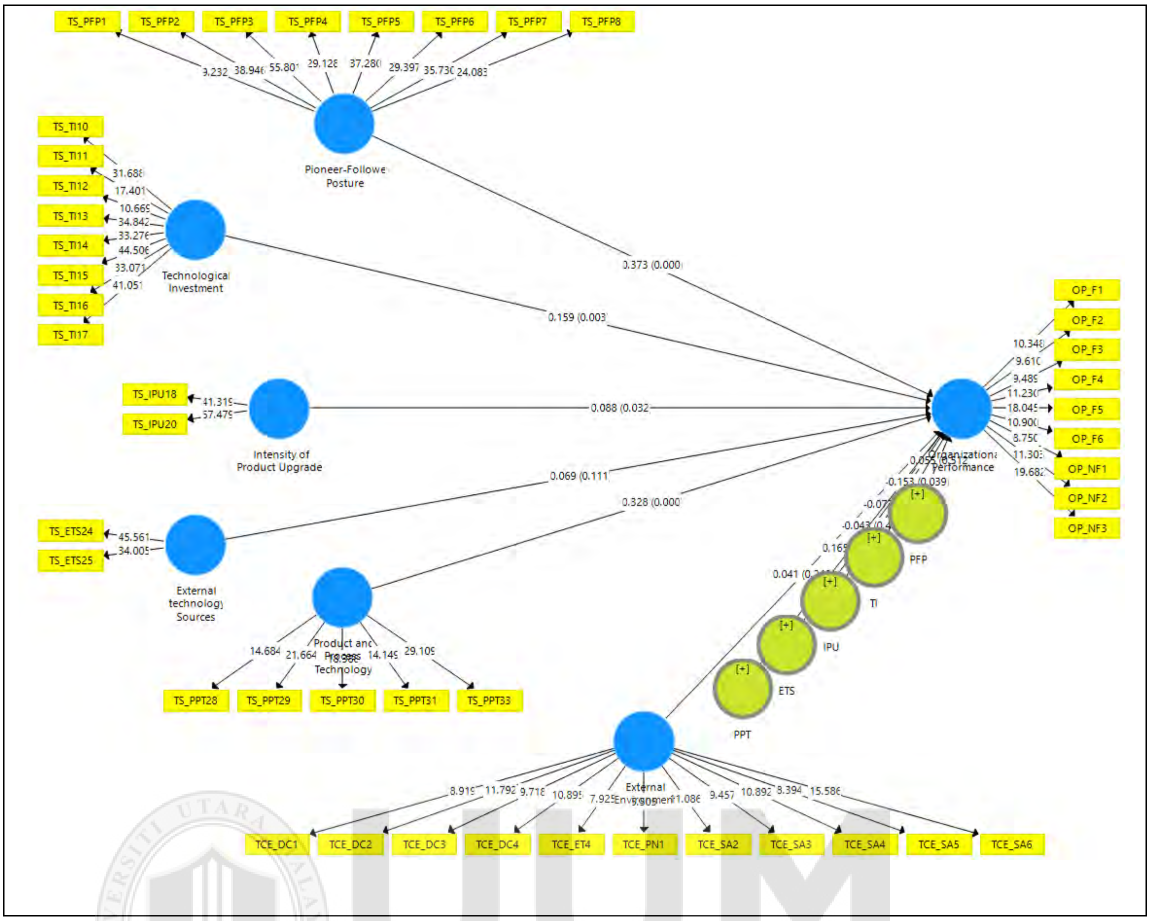

Figure 5.3
PLS Structural Model Path Coefficient and p-Values

Table 5.21
Hypothesis Testing

Hypothesis	Relationship	Std Beta (β)	Std Error	t-values	p-values	Decision	95% BCa CI
H1	PFP –> OP	0.373	0.062	6.042***	0.000	Supported	[0.262, 0.498]
H2	TI -> OP	0.159	0.052	3.066***	0.002	Supported	[0.054, 0.251]
H3	IPU -> OP	0.088	0.043	2.051**	0.041	Supported	[-0.004, 0.164]
H4	ETS -> OP	0.069	0.042	1.666*	0.096	Supported	[-0.006, 0.152]
H5	PPT -> OP	0.328	0.051	6.376***	0.000	Supported	[0.226, 0.434]
H6	PFP*EE -> OP	0.055	0.079	0.699	0.485	Not Supported	[-0.107, 0.210]
H7	TI*EE -> OP	-0.153	0.072	2.117**	0.035	Supported	[-0.276, 0.006]
H8	IPU*EE -> OP	-0.073	0.072	1.013	0.312	Not Supported	[-0.193, 0.081]
H9	ETS*EE -> OP	-0.043	0.049	0.866	0.387	Not Supported	[-0.149, 0.042]
H10	PPT*EE -> OP	0.165	0.058	2.857***	0.004	Supported	[0.031, 0.254]

Note: ETS, External Technology Sources; IPU, The Intensity of Product Upgrades; OP, Organizational Performance; PFP, Pioneer-Follower Posture; PPT, Product and Process Technology; TI, Technological Investments

*** p<0.01, ** p<0.05, * p<0.1

5.8.2.1 Direct Relationship between Pioneer – Follower Posture (PFP) (Exogenous) and Organizational Performance (Endogenous)

Research Question (Q1)	Does pioneer – follower posture have a relationship with the organizational performance of manufacturing companies?
Hypothesis 1 (H1)	There is a relationship between pioneer – follower posture and organizational performance of manufacturing companies.

Table 5.21 shows the direct effect of pioneer – follower posture and organizational performance as previously hypothesized associated standardized path coefficient (β), t-values, and p-values. Subsequently, Figure 5.3, as portrayed earlier, have explicitly

designated the standardized path coefficient (β) and t-values for the hypothesized relationships. The result indicates that the pioneer – follower posture is positively related ($\beta = 0.373$, $t = 6.042$, $p<0.01$) to the organizational performance of manufacturing companies. Thus H1 of this study is supported.

5.8.2.2 Direct Relationship between Technological Investments (TI) (Exogenous) and Organizational Performance (Endogenous)

Research Question (Q2)	Do technological investments have a relationship with the organizational performance of manufacturing companies?
Hypothesis 2 (H2)	There is a relationship between technological investments and the organizational performance of manufacturing companies.

The results show that technological investment positively impacts organizational performance ($\beta = 0.159$, $t = 3.066$, $p<0.01$); thus, the results support H2.

5.8.2.3 Direct Relationship between Intensity of Product Upgrades (IPU) (Exogenous) and Organizational Performance (Endogenous)

Research Question (Q3)	Does intensity of product upgrades have a relationship with the organizational performance of manufacturing companies?
Hypothesis 3 (H3)	There is a relationship between the intensity of product upgrades and the organizational performance of manufacturing companies.

Similarly, the result designates that the intensity of product upgrades has a positive relationship with organizational performance due to the b value is 0.088, whereas the value of $t = 2.051$ and the value of $p = 0.041$. It was shown that this hypothesis was found to be significant (β = 0.088, t = 2.051, $p<0.05$). Therefore, H3 was empirically supported.

5.8.2.4 Direct Relationship between External Technology Sources (ETS) (Exogenous) and Organizational Performance (Endogenous)

Research Question (Q4)	Do external technology sources have a relationship with the organizational performance of manufacturing companies?
Hypothesis 4 (H4)	There is a relationship between external technology sources and the organizational performance of manufacturing companies.

The result revealed in Table 5.21, that the external technology sources is positively related (β = 0.069, $p<0.1$) to organizational performance of manufacturing companies with t-values of = 1.666, and p-values = 0.096. Hence, the result has shown a significant relationship between external technology sources and organizational performance. Therefore, H4 is supported.

5.8.2.5 Direct Relationship between Product and Process Technology (PPT) (Exogenous) and Organizational Performance (Endogenous)

Research Question (Q5)	Do product and process technology have a relationship with the organizational performance of manufacturing companies?
Hypothesis 5 (H5)	There is a relationship between product and process technology and the organizational performance of manufacturing companies.

H5 is also supported. The results of this empirical study reveal that both constructs have a significant ($p<0.01$) positive effect (β = 0.328) between product and process technology and organizational performance.

5.8.3 Moderating Effects

Research Question (Q6)	Do the external environments moderate the relationship between technology strategy (pioneer – follower posture, technological investments, intensity of product upgrades, external technology sources and product and process technology) with organizational performance?
Hypothesis 6 (H6)	External environments significantly moderate the relationship between pioneer – follower posture and organizational performance.
Hypothesis 7 (H7)	External environments significantly moderate the relationship between technological investments and organizational performance.
Hypothesis 8 (H8)	External environments significantly moderate the relationship between the intensity of product upgrades and organizational performance.
Hypothesis 9 (H9)	External environments significantly moderate the relationship between external technology sources and organizational performance.
Hypothesis 10 (H10)	External environments significantly moderate the relationship between product and process technology and organizational performance.

Hypothesis 6 to Hypothesis 10 have been formulated to explain the moderating effects of external environments on the relationship between pioneer – follower posture, technological investments, the intensity of product upgrades, external technology sources and product and process technology towards organizational performance. In general, the word moderator refers to a qualitative or quantitative variable that modifies the direction and/or intensity of the relationship between the independent and dependent variables (Baron & Kenny, 1986). However, some scholars refer to the situation in which the magnitude of an impact varies (Aguinis et al., 2014). The association between two constructs in the model has been altered in terms of directional strength with the moderating variable (Hair et al., 2017), typically the case with a continuous moderator.

In this study, the researcher analyzed the moderating effect of external environments between pioneer – follower posture and organizational performance, the moderating effect of external environments between technological investments and organizational performance, the moderating effect of external environments between the intensity of product upgrades and organizational performance, the moderating effect of external environments between external technology sources and organizational performance and the moderating effect of external environments between product and process technology and organizational performance using PLS-SEM as recommended by Hair et al. (2017). Therefore, a standard bootstrapping procedure with 500 re-samples was applied to examine the significant impact of the interaction effects. The other result presented in the next section.

Prior to the discussion, it has been understood that there is a significant relationship between pioneer – follower posture, technological investments, the intensity of product upgrades, external technology sources and product and process technology towards organizational performance. Thus, this study hypothesized that the external environment theoretically moderates the influence of pioneer – follower posture, technological investments, the intensity of product upgrades, external technology sources and product and process technology on organizational performance with the value of $\beta = 0.059$, $t = 2.200$, $p < 0.05$. Depicted in Table 5.22 below is the result obtained through the moderating effects of external environments, which is further explained in the next section.

Table 5.22
Result of Direct Hypothesis

Path Coefficient	Std Beta (β)	Std Error	t-values	p-values	Decision	95% BCa CI
External Environments –> Organizational Performance	0.059	0.027	2.200**	0.028	Supported	[0.006, 0.110]

*** p<0.01, ** p<0.05, * p<0.1

5.8.3.1 Moderating Results

To empirically explore how external environments as a moderator influence the relationships between pioneer – follower posture and organizational performance, technological investments and organizational performance, the intensity of product upgrades and organizational performance, external technology sources and organizational performance, and product and process technology and organizational performance. This study adopted a two-stage approach. The study used SmartPLS 3.3 (Ringle et al., 2015) to create and estimate the model. The two-stage approach outperforms all the other approaches to operationalise the interaction term in terms of parameter recovery. The two-stage approach performs very much like the product-indicator approach with standardised indicator data in a model that only includes reflective measurement models. However, the two-stage approach is the superior option in PLS path models, including formatively measured constructs (Ali et al., 2018; Nitzl, 2016; Ringle et al., 2020). Additionally, Hair et al. (2017), assuming that the exogenous construct and moderating variable are examined reflectively, the analysis's objective determines the subsequent approach of option. When determining whether or not the moderator directly impacts the relationship, it is preferable to use a two-stage approach.

Therefore, Table 5.21 shows that the two-stage approach has been applied to obtain the desirable estimates to examine the relationship between exogenous and endogenous latent variables considering the external environment as the moderating effect. The findings in Table 5.21, on the other hand, did not support Hypothesis 6, which posited that the external environment moderates the relationship between pioneer – follower posture and organizational performance. This path is more significant (negatively) for manufacturing companies with a high external environment than for manufacturing companies with a low external environment. (β=0.055, t = 0.699, p>0.1).

On the other hand, one might remember that Hypothesis 7 claimed that external environments moderate the relationship between technological investments and organizational performance significantly. To be more precise, this path is weaker (less positive) for manufacturing companies with a high external environments compared to manufacturing companies with a low external environments. The interaction term (*technology investment * external environments*) had a statistically important negative effect on the relationship between technological investment and organizational performance shown in Table 5.21 (β=-0.153, t=2.117, p<0.05). The above result confirmed and supported Hypothesis 7.

The path coefficients were used to determine the relationship between technological investment and organizational success, following Jeremy Dawson's (http://www.jeremydawson.co.uk/slopes.htm) recommendations to plot the moderating effect of the external environments. The slope is much flatter for high external environments (moderator construct M), as shown in Figure 5.4. As a result, when external environments are high, the relationship between technological investment and organizational performance deteriorates. In other words, when external environments are at a high level, the relationship between technological investment and organizational performance is weaker, while when external environments are at a lower level, the relationship between technological investment and organizational performance is stronger.

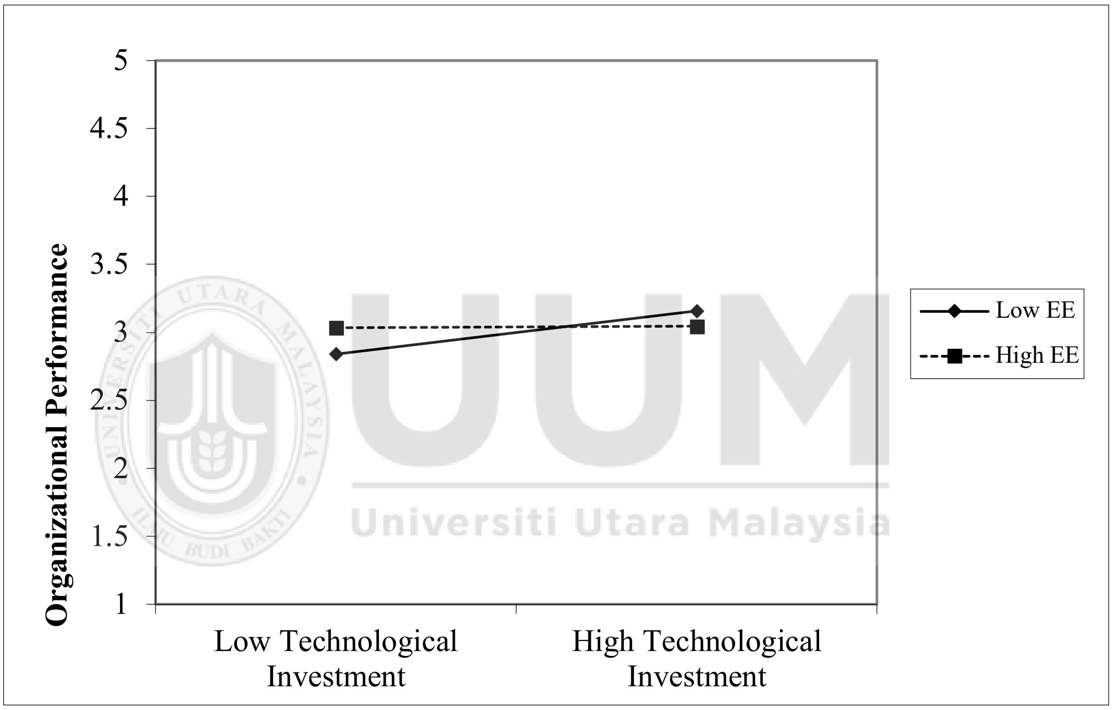

Figure 5.4
Interaction Effect of Technological Investment and External Environments on Manufacturing Companies

Hypothesis 8 posited that external environment moderate the relationship between the intensity of product upgrades and organizational performance. This relationship is greater (more negative) for manufacturing firms with a high external environment than those with a low external environment. The result shown in Table 5.21 did not support Hypothesis 8 (β = -0.073, t = 1.013, $p>0.1$). Similarly, Hypothesis 9, which predicted an interaction between external technology sources and the external environments with regard to their effect on the organizational performance, was not supported ($\beta = -0.043$, $t = 0.8866$, $p > 0.1$).

Finally, Hypothesis 10 stated that external environments significantly moderate the relationship between product and process technology and organizational performance. This relationship is greater (i.e. more negative) for manufacturing companies with a high external environment than those with a low external environment. That is, the relationship between product and process technology (*Y1*) and organizational performance (*Y2*) becomes more effective in the presence of strong external environments (*M*). This hypothesis was also supported because the interaction between the product and process technology and external environments in predicting organizational performance was significant ($\beta = 0.165$, $t = 2.857$, $p < 0.01$). Due to the positive moderating effect of the interaction term (product and process technology * external environment) on organizational performance, the moderator line indicates a higher slope. When the external environment is at a high level, the relationship between product and process technology and organizational performance becomes greater. The slope is much flatter when the external environment is low, as shown in Figure 5.5. As a result, when the moderator construct (external environments) is low, the relationship between product and process technology and organizational performance deteriorates.

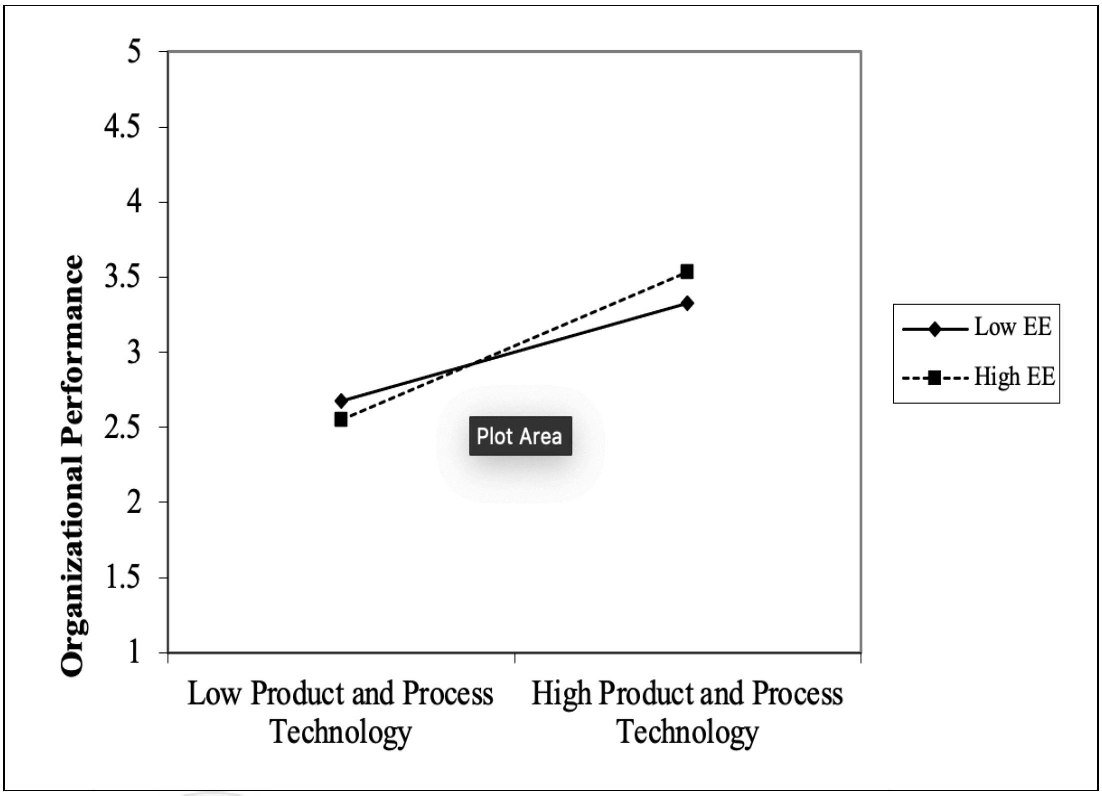

Figure 5.5
Interaction Effect of Product and Process Technology and External Environment on Manufacturing Companies

5.8.3.2 Determining the Moderating Effects' Strength

In terms of moderation, special attention should be emphasized to the interaction effect's f^2 effect size. Particularly, f^2 effect size indicates how much moderation helps to the clarifying of the endogenous latent variable.

$$f^2 = (R^2_{\text{model with moderator}} - R^2_{\text{model without moderator}}) / (1 - R^2_{\text{model with moderator}})$$

R^2 included and R^2 excluded represent the R^2 values of the endogenous latent variable when the moderator model's interaction term is included or excluded from the PLS path model, respectively. Cohen (1988) recommended that values of 0.02, 0.15, and 0.35 reflect small, medium, and high moderating effects. Aguinis et al. (2005), on the other hand, demonstrated that aggregate level the effect size in measuring moderation of 0.009. In light of that, Kenny (2016) suggests that 0.025, 0.01 and 0.005 are highly acceptable expectations for large, medium, and small effect sizes, respectively, but states that even these values are optimistic.

The interaction term's f^2 effect size for pioneer-follower posture has a value of 0.834. The value indicates a large effect. While *the* f^2 effect size of the technological investment has a value of 0.341, the value indicates a medium effect. On the other hand, the intensity of product upgrades and external technology sources have a value of 0.603 and 0.721. The value indicates a large effect. Whereas product and process technology has a value of 0.222, the value indicates a medium effect (Cohen, 1988; Henseler & Fassott, 2010).

5.8.4 Coefficient of Determination (R^2 Value) (Step 3)

In an effort to assess predictive power of the structural model is the coefficient of determination (R^2 value). This indicates that the variance of endogenous constructs are explained by all of the associated exogenous variables (predictor variable). (Barclay et al., 1995; Chin, 1998). This R^2 value is essential when calculating predictive relevance. R^2 values range from 0 to 1, with higher values suggesting increased predictive accuracy. The acceptable level of R^2 value is context-dependent (such as scope area of the study, the researcher manage to get the most appropriate respondent to answer the questionnaire etc). In this study, the R^2 value is 0.952, suggesting that 95.2% of the variance of organizational performance can be explained by pioneer-follower posture, technological investments, the intensity of product upgrades, external technology sources, product and process technology and the external environment. Following rules of thumb, the R^2 values of 0.25, 0.50 and 0.75 for the endogenous construct considered weak, moderate or substantial, respectively (Hair et al., 2011; Henseler et al., 2015). In summary, the R^2 for organizational performance is considered substantial.

5.8.5 Assess the Effect Sizes f^2 (Step 4)

Effect size f^2 evaluate whether the omitted construct has a substantive impact on the endogenous construct which, is also known as the effect size of the exogenous latent variable on the model. R^2 is used to predict the effect size f^2. Effect size f^2 assesses how strongly one exogenous construct contributes to explain a certain endogenous construct in terms of R^2. Below is the formula to calculate the effect size.

$$f^2 = (R^2_{included} - R^2_{excluded}) / 1 - R^2_{included}$$

$R^2_{included}$ and $R^2_{excluded}$ are the R^2 values of the endogenous latent variable included or excluded from the model. The change in the R^2 values is calculated by estimating the PLS path model twice. Once with the exogenous latent variable included (yielding $R^2_{included}$) and the second time with the exogenous latent variable excluded (yielding $R^2_{excluded}$). Rules of thumb as explain by Cohen (1988):

$$0.02 \leq f^2 < 0.15 : \text{weak effect}$$

$$0.15 \leq f^2 < 0.35 : \text{moderate effect}$$

$$f^2 \geq 0.35 : \text{strong effect}$$

According to Hair et al. (2017), f^2 values of 0.02, 0.15, and 0.35, respectively, indicate that an exogenous construct has small, medium, or large effects for a certain endogenous construct. Effect sizes smaller than 0.02 indicate a lack of substantiality.

The endogenous construct is organizational performance. To calculate the effect size for organizational performance, Y_1 represents pioneer-follower posture, Y_2 represent technological investments, Y_3 represent the intensity of product upgrades, Y_4 represent external technology sources, and Y_5 represent product and process technology. In this study, the R^2 included value is 0.952. In contrast, the R^2 excluded Y_1 value is 0.921, the R^2 excluded Y_2 value is 0.944, the R^2 excluded Y_3 value is 0.949, the R^2 excluded Y_4 value is 0.950, and the R^2 excluded Y_5 value is 0.936. Consequently, the exogenous constructs pioneer-follower posture has a large effect size of 0.646. While technological investment and product and process technology have a medium f^2 effect size of 0.167 and 0.333 for explaining the endogenous latent variable organizational performance. On the other hand, the intensity of product upgrades and external technology sources have a small f^2 effect size on organizational performance.

5.8.6 Assess the Predictive Relevance Q^2 (Step 5)

Q^2 is the predictive relevance criterion used to determine how well the model estimates the excluded data. Exogenous constructs' predictive relevance Q^2 is estimated using a blindfolding procedure in which the nth data point in the endogenous construct's indicators is omitted to allow for parameter estimation utilising the remaining data points (Chin, 1988; Henseler et al., 2009; Tenenhaus et al., 2005). The value of predictive relevance Q^2 should be more than 0. The value of predictive relevance Q^2 in this study for organizational performance is 0.504. Therefore, the Q^2 value shows that this study has a predictive relevance as the Q^2 for organizational performance is more than 0. In contrast, values of 0 and below indicate a lack of predictive relevance.

5.8.7 Assess the q^2 Effect Sizes (Step 6)

The predictive relevance can be computed by means of the measure to the q^2 effect size as follows:

$$q^2 = (Q^2_{included} - Q^2_{excluded}) / (1 - Q^2_{included})$$

Values of 0.02, 0.15 and 0.35 indicate small, medium and large predictive relevance, respectively, for a certain exogenous construct on the model. The endogenous construct is organizational performance. To calculate q^2 effect size for organizational performance, Y_1 represents pioneer-follower posture, Y_2 represent technological investments, Y_3 represent the intensity of product upgrades, Y_4 represent external technology sources, and Y_5 represent product and process technology. In this study, the Q^2 included value is 0.504. In contrast, the Q^2 excluded Y_1 value is 0.488, the Q^2 excluded Y_2 value is 0.495, the Q^2 excluded Y_3 value is 0.477, the Q^2 excluded Y_4 value is 0.490, and the Q^2 excluded Y_5 value is 0.496.

Consequently, the exogenous constructs pioneer-follower posture, technological investment, intensity of product upgrades, external technology sources and product and process technology for explaining the endogenous latent variable organizational performance have q^2 effect sizes of 0.032, 0.018, 0.054, 0.028 and 0.016, respectively. Hence the effect size of pioneer-follower posture on the endogenous latent variable organizational performance is small. The q^2 effect size of construct technological investment on the endogenous latent variable organizational performance is small. The q^2 effect size of construct intensity of product upgrades on the endogenous latent variable organizational performance is small. The q^2 effect size of construct external technology sources on the endogenous latent variable organizational performance is small, and the q^2 effect size of construct product and process technology on the endogenous latent variable organizational performance also has a small effect size.

5.9 Model Fit

Though PLS-SEM was designed initially as a tool for prediction purposes, numerous studies have broadened its application, especially for theory testing by developing model fit steps. Model fit indices allow for evaluation of the ideal in the hypothesised model's structure that matches the empirical evidence. Therefore, this could assist in the identification of model misspecifications. The researcher uses standardised root mean square residual (SRMR) to measure this study model fit. The researcher use standardised root mean square residual (SRMR) to measure this study model fit. Henseler et al. (2014) evaluated the standardised root mean square residual (SRMR) initially proposed in CB-SEM. The SRMR, on the other hand, behaves differently in CM-SEM and PLS-SEM. The discrepancy of the root mean square among observed and model-implied correlations is known as the standardised root mean square residual. If <0.1 or <0.08 indicates that the data fits the model (Henseler et al., 2014; Hu & Bentler, 1998). Due to the fact that the SRMR is used as an absolute measure of fit, which indicated by zero means perfect fit. The discrepancy arises during model estimation in PLS-SEM, where the objective of the explained variance of the endogenous was mainly used for optimisation. As a result, the SRMR value for this model was determined using the PLS algorithm, and it demonstrates a value of 0.078, indicating that the model is a good fit for this analysis.

5.10 Summary of Hypotheses Testing

The following Table 5.23 summarizes the hypotheses.

Table 5.23
Hypotheses Results for the Study

Hypothesis	Variables	Results
HI	There is a relationship between pioneer-follower posture and organizational performance of manufacturing companies.	Supported
H2	There is a relationship between technological investment and the organizational performance of manufacturing companies.	Supported
H3	There is a relationship between the intensity of product upgrades and the organizational performance of manufacturing companies.	Supported
H4	There is a relationship between external technology sources and the organizational performance of manufacturing companies.	Supported
H5	There is a relationship between product and process technology and the organizational performance of manufacturing companies.	Supported
H6	External environments significantly moderate the relationship between pioneer-follower posture and organizational performance.	Not Supported
H7	External environments significantly moderate the relationship between technological investments and organizational performance.	Supported
H8	External environments significantly moderate the relationship between the intensity of product upgrades and organizational performance.	Not Supported
H9	External environments significantly moderate the relationship between external technology sources and organizational performance.	Not Supported
H10	External environments significantly moderate the relationship between product and process technology and organizational performance.	Supported

5.11 Summary of the Chapter

This chapter outlines the statistical analysis performed throughout this study. The constructs' reliability and validity were evaluated in relation to the measuring model. In the structural model, the hypothesis statements were tested to answer the research questions and fulfil the research objectives. In brief, the study's findings show that pioneer – follower posture, technological investment, the intensity of product upgrades, external technology sources, product and process technology are significant predictors to organizational performance among manufacturing companies. Notably, when it came to the moderating effects of external environments on the relationship between the five predictor variables, the PLS path coefficients showed that only two of the five formulated hypotheses were important. External environments, in particular, contribute to the relationship's moderating effect between (1) technological investments and organizational performance and (2) product and process technology and organizational performance. The researcher addresses the study's findings in greater detail in the following sections, followed by implications, limitations, recommendations, and a conclusion.

CHAPTER SIX

DISCUSSION AND CONCLUSION

6.1 Introduction

This final chapter summarizes the findings from Chapter Five. It reflects the main ideas based on the research objectives, aiming to identify the technology strategies of Malaysian manufacturing companies and the relationship between constructs. This chapter consists of seven sections: Section 6.1 on Introduction; Section 6.2 on Recapitulation and summary of findings where the researcher concisely reiterates the research problem, research questions, research objective, methodology of the study, data sampling, data collection method and data analysis. Section 6.3 theories and past research are summarized while relating to the findings of this study concerning research objectives. Moreover, Section 6.4 and 6.5 elucidates the research implications and limitations of the study. Finally, Section 6.6 discusses possible future research directions, and Section 6.7 concludes this chapter by summarizing the study's findings. Following that, the researcher makes various recommendations based on the study's findings. This recommendation enables related parties to implement the policy and guideline based on the result in this study on manufacturing sectors. Furthermore, the researcher also points out several important areas in the technology strategy field to be further investigated by future researchers, particularly in manufacturing industries.

6.2 Recapitulation and Summary of Findings

Studies found that most companies failures are due to the lack of an effective technology strategy, whose case of a poorly conceived strategy was doomed to failure (Cooper & Edgett, 2009). Therefore, it is vital to identify the technology strategies employed and the factors of external environments, particularly in Malaysia, as discussed in Chapter One. Experienced top management or business leaders are highly anticipated to implement the best technology strategy because businesses with a lack of technology strategy lead to deficiency and are likely to undermine organizational performance. No known study empirically investigate this element specifically in the Malaysian context in comparison to the Western hemisphere. This research gap motivates the researcher to incorporated these elements in the study.

The study aims to identify the technology strategy of manufacturing companies. This study also examines the association of technology strategy and external environments in relation to organizational performance. Additionally, this study evaluates selected significant environmental factors as a moderating variable. These external environmental factors profoundly influence in terms of the intensity or direction of the relationship between manufacturing companies' technological strategy and organizational performance. In achieving the objectives, the researcher firstly identified the technology strategy of manufacturing companies' variables that determine technology strategies. The researcher proposed five constructs consist of pioneer – follower posture, technological investment: internal R&D, the intensity of product upgrades, external technology sources, and product and process technology.

In this study, these five constructs are examined to determine their relationship with organizational performance.

The literature reviewed, relevant theories and the Technology Strategy Model by Burgelman and Rosenbloom (1989) are the basis for developing this study's conceptual framework. The model is said to have a specific explanatory value of technology strategy, which combined many of the same basic dimensions, namely competitive positioning, technology and the value chain, the scope, and depth of technology strategy. The existing technology strategy model is adapted to the manufacturing companies context. The Resource-Based View theory (RBV) by Penrose (1959) and Resource Dependence Theory (RDT) by Pfeffer and Salancik (1978) are applied in this study.

Resource-Based View theory by Penrose (1959) stated that each organization is endowed and could be viewed as a collection of resources (Pisano, 2015; Di Zhang & Bruning, 2011). This theory is observed to examine the path between technology strategy and organizational performance. Hence, in this study, Resource-Based View theory explains the relationship between pioneer-follower posture, technological investments: internal research and development (R&D), the intensity of product upgrades, external technology sources, and product and process technology and organizational performance. Another theory applied in this study is Resource Dependence Theory (RDT) by Pfeffer and Salancik (1978). According to Resource Dependence Theory, resource dependence is postulated based on the idea that all organizations critically depend on each other to gain access while securing vital resources. This nature of dependence is commonly reciprocal.

Moreover, the theory equally stresses inter-organizational interdependencies to explain why formally independent organizations are involved in different kinds of inter-organizational engagements. Inter-organizational engagements include board interlocks, alliances, joint-ventures, in-sourcing, and mergers and acquisitions (Pfeffer & Salancik, 1978). As a result, this nature of arrangements enables organizations to benefit from interdependencies by bolstering their autonomy (or freedom to make decisions without outside interference) and legitimacy (or presumption of propriety stemming from conformity to social guidelines).

The essence of Resource Dependence Theory is that inter-organizational relationships refer to longer-term relationships between and among organizations (e.g., suppliers, customers, competitors, trade associations, and public sector organizations) that are pursuing a mutual interest while also remaining independent and autonomous, thus retaining separate interests. Hence, in this study, Resource Dependence Theory explains the relationship between dysfunctional competition, institutional support, environmental turbulence, strategic alliance for product development and political networking strategy and organizational performance.

As such, a conceptual framework was developed to test ten hypotheses in an effort to answer the following questions:

1. Does pioneer-follower posture have a relationship with the organizational performance of manufacturing companies?
2. Do technological investments have a relationship with the organizational performance of manufacturing companies?

3. Does intensity of product upgrades have a relationship with the organizational performance of manufacturing companies?
4. Do external technology sources have a relationship with the organizational performance of manufacturing companies?
5. Do product and process technology have a relationship with the organizational performance of manufacturing companies?
6. Do the external environments moderate the relationship between technology strategy (pioneer-follower posture, technological investments: internal R&D, the intensity of product upgrades, external technology sources, and product and process technology) with organizational performance?

The implementation of this research applies the quantitative data collection method. Two types of studies were identified: descriptive to describe the demographic of respondents, and inferential study which to test the relationship. Whereas the research design applied is a cross-sectional study. Validity was conducted using content validity and face validity to ensure the questionnaire is easy to understand by the respondents by three academicians and three highest-ranking executives from manufacturing companies. The expert review has validated that 16 indicators need to be deleted from 81 indicators or items to ensure the validity of the questionnaires. This study maintains the factor loading for items with values not more than a 0.5 threshold. Consequently, it has reduced items in the questionnaire. The measurement scale of this study is set at 6 Likert scales, while SPSS and SmartPLS 3 developed by Ringle et al. (2015) were performed to analyse the data.

The study's target population is manufacturing companies in the northern region of Malaysia from various industries, and 181 of sample size has been chosen. The sampling design is cluster sampling. The top management consisting of chief executive officers (CEOs) or highest-ranking executives from manufacturing companies is chosen as the sample of this study. The number of samples chosen is 181. 96 respondents returned the questionnaire and useable for data analysis.

The study's hypotheses were tested using Partial Least Squares – Structural Equation Modelling (PLS-SEM). This technique is primarily utilised in exploratory research to establish theories by drawing attention to the variance in dependent variables while assessing the model (Hair et al., 2011). This approach was ideal for this study since it made no assumptions about data distribution (Vinzi et al., 2010). Thus, PLS-SEM becomes a good alternative when the sample size is small, apply little available theory, predictive accuracy is paramount and correct model specification cannot be ensured (Bacon, 1999; Hwang et al., 2010; Wong, 2010). The PLS-SEM path method is typically applied in two stages: (1) The analysis of the measurement models (to measure the relationships between indicators and the variables) and (2) the analysis of the structural models (estimated to analyse the associations hypothesised in the research path model).

6.3 Discussion of Hypothesis Findings

The subsequent section focuses on several areas. Firstly, the construct of the technology strategy among manufacturing companies is discussed. Then, the structural model is evaluated in order to see whether the hypothesis is supported or otherwise.

The hypothesis statement was built based on the previous literature to examine the direct influence of the exogenous variables on the endogenous variable with the moderator variable. The following section elaborates on the influence of the exogenous variables pioneer-follower posture, technological investments: internal R&D, the intensity of product upgrades, external technology sources and product and process technology on the endogenous variable organizational performance of manufacturing companies. Consequently, external environments as a moderator variable that can be assumed to influence the relationship between technology strategy and organizational performance are discussed. As a result, only three hypotheses were not supported among the ten formulated hypotheses where the findings will be elaborated further in the next section.

6.3.1 Pioneer – Follower Posture and Organizational Performance

This part focused on the findings of the first research question in relation to the following research objective:

Research Objective 1 (RO1)	To examine the relationship between pioneer – follower posture and organizational performance in manufacturing companies.

It is hypothesized that the pioneer – follower posture has influenced organizational performance. Dasgupta et al. (2009) claimed that the company outperform rivals can be influenced by conserving the established uniqueness in terms of timing relative to rivals while considering the utilization of new technology commercially. In the context of manufacturing, these companies prefer to embrace the pioneering or technology leadership posture, which essentially chooses with respect to lead time while taking into account this factor to lead their competitors (Reick & Dickson, 1993). According to Lieberman and Montgomery (1988), the research and development (R&D) by these companies are mainly emphasize a pioneering or a technology leadership posture. The effort is primarily focused on innovations deriving from state-of-the-art technologies while considering the potential first-mover advantages.

In contrast, low-cost manufacturing strategies primarily focus on the technology-follower firms on their proven products and technologies (Galbraith et al., 2008). The statement above supports the findings of this study. Based on the findings, the pioneer – follower posture is found to have a significant relationship with the organizational performance of manufacturing companies. Several studies have shown that pioneers have long-lived market share advantages, are likely to be market leaders in their product categories. This phenomenon enables companies to achieve economies of scale while capturing premium segments. In addition, it allows companies to control distribution channels while setting industry-standard (Golder & Tellis, 1993). On the other hand, early follower's companies that aim for the right new technology may have the advantages of building a solid market position. However, this could lead to making a wrong choice (even if the firm supports the right technology simultaneously) can dilute or eliminate the potential for advantage (Eggers, 2012).

For the conclusion, its implies that this Malaysian manufacturing companies strive for dominance in key technologies and pursue high technical risk. Thus, H1 is supported.

6.3.2 Technological Investments and Organizational Performance

This part focused on the findings of the second research question in relation to the following research objective:

Research Objective 2 (RO2)	To examine the relationship between technological investments and organizational performance in manufacturing companies.

Ulloa et al. (2018) claimed that technological investment helps in establishing a manufacturer's performance. Ozturk and Zeren (2015) found that manufacturers with higher technological investments positively affect sales growth in manufacturing industry performance than companies invested in patents or intangibles to protect existing technologies from competitors. These intangibles contribute less to innovation or a rise in revenue. This result supports the findings of this study which revealed that technological investments are positively related to the organizational performance of manufacturing companies. Other studies also revealed that technological investments are positively related to organizational performance (Ramdani, 2012; Bagheri et al., 2012; Jung, 2009). However, these findings contrast previous results by Mithas and Rust (2016) and Thouin et al. (2008) that technological investments did not affect organizational performance. The inconsistent results obtained in past studies indicate that this field of research requires further investigation. As a result, the results obtained may differ according to the research context.

In this study, technological investments have been referred to in this study by the amount to which manufacturing companies emphasize attaining a specified return on investment in R&D activities. Therefore, the findings show that the more technological investments the companies have, the greater their chance to obtain higher organizational performance. Similarly, the statistics indicated that manufacturing companies were committed to retaining highly skilled staff, utilizing cutting-edge research and development facilities, and giving substantial financial support for R&D. This highlighted those technological investments are a crucial element in enhancing organizational performance.

6.3.3 Intensity of Product Upgrades and Organizational Performance

This part focused on the findings of the third research question in relation to the following research objective:

Research Objective 3 (RO3)	To investigate the relationship between the intensity of product upgrades and organizational performance in manufacturing companies.

The study's findings indicate that the intensity of products upgraded has a substantial effect on organizational performance. Additionally, bootstrapping 500 procedures indicated a modest coefficient of determination of the effect size, f^2, and the predictive relevance shows a small effect size, q^2. As a result, H3 is supported. Despite the direct link between intensity product upgrade and organizational performance is considered as substantial. This linkage indicates a negligible impact on the variance explained while producing a small predictive significance of the organizational performance. As a result, this investigation supports H3. The intensity of product upgrades was measured through the frequency of revision or extensions regarding product redesign on the product portfolio being introduced. According to several studies (Bell &

McNamara, 1991; Brown & Eisenhardt, 1995; McGrath, 1994) suggest that companies with a high score of rapid product upgrades would have an inexhaustible frequency in introducing upgrades for superior products than its counterpart.

The study's important finding implies the critical nature of product upgrading intensity in achieving improved organizational performance. Buzzell and Gale (1987) claim that it is crucial to measure a manufacturer's intensity in product upgrades. This measurement allows companies to achieve better organizational performance while benefiting from increased market share, retaining loyal customers, gaining access to distribution channels while ensuring profitability. This finding is supported by Zahra and Covin (1993), who found that the intensity of product upgrades has a significant relationship with organizational performance. Businesses are devoted to releasing product updates or expansions as quickly as possible, considerably outpacing their main competitors.

Hence, this explains that manufacturing companies increasing their performance by concentrating their efforts on product design and development and improving their manufacturing processes. Therefore, intensity of product upgrades allow companies to achieve better organizational performance. Through product diversification, firms with superior product designs acquire a competitive edge, resulting in increased profits. Additionally, manufacturing costs may be reduced due to process improvements arising from R&D, which may increase company profitability.

6.3.4 External Technology Sources and Organizational Performance

This part focused on the findings of the fourth research question in relation to the following research objective:

Research Objective 4 (RO4)	To investigate the relationship between external technology sources and organizational performance in manufacturing companies.

The study's findings indicate that external technology sources have a major impact on organizational performance. Furthermore, bootstrapping 500 operations indicated a negligible f^2 effect size of coefficient of determination and a negligible q^2 effect size of predictive relevance. As a result, H4 is supported for this study. External technology sources were quantified by the extent to which businesses used strategic partnerships, licensing agreements, acquisitions, and outright purchase of technology from other parties or external sources. Businesses that rely on external sources of technology are either involved in technology-based partnerships or have licensed to use other companies' technologies.

The findings of this study corroborate earlier research indicating that external technology sources have a significant effect on organizational performance (Berchicci, 2013; Zaadnoordijk, 2012; Zahra & George, 2002). However, following thorough studies of the literature, mixed findings were revealed, indicating an insignificant finding (Belderbos et al., 2004; Jones et al., 2001; Tsai & Wang, 2007).

On the other hand, this study's findings are consistent with the findings of most studies on external sources of technology. It points to the fact that external sources correlate to organizational performance (Kang et al., 2015; Hung & Chou, 2013; Tsai et al., 2011). External technology sources might also help a business strengthen its technological capabilities and increase its market responsiveness. Manufacturing companies that effectively leverage their external technology sources through new product development or product improvement could enhance companies' market shares and increase their earnings (Nonaka & Takeuchi, 1995). Therefore, it can be concluded that companies are actively seeking external technology to complement their knowledge base or capabilities have advantages over their counterparts that direct everything in-house when firms compete in the products or service market (Gassmann, 2010; Chesbrough & Crowther, 2006; Grant & Baden-Fuller, 2004).

Hence, this explains why in the emerging economies, domestic manufacturing firms heavily rely on external technology sourcing activities in technology development (Lall, 2000). With this strategy, manufacturing companies can mitigate risks and expenses while shortening the time to accumulate technological competency (Xie, 2004).

6.3.5 Product and Process Technology and Organizational Performance

This part focused on the findings of the fifth research question in relation to the following research objective:

Research Objective 5 (RO5)	To assess the relationship between product and process technology and organizational performance in manufacturing companies.

The study's findings have confirmed that product and process technologies substantially influence organizational performance. Additionally, the bootstrapping of 500 procedures revealed a moderate effect size for the coefficient of determination, f^2, and small effect size for predictive relevance, q^2. As a result, H5 is recommended for this study. The product and process technology were measured based on how new technology is integrated into the firm's manufacturing plants and processes.

Zahra and Covin (1993) claimed that product and process technology greatly influences enhancing organizational performance and can be defined as integrating newer technology in the firm's daily business. The benefit of determining the importance of technology is positively associated with organizational performance in lowering manufacturing costs, manufacturing unique products, expanding production flexibility and reducing lead times as a result of focusing their resources and efforts on product and process improvements and technology (Tan et al., 2007; Hassan et al., 2013; Saunila et al., 2014; Shaukat et al., 2013). This result is in line with the findings of this study. This study establishes that product and process technology have a significant relationship with organizational performance towards manufacturing companies. Consequently, firms strive to increase their product and process technology implementation to seize the opportunities provided in such environments while gaining market share. Moreover, firms are also driven to implement changes in technological progress (Goos, 2018) in highly dynamic environments.

Product and process technology are often required new processes and technologies. The need to develop new products may motivate firms to carry out the utilization of advanced technologies in the process innovation strategy implementation to improve production processes, consequently enhancing the speed of product delivery. Moreover, this has significantly reduced cost while increasing the quality of the products, allowing firms to penetrate a new niche market in a dynamic environment (Jayaram, 2014). Therefore, product and process technology plays a vital role in enhancing manufacturing companies' existing speed and efficiency in terms of production and processes by using advanced technology.

6.3.6 The Moderating Effect of External Environments

This part focused on the findings of the sixth research question in relation to the following research objective:

Research Objective 6 (RO6)	To analyze the moderating effect of external environments on the relationship between technology strategies and organizational performance in manufacturing companies.

External environment factors are defined as situations, factors or events that exist in the business environment in which a business operates that pose various and different challenges to the in which a business works that present a variety of unique difficulties to the business's performance (Hashim, 2005) while influencing the future direction of the firm. The firm's operations are affected by the striking advances in globalization, such as shifts in technology, stiff competition among business entities and new entrances within an industry (W Ndegwa et al., 2020). Therefore, the firms including manufacturing companies should have the ability to predict future trends in the external environments for survival. This study also proposes external environments as a moderator in technology strategy – performance relationships. This situation is consistent with Zahra (1996) and Ali (1996).

Additionally, Zahra (2000) noted that if the moderating relationship is empirically demonstrated various technology strategies would be more reasonable in various environments. Zahra (1999) and Wilbon (1999) explained that applying technology strategy has accumulated a positive performance impact, but there is a need to closely investigate the potential moderators of the technology strategy – performance relationship. Sikander (2011) concluded that the technology strategy – performance relationship is situation specific and subject to several moderating influences.

The sixth research question has been proposed to determine whether external environments as a moderator would strengthen the direction between the relationship between constructs. In line with this research question, the last research objective of this study examines the moderating effect of external environments on the relationship between technology strategies and organizational performance in manufacturing companies. In addition to this, present literature has emphasized and explained external environments in a different context. External environments are hypothesized to influence the relationship between constructs technology strategies and organizational performance.

The hypotheses and objectives of this research analyze the impact of moderating effect on several constructs as follows; the moderating effect of external environments between pioneer – follower posture and organizational performance, the moderating effect of external environments between technological investment and organizational performance, the moderating effect of external environments between the intensity of product upgrades and organizational performance, the moderating effect of external environments between external technology sources and organizational performance and the moderating effect of external environments between product and process technology and organizational performance. Five research hypotheses were formulated and tested using the PLS path modelling (H6, H7, H8, H9 and H10).

According to hypothesis H6 proposed that external environments might moderate pioneer – follower posture and organizational performance. Specifically, this study reveals that the relationship is stronger (more negative) for manufacturing companies with a high external environment than those with low external environments since moderating effects were deemed an essential contribution of this research. Moreover, possible explanations on moderating effect of external environments can be found in the previous empirical studies. Nevertheless, the findings of this study confirmed that the interaction term *pioneer-follower posture*external environments* establish the negative effect of the external environments moderator variable on the path from pioneer-follower posture to organizational performance. Hence, hypothesis H6 is not supported. The reason of this insignificant findings might be due to the fact that Malaysian's manufacturing companies are unable to address the external environments factor as per the standard which can enhance the impact of pioneer – follower posture on the organizational performance. Its shows that Malaysian's manufacturing companies is very vulnerable in term of technological wise, cost wise etc.

The moderation testing was carried out for this study shows that external environments moderate the relationship between technological investment and organizational performance. This study indicated that technological investment was highly associated with organizational performance at an early phase of the discussion. Specifically, this relationship is weaker (i.e. less positive) for manufacturing companies with a high external environment than for companies with low external environments. The study's findings indicated a statistically significant negative effect on the relationship between technological investment and organizational effectiveness. Hence, hypothesis H7 was fully supported. This finding is consistent with the view that external environments are an important factor influencing the firms' future direction toward the firm's investment in technology and internal R&D (Zahra & Covin, 2000). Therefore, this conclude that firms have address the external environments factor as another pressure while attaining the desired results. In contrast, the relationship of technological investment and organizational performance is stronger for companies with low external environments against companies with high external environments.

Hypothesis H8 stated that external environments have a moderating effect on the relationship between product upgrades and organizational performance. At the same time, Hypothesis H9 posited that external environments moderates the relationship between external technology sources and organizational performance. Surprisingly, the findings did not support either of these two hypotheses (H8 and H9). This relationship implies a lack of support on these hypothesized relationships on the businesses that encounter a fierce rivalry from these emerging nations such as China, India, and Vietnam (Wahab & Mohd Nazri, 2019), where outsourcing is much cheaper than new products introduced. This plausible relationship confirms that these hypotheses is rejected on the relationships pertaining to cultural conflicts, especially gaining acceptance without resistance when innovation was introduced to these firms (Kang, 2015). Therefore, based on the findings, external environments do not moderate the relationship between product upgrades and organizational performance. Other than that, external environments also do not moderate the relationship between external technology sources and organizational performance.

The moderating effect of external environments shows that the relationship between product and process technology and organizational performance is also in line with the study by Zahra (1999). Hypothesis H10 stated that external environments significantly moderate the relationship between product and process technology and organizational performance. Specifically, this relationship is more significant (i.e., more negative) for manufacturing companies with a high external environment than companies with a low external environment. Thus, the relationship between product and process technology and organizational performance becomes stronger with high levels of the external environment. This hypothesis was also supported because the interaction between product and process technology and the external environment in predicting organizational performance was significant. Hence, the relationship between product and process technology and organizational performance becomes stronger with high levels of the external environment. In contrast to the low level of the moderator construct (external environment), the relationship between product and process technology and organizational performance becomes weaker. Hence, H10 is supported.

6.4 Research Implications and Contributions

This study aims to examine the relationship between constructs, namely technology strategy and organizational performance. Consequently, this study has been estimated moderating effect in PLS-SEM to model the influence of an external environments moderator on a relationship between technology strategy and organizational performance by generating different interaction terms.

Furthermore, to gain a better understanding of technology strategy, external environments and organizational performance, the Resource-Based View (RBV) is chosen as an underpinning theory. Hypotheses designed for the relationships in the model were formulated, tested, and findings were presented and deliberated. This research provides clarity for further understanding of the concept of technology strategy. The study's results and discussion added to the corpus of knowledge and practice while also emphasizing many consequences, including theoretical, methodological, and managerial ramifications.

6.4.1 Theoretical Implication

The findings of this study have contributed towards three main streams of theoretical implications. Firstly, technology strategy research contributes to expanding the strategic technology management concept, model, findings, and literature. Secondly, the study extends the application of the Resource-Based View, not only as of the underpinning theory of the study but also extending the theory in the aspects of technology strategy in relation to organizational performance. Thirdly, the study provides theoretical implications in technology strategy on the importance of the moderating effect of external environments in enhancing organizational performance.

6.4.1.1 Contribution towards Management Research

This research provides several implications for theory. Firstly, the technology strategy literature is expanded through the findings of this research. This finding includes the examination of external environments in terms of competitive technology elements. This research provides several implications for theory. Although numerous issues deserving more investigation have been explored, others require additional study.

Furthermore, the definitions of technology strategy, both conceptual and practical, must be improved. Surveys and field studies can be beneficial in the discovery of new technology strategy components. Additionally, it is essential to comprehend the relationship framework of technology strategy dimensions that require deeper examination. By constructing this technology strategy sequence, researchers may gain a deeper insight into the relationship between technology strategy and organizational performance in dynamic surroundings. Path analysis should be used to establish this sequence in future studies. Perhaps by assessing multiple dimensions of organizational performance, this can be accomplished. To evaluate the effect of technology strategy on organizational performance, this sort of study should place a greater emphasis on younger organizations, especially new start-ups.

6.4.1.2 Contribution towards Resource-Based View

Chapter Two identified the Resource-Based View (RBV) as the fundamental underpinning theory to better understand technology strategy. The Resource-Based View proposes that a sustainable competitive advantage comes from having unique resources that create value in the marketplace. Underpinned by this theory, a resource (technology) is valuable when it enables strategies (strategy) that improve efficiency and effectiveness (organizational performance). Their uniqueness derives from being rare (at most, only a few other firms have the resource) by having imperfect imitability (other firms cannot easily imitate or acquire it) and non-substitutable (there are no other strategically equivalent resources available to other firms).

Based on the literature review conducted in this study revealed that there are five technology strategies. The technology strategies include pioneer-follower posture, technological investments, the intensity of product upgrades, external technology sources, and product and process technology. In this research, technology strategies were proven to have a significant impact on organizational performance. Thus, the findings of the study can be used by higher education institutions to design a comprehensive yet specific curriculum that would match with the requirement of the evolution in the field of technology strategy in relation to manufacturing. This contribution is elaborated by integrating theory and practises of Industry 4.0 applications into tertiary education curricula, including restructuring industry placement opportunities.

6.4.1.3 Contribution towards External Environments

Apart from that, the theoretical implication is related to the role of external environments. This research supported that the moderating role of external environments has a significant relationship between technological investments and organizational performance and the relationship between product and process technology and organizational performance. Theoretically, these findings indicated that technological investments and product and process technology are positively related to organizational performance through external environments. It shows that the vital role of external environments in influencing organizational performance among manufacturing companies. Therefore, external environments should be developed in order to enhance organizational performance.

In conclusion, this study contributes to the current body of knowledge related to the application of Resource-Based View in explaining the influence of technology strategy on organizational performance.

6.4.2 Managerial Implication

In order to complement the theoretical contributions, this study provides three managerial implications, namely to academicians, policymakers and regulatory authorities, and manufacturing companies.

6.4.2.1 Significance to Academicians

The role of technology strategy has become more critical, especially in technological progress where practitioners and academic scholars are racing to capture or be part of technological progress. The findings of this study have highlighted some essential features to the literature of technology strategy and organizational performance. The findings indicate that the effectiveness of a given technological strategy is heavily dependent on the external environment in which the company operates. Additionally, the study would serve as an important reference for academicians keen to conduct further studies on the uniqueness of the technology strategy. They are taking into account organizational performance and its association to the environments. This potential area of study could help scholars better grasp how technology variables contribute to the competitive advantage that a company can possess in the marketplace. As a result, these studies will assist managers and executives in selecting technological solutions that are most compatible with their competitive environment, boosting the likelihood of financial success for the business.

Considering the findings of this study, the academicians would potentially benefit through the following:

1) The academicians could replicate this study to further examining the other specific technology strategy – organizational performance relationships. It is highly suggested that this study can be replicated to further investigate from a different dimension of specific technology strategy and its relationship toward organizational performance. There is a need to reinvestigate further the differences of the multidimensional environment with respect to the unique nature of every environment. Thus, these studies would enable academics to comprehend how technology variables contribute to a company's competitive edge without harming the effort to maximize organizational performance wealth.
2) This study would assist academicians to transfer the knowledge of technology strategy into the mindset of technology strategy learners. This action will create an impression that technology strategy would be widely adopted in every institution or company to manage technological resources strategically.
3) Academicians' role is to ensure that manufacturing companies, especially SMEs, should strategically collaborate with industry to remain sustainable. This role would help the government form talent and competency development programs while providing mentoring facilities on technology education.

4) Academicians should engage themself in developing a comprehensive manufacturing industry index by sharing data while performing industry analysis across all ministries and agencies.

6.4.2.2 Significance to Policymakers and Regulatory Authorities

Policymakers are responsible for making policy, whereas regulatory agencies are independent government bodies established by legislative acts to set standards for manufacturing industries. Their primary purposes are to implement laws and enforcement particularly in manufacturing sectors while ensuring compliance. The outcome of this research can provide valuable information to regulatory authorities to devise a comprehensive guideline in making the decision and implementing policies for corporations. Thus, the findings of this study will benefit policymakers to derive policies that benefit the planet, society, and the economy of the country as a whole. Consequently, this practice would benefit regulatory agencies through the following:

1) Outcome of this research will be of great importance to strengthening policies and introducing new programs consistent with a long-term government policy toward attaining a sustainable market.
2) The results obtained from this study provide new information that could help regulatory agencies to formulate strategies while ensuring that strategy and activities are observed by manufacturing companies. These findings also could provide an essential piece of information for the Ministry of International Trade & Industry (MITI) in regulating the standards and policies. The future policies should provide comprehensive strategies and action plans outlined to

accelerate or improve the growth of manufacturing companies which is essential towards the nation's economy.

3) The findings of this study also provide crucial fundamental information to strengthen the government to devise the right ecosystem for manufacturing companies through collaborative platforms.
4) The importance of Technical and Vocational Education and Training (TVET) and Science, Technology, Engineering and Mathematics (STEM) education programmes have been confirmed in terms of their significance in this study.
5) The study's finding has promoted the importance of the manufacturing sector into a mainstream industry. This is evidence of the increasing importance of food security that has become an issue of concern to countries worldwide.
6) The study's would potentially help educators, trainers, and instructors better understand the context of technology strategy from the perspective of manufacturing sectors.

6.4.2.3 Significance to Manufacturing Companies in Malaysia

This study captured important information from the sources that are mainly top-ranked executives (such as CEO, COO and so forth), managers and executives. Therefore, their invaluable response to the questionnaire of this study has contributed significantly to the understanding of technology strategy in Malaysian manufacturing.

The findings have several consequences for managers' behaviour. In attaining superior performance, the manager appreciates the crucial significance of a business's technology strategy. In order to gain a competitive edge, managers are highly advised to construct the processes and systems essential while creating and implementing an effective dimension of technology strategies. By default, managers and executives have a considerable influence on adhering to the company's technological strategies.

Executives routinely receive generic prescriptions for how to maximize profitability through the utilization of technological resources. For instance, leaders recommend investing considerably in research and development, leveraging external technology sources extensively, and pioneering new goods. These approaches have been demonstrated to be valid. Managers should implement cautions when making broad technological policy as the outcome from such decision could have a long term impact on technology strategy dimensions considering the differences in the environmental settings. The primary focus of managers should concentrate their effort on its goals and build capabilities to handle diverse products and processes. Meanwhile, the risk-taking and resource management orientation should not be undermined while developing a technology strategy. Managers must implement effective measures to scan environments to identify the potential influences that could affect the industry due to the organization's technological decisions.

According to the study's findings, companies can obtain a competitive edge from their technological strategy. This information can be used to examine the company's technological choices in specific competitive settings. As a result, the presented data appropriately represent the sample size and measurement methods used in the study. Managers should exercise caution when implementing the findings. The information and examples show how a company's technological capabilities can be maximized with innovation and resourcefulness crucial to its success.

It cannot be overstated how critical it is to take a long-term approach when investing in technology. While some businesses may experience a rapid return on their technological investments, this is more of an exception than the rule. Increased research and development expenditures should not be viewed as a magic potion to curb a competitive disadvantage. However, the allocated R&D resources should align with the long-term goals and strategy of the organization.

External technology sources should not be underestimated, particularly when it comes to developing technological competence. External technology sources could complement technological investment while improving organizational performance. Companies could create a competitive advantage through the acquisition of licensing or purchasing technologies from other companies. Managers have to instil the elements of appreciation amongst companies employees towards external technology sources. This effort should be able to counteract employees attitudes that may slow down the technology adaptation process.

Developing and implementing product and process technology is necessary for managerial attention. It is important to have a wide range of product and process technology that significantly influences organizational performance. Adner and Levinthal (2001) and Skinner (1992) suggested that product and process technology increased shareholders' wealth by achieving higher growth while increasing profits. Traditionally, some companies ignored product and process technology would consequently place themselves at a disadvantage position among their rivals in the global competitive arena. The success of product and process technology could lead to reductions in both the cost and product price. It is essential for managers to constantly increase product and process technology to improve their organizational performance. As companies were put under pressure to introduce new products, product and process technology remains critical, especially to develop and commercialize new products.

6.5 Study Limitations

Each study has significant limits. As it is the practice in scientific research, particularly in social science research, there are potential concerns that other statistical testing might not have been fully considered due to the limitation of this study which might improve the reliability and validity of the future research. Caution should be exercised in generalizing the findings of the study. These limitations involved in conducting this study are as a result of this enumerated and described as follows:

1) The data were collected from a single cluster rather than a simple random sampling.
2) The data collected for this study were based on perceptions. Thus, a direct comparison through official documents and company records could not be executed, aiming to validate using the actual data, due to limitations of time and resources. This research is confined within the context of organizational performance from the perspective of manufacturing sectors.
3) This study applies a cross-sectional study. Hence, the data were gathered at one point in time.
4) This study is limited to companies registered under the Federation of Malaysian Manufacturers (FMM) in Malaysia. Therefore, findings may not be

fully generalized to other private and public listed companies in Malaysia which are not registered under FMM. Different natures, characteristics, and cultures of these industries may vary compared to companies under FMM.

6.6 Recommendations for Future Study

Taking into account the limitations of the study which were mentioned and discussed in the previous section, this section makes recommendations for future research. As a result, this section reviewed these avenues and provided some recommendations that could be investigated further in future research.

This study has revealed that the moderating variable items of external environment use are dysfunctional competition, institutional support, environmental turbulence, strategic alliance for product development, and political networking strategy. Future researchers should gather a larger sample size that represent the true proportion of the size and type of sectors in the manufacturing. These might significantly contribute to pioneer-follower posture, the intensity of product upgrades, and external technology sources and organizational performance. Consequently, increase the generalizability with a sufficient sample representing the population. Furthermore, the extended model could be tested within other study contexts by using different estimation methods. Additionally, scientific research anticipates further validation of the extended model when reapplied and retested in a similar context.

However, this study may have disregarded some important predictors of organizational performance in maintaining the parsimonious model like many other previous studies. It is recommended that future studies should expand the horizon of the current understanding of phenomena. The expansion can be executed in the form of theoretically or contextually driven aspects that may improve existing knowledge and understanding. Furthermore, other than the moderation construct, future studies may explore other intervening mechanisms or consider other potential moderators' roles in moderating the association of technology strategy in relation to organizational performance.

The importance of technology strategy cannot be debated. Other characteristics of the technology strategy may also be further observed to enrich the understanding of the present notion. These include as follows:

1) This study is centred on a generic framework on technology strategy. Therefore, the framework of this study can be extended to another context or different populations not limited to manufacturing companies or within the Malaysian context. Future researchers might be interested in researching this notion of study in other contexts, such as companies listed in the Bursa Malaysia and SMEs in Malaysia.
2) In addition to that, examining this concept in other Asian countries to investigate whether it produced similar or different outcomes might provide valuable insights.
3) A perception based on this empirical analysis was performed by a cross-section study where the questionnaire respondents based on their understanding and opinion related to concerned aspects. This analysis presents a one-off attempt at perceptions on technology strategy, external environments, and organizational performance. For that reason, there is a need for a longitudinal

study to evaluate organizational performance for a certain period in order to analyze the influence of technology strategy on organizational performance.

6.7 Conclusions

The importance of sustainable organizational performance and technology strategy has become the critical elements and the backbone of the nation's economy (Ministry of International Trade & Industry, 2018). Technology strategy and its nexus with organizational performance research have gained a considerable place in the literature. Scholars and researchers have approached this subject from a variety of perspectives. Recent research has documented the increasing importance of technology strategy for firms to pursue survival and growth strategies towards organizational performance.

The presence of technology strategies such as pioneer – follower posture, technological investment, the intensity of product upgrades, external technology sources, and product and process technology in this study are demonstrated to contribute to the organizational performance of manufacturing companies. Furthermore, because of their different risk orientations, relative capacities, and past performance histories, external environments may have a different influence on the relationship between technology strategy and organizational performance. With many companies struggling to balance their technology and business strategies, the literature gap calls for a better understanding of how the external environment moderates the relationship between technology strategy and organizational performance. With the number of external environment factors such as strategic technological changes, policymakers, the labor market, and human resource development need to understand how these factors affect technology strategy and organizational performance.

Therefore, this study is designed to examine the relationships between pioneer-follower posture, technological investment, the intensity of product upgrades, external technology sources, and product and process technology on organizational performance and to analyze the moderating effects of the external environment on the relationship between technology strategies and organizational performance. This study was initiated in response to previous research's inconclusiveness, fragmented findings, and omission of sustainable organizational performance. Additionally, prior research has been inadequate in addressing the moderating effects of the external environment on the relationship between technology strategies and organizational performance.

Furthermore, past studies provided inconsistent findings and limited investigation into this relationship with Malaysian manufacturing companies, despite its highlighted impact on financial and non-financial organizational performance. The majority of past studies were investigated in the Western context. This study expanded on the aspect of the external environment's moderating effect on the relationship between technology strategies and organizational performance after recognizing the unfulfilled gap.

The literature reviews were presented comprehensively, which assisted in providing the foundation for constructing the study's conceptual framework, hypothesis development, and research instruments. The conceptual framework for this study interpreted the theoretical gaps in organizational performance (an endogenous variable) explained by the pioneer-follower posture, technological investment, the intensity of product upgrades, external technology sources, and product and process technology (exogenous variables), which were influenced by the external environment (moderator). This study was underpinned by two theories: Resource-Based View (RBV) Theory and Resource Dependency Theory (RDT), and ten hypotheses were formulated to test the nexus between variables. Following data assemblage, PLS-SEM analysis with SmartPLS 3.0 was used to transform the data into comprehensive and reasonable findings.

The study was concluded with the enclosed findings, designed in response to the research questions and research objectives. From the findings of this study, the researcher concludes that technology strategy is considered a nerve system and a backbone in determining the organizational performance and success of the Malaysian manufacturing industry. Interestingly, the result was found to be positive where it showed seven hypotheses were supported, but the inverse result appeared in the other three unsupported hypotheses. The findings revealed that all independent variables (pioneer – follower posture, technological investments, the intensity of product upgrades, external technology sources, and product and process technology) have a positive relationship with organizational performance. These results have highlighted the importance of technology strategies for enhancing and improving sustainable organizational performance.

On the other hand, referring to the analysis performed on the role of the external environment (moderator), it was established that the external environment does moderate the relationship between technological investments and organizational performance. Aside from that, external environments moderate the relationship between product and process technology and organizational performance. Unfortunately, the external environment did not perform as a moderator between pioneer-follower posture, the intensity of product upgrades, and external technology sources with organizational performance. Thus, it suffices to conclude that in Malaysian manufacturing companies, organizational performance is significantly explained by the pioneer – follower posture, technological investment, the intensity of product upgrades, external technology sources, and product and process technology, which then affect organizational performance through the influence of the external environment.

These reputable findings have provided contributions theoretically, practically, and methodologically with imperative implications for academicians, policymakers and regulatory authorities, and manufacturing companies specifically. This study enhances the researcher's understanding by providing new and insightful information regarding various technological choices that manufacturing companies make to strengthen their competencies. Hence, this study contributes to the field of technology strategy. This study proposed the path model of technology strategy, a moderating effect of the external environment, and organizational performance is considered as an initiative to enhance the existing theory.

Whether or not the company want to improve efficiency, scalability or operations. The implementation of a technology strategy is a great way to increase a company's growth potential. Technology strategy studies should include a sophisticated and nuanced strategy for emerging technologies. Based on the maturity of the technology spectrum, including a comprehensive analysis of emerging technologies and their impact on business development. In various contexts, a more dynamic view of the technology strategy is needed. Technology strategy starts with business strategy and customer needs. However, it should also recognize new insights from emerging technologies and move the entire company to change.

In order to encourage manufacturing companies, the Ministry of International Trade & Industry, the Federation of Malaysian Manufacturers and a broad range of relevant stakeholders should cooperate and collaborate to develop more series of industry and government agency strategic collaboration such as technology transformation program. These efforts might help:

1) to reduce the shortage of expertise in the industry, universities and research institutes.
2) to increase the attractiveness of manufacturing as a career destination for top talent.
3) to help the universities to offer related subjects that match with industry needs.
4) to ensure that nation's dependencies on foreign countries exporter on an essential product is reduced or eliminated. Take on the example of Israel, which produced everything locally out of barren sand with the help of smart technologies.

Besides, in a post-modern world, companies can no longer afford to spin an endless cycle and must develop a technology strategy that uses the full range of all technologies at their disposal. To do so, developed countries such as the United States adopt a proactive technology position similar to China, Japan, and other advanced economies. Companies should adopt technology strategies that prioritize all the technologies, which consists of continuously researching innovations in processes and technologies while continuously developing its manufacturing technologies. These processes are not necessarily sequential or iterative but are being developed and renewed because implementing a technology strategy will change the future.

6.8 Summary of the Chapter

This chapter summarises the findings of this study. It includes a comprehensive study by discussing the research method from Chapter One to Chapter Five. The study's theoretical implications have been discussed through the application of Resource-Based View Theory and Resource Dependency Theory, both of which are proved to support the propositions stated in this study. The theoretical and managerial implications were discussed from a practical standpoint, with an emphasis on its contribution to the implementation of technology strategies in the manufacturing industry. This chapter concludes with a discussion of the study's limitations, recommendations for future study, and conclusions.

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APPENDICES

Appendix A: List of Manufacturing Companies registered with Federation of Malaysian Manufacturers (FMM)

No	Manufcturers
1	A.S Komasu Battery Technology Sdn Bhd
2	Agro-Industrial Supplies (M) Sdn Bhd
3	Alpha Precision Turning and Engineering Sdn Bhd
4	Anpers Industries Sdn Bhd
5	Avantis Technologies Sdn Bhd
6	Bard Sdn Bhd
7	BCM Electronics Corporation Sdn Bhd
8	Central Industrial Corporation Berhad
9	Chianta Plastic Industries Sdn Bhd
10	Cocon Food Industries Sdn Bhd
11	Creative Rubber Products Sdn Bhd
12	CSC Engineering Sdn Bhd
13	Diptech Industries Sdn Bhd
14	DXN Industries (M) Sdn Bhd
15	Dynamic High Purity Engineering Sdn Bhd
16	Fikrisz (M) Sdn Bhd
17	First Solar Malaysia Sdn Bhd
18	Fmefamax Engineering (M) Sdn Bhd
19	Gajah Emas Industries Sdn Bhd
20	Gano Excel Industries Sdn Bhd
21	Global Point Foods Industries Sdn Bhd
22	Go Automobile Manufacturing Sdn Bhd
23	Grand Platters Sdn Bhd
24	GS Yuasa Battery (Malaysia) Sdn Bhd
25	Gula Padang Terap Sdn Bhd
26	Hexion Sg Petani Sdn Bhd
27	Hiap Seng Tyre (Kulim) Sdn Bhd
28	Hicom-Honda Manufacturing Malaysia Sdn Bhd
29	Huan Hsin Electrical System (M) Sdn Bhd
30	Ideal Healthcare Sdn Bhd
31	Kholin Sdn Bhd
32	Kilang Bihun Bersatu Sdn Bhd
33	Mace Instrumentation Sdn Bhd
34	Macro Dimension Concrete Sdn Bhd
35	Maidamax (M) Sdn Bhd
36	Malaysian NPK Fertilizer Sdn Bhd
37	Minebea Electronics Motor (Malaysia) Sdn Bhd
38	Oxford Bond Sdn Bhd
39	Panasonic Energy Malaysia Sdn Bhd
40	Perusahaan Saudee Sdn Bhd
41	Respack Manufacturing Sdn Bhd
42	Rider Tech Sdn Bhd
43	RYCO Hydraulics Sdn Bhd
44	S&O Electronics (Malaysia) Sdn Bhd
45	SCS Industries Sdn Bhd
46	Silterra Malaysia Sdn Bhd
47	Sinaran Manufacturing Sdn Bhd
48	SJ Circle Sdn Bhd

49	SKI Industry Sdn Bhd
50	Smartrac Technology Malaysia Sdn Bhd
51	SMT Technologies Sdn Bhd
52	Southern Cable Sdn Bhd
53	Sunfresh (M) Sdn Bhd
54	Swiss Lab Biotech Sdn Bhd
55	Tastiway Sdn Bhd
56	Thong Guan Plastic & Paper Industries Sdn Bhd
57	Thunder Print Sdn Bhd
58	Visdamax (M) Sdn Bhd
59	Wetra Food Industries Sdn Bhd
60	Wong Engineering Industries Sdn Bhd
61	Mediquip Sdn Bhd
62	MSM Perlis Sdn Bhd
63	A Tu Z Wedding House Sdn Bhd
64	Acku Metal Industries (M) Sdn Bhd
65	Actiforce Mechatronics Technology (M) Sdn Bhd
66	Advanced Ceramics Technology (M) Sdn Bhd
67	AEM Microtronics (M) Sdn Bhd
68	Agricultural Chemicals (M) Sdn Bhd
69	Aident Corporation Sdn Bhd
70	Akty Technologies Sdn Bhd
71	AL Asia Chemical Industry Sdn Bhd
72	Alagappa Flour Mills Sdn Bhd
73	Alliance Contract Manufacturing Sdn Bhd
74	Amlex Technology Sdn Bhd
75	Amphenol TCS (Malaysia) Sdn Bhd
76	Anglo Wax Industries Sdn Bhd
77	Ann Joo Steel Berhad
78	Armstrong Auto Parts Sdn Bhd
79	Asia File Products Sdn Bhd
80	Astino Netting Sdn Bhd
81	ATS Automation Malaysia Sdn Bhd
82	B&W Food Products Sdn Bhd
83	Barkath Co-Ro Manufacturing Sdn Bhd
84	Barkath Foods Sdn Bhd
85	BCL Packaging Sdn Bhd
86	Bluemetal Sdn Bhd
87	Boon Siew Honda Sdn Bhd
88	Brady Technology Sdn Bhd
89	Butterworth Iceworks Sdn Bhd
90	BW Yee Seng Steel Industries Sdn Bhd
91	Canon Electronics (Malaysia) Sdn Bhd
92	CCL Design (Penang) Sdn Bhd
93	Central Elastic Corporation Sdn Berhad
94	Century Chemical Works Sdn Bhd
95	Chee Wah Corporation Berhad
96	CHT Manufacturing Sdn Bhd
97	Chung Yih Steel Sdn Bhd
98	Clarion (Malaysia) Sendirian Berhad
99	Cleanroom Industries Sdn Bhd
100	CLPG Packaging Industries Sdn Bhd
101	Coco Industry Sdn Bhd
102	Comfish Industries Sdn Bhd
103	Continental Automotive Components Malaysia Sdn Bhd

104	Core Electronics (M) Sdn Bhd
105	Cradotex (M) Sdn Bhd
106	Creative Precision Engineering Sdn Bhd
107	Custom Food Ingredients Sdn Bhd
108	Cycle Trend Industries Sdn Bhd
109	Danisco Malaysia Sdn Bhd
110	Davex Engineering (M) Sdn Bhd
111	Dell Global Business Center Sdn Bhd
112	DES Building Innovate Sdn Bhd
113	DIC Compounds (Malaysia) Sdn Bhd
114	Dynamic Frank Sdn Bhd
115	Dynapharm (M) Sdn Bhd
116	Eagle & Pagoda Brand Teck Aun Medical Factory Sdn Bhd
117	Eastboard Chemicals Sdn Bhd
118	Eko Metal Industries Sdn Bhd
119	Elna – Sonic Sdn Bhd
120	Elna PCB (M) Sdn Bhd
121	Emico Metalizing Sdn Bhd
122	Eng Heap Seng Rice & Flour Mill (M) Sdn Bhd
123	Eng Kah Enterprise Sdn Bhd
124	Eng Teknology Sdn Bhd
125	Eonmetall Technology Sdn Bhd
126	EPE Packaging (Penang) Sdn Bhd
127	Epsilon Technology (M) Sdn Bhd
128	EQX Materials Sdn Bhd
129	ESCATEC Electronics Sdn Bhd
130	Esmo Automation (M) Sdn Bhd
131	EZI Motartech Sdn Bhd
132	Farben Technique (M) Sdn Bhd
133	Fasteners Marketing Sdn Bhd
134	Fastron Sdn Bhd
135	Fatty Chemical (Malaysia) Sdn Bhd
136	Federal Fertilizer Co Sendirian Berhad
137	Federal Packages Sdn Bhd
138	Flextronics Technology (Penang) Sdn Bhd
139	Foil Laminate Industries Sdn Bhd
140	Follow Me Industries Sdn Bhd
141	FoundPac Technologies Sdn Bhd
142	Fu Hao Manufacturing (M) Sdn Bhd
143	Fujikura Federal Cables Sdn Bhd
144	Fulian (M) Sdn Bhd
145	Fundamental Gains Sdn Bhd
146	Gaban Spice Manufacturing (M) Sdn Bhd
147	GB Plas Sdn Bhd
148	Ghee Hiang Manufacturing Co Sdn Berhad
149	Globetronics Sdn Bhd
150	Gold Choice Food Industries Sdn Bhd
151	Gold Leaf Manufacturing Sdn Bhd
152	Golden Frontier Packaging Sdn Bhd
153	G-Tek Electronics Sdn Bhd
154	Haemonetics Malaysia Sdn Bhd
155	Harimic (Malaysia) Sdn Bhd
156	Heng Lee Sauce Sdn Bhd
157	High Ace Industries Sdn Bhd
158	Hinrich Industries Sdn Bhd

159	HK Kitaran Sdn Bhd
160	Hockpin Precision Engineering Sdn Bhd
161	Hong Yang Hoo Pharma Sdn Bhd
162	Hotayi Electronic (M) Sdn Bhd
163	Hung Thong Food Technology Sdn Bhd
164	Ibiden Electronics Malaysia Sdn Bhd
165	Inari Technology Sdn Bhd
166	Incline Dynamics Sdn Bhd
167	International Footwear (Penang) Sdn Bhd
168	IOI Acidchem Sdn Bhd
169	IP SoftCom (Malaysia) Sdn Bhd
170	ITP Foods Sdn Bhd
171	Ixmation (Asia) Sdn Bhd
172	JA Solar Malaysia Sdn Bhd
173	Jeenhuat Foodstuffs Industries Sdn Berhad
174	Jusprint (Penang) sdn Bhd
175	Kasatani Advance Technology Sdn Bhd
176	KCK Pharmaceutical Industries Sdn Bhd
177	Kelpen Plastics Technology Sdn Bhd
178	Ken Prima Cosmeceuticals Sdn Bhd
179	Kheng Hwa Paper Products Sdn Bhd
180	Kimia Zue Huat Sdn Bhd
181	KLS Martin Malaysia Sdn Bhd
182	Knowles Electronics (M) Sdn Bhd
183	Kobe Precision Technology sdn Bhd
184	Koes Dairies (M) Sdn Bhd
185	Kong Guan Sauce & Food Mfg Co Sdn Bhd
186	LBSB Technical Services Sdn Bhd
187	Le Nam Megasheet (M) Sdn Bhd
188	Leader Steel Sdn Bhd
189	Lee & Sons Enterprise Sdn Bhd
190	Leverage Business Sdn Bhd
191	LHT Kitar semula Sdn Bhd
192	Linear Semiconductor Sdn Bhd
193	Lintec Industries (Malaysia) Sdn Bhd
194	Lippotex Industries Sdn Bhd
195	Lucky Food Processing Sdn Bhd
196	Lybragold Jewellery
197	M S Elevators Sdn Bhd
198	Maestro Swiss Chocolate Sdn Bhd
199	Maestro Swiss Corporation (M) Sdn Bhd
200	Maicador Sdn. Bhd.
201	Malayan Electro-Chemical Industry Co Sdn Bhd
202	Malayan Metal Works Sdn Bhd
203	Malaysian Automotive Lighting Sdn Bhd
204	Masfloor Sdn Bhd
205	Master-Pack Sdn Bhd
206	Mattel (Malaysia) Sdn Bhd
207	MED8 Sdn Bhd
208	Menara Kerjaya Fasteners Sdn Bhd
209	Metoxide Malaysia Sdn Bhd
210	Miami Food Products Sdn Bhd
211	Mighty Synergy Manufacturing Sdn Bhd
212	Mipox Malaysia Sdn Bhd
213	MMK Spices Sdn Bhd

214	Modernria Plastic Industries (M) Sdn Bhd
215	MY Flexitank Industries Sdn Bhd
216	MYwave Sdn Bhd
217	Nanotronic (Malaysia) Sdn Bhd
218	Nastah Industries Sdn Bhd
219	Nationgate Solution (M) Sdn Bhd
220	Newbillion Industries (M) Sdn Bhd
221	NGK Spark Plugs Malaysia Berhad
222	NI Malaysia Sdn Bhd
223	Nibong Tebal Paper Mill Sdn Bhd
224	North Malaya Engineers Trading Co Sdn Bhd
225	NSW Automation Sdn Bhd
226	Onduline Building Materials (M) Sdn Bhd
227	One Flexitank Industries Sdn Bhd
228	Ooi Beng Huat Food Industries Sdn Bhd
229	Opulent Solutions Sdn Bhd
230	Oriental Fastech Manufacturing Sdn Bhd
231	OSRAM Opto Semiconductors (Malaysia) Sdn Bhd
232	Panasonic Automotive Systems Malaysia Sdn Bhd
233	Pangkal Sinar Sdn Bhd
234	Paramit Malaysia Sdn Bhd
235	Penchem Technologies Sdn Bhd
236	Pen-Classic Industries Sdn Bhd
237	Penfabric Sdn Berhad
238	Penfibre Sdn Bhd
239	Pensonic Industries Sdn Bhd
240	Perusahaan Sindi Sdn Bhd
241	Peter Greven Asia Sdn Bhd
242	PGF Insulation Sdn Bhd
243	Polar Electro Malaysia (M) Sdn Bhd
244	Polyplas Sdn Bhd
245	PPH Printing & Packaging (Penang) Sdn Bhd
246	PPI Industries Sdn Bhd
247	Precico Electronics Sdn Bhd
248	Precisetech Sdn Bhd
249	Premium Sound Solutions Sdn Bhd
250	Printout Packaging Sdn Bhd
251	Professional Tools & Dies Sdn Bhd
252	Protigam Food Industries Sdn Bhd
253	Punch Industry Malaysia Sdn Bhd
254	QDOS Flexcircuits Sdn Bhd
255	R & M Electronics Sdn Bhd
256	Rapid Growth Technology Sdn Bhd
257	Reclaimtek (M) Sdn Bhd
258	Renesas Semiconductor (Malaysia) Sdn Bhd
259	Rex Canning Co Sdn Bhd
260	RGB Sdn Bhd
261	Rigel Metalcraft (M) Sdn Bhd
262	Robert Bosch (Malaysia) Sdn Bhd
263	Robert Bosch Automotive Steering Sdn Bhd
264	Safetyware Sdn Bhd
265	Samtec Asia Pacific (M) Sdn Bhd
266	Sanmina-SCI Systems (Malaysia) Sdn Bhd
267	Schlumberger Seismic Manufacturing Sdn Bhd
268	SchmitterAutomotiveAsia Sdn Bhd

269	SDKM Technologies Sdn Bhd
270	Seberang Flour Mill Sdn Bhd
271	Sequoia Marketing Sdn Bhd
272	Shan Poornam Metal Sdn. Bhd.
273	Silitech Technology Corporation Sdn Bhd
274	Sin Chian Hing Food Industries Sdn Bhd
275	Sirius Technology Sdn Bhd
276	Sky Resources Sdn Bhd
277	Smart Modular Technologies Sdn Bhd
278	Southern Latex Products Sdn. Bhd.
279	Southern Steel Berhad
280	Street's Food Products Sdn Bhd
281	Sun Sung Lee Engineering Sdn Bhd
282	Sunrise Paper (M) Sdn Bhd
283	Swanson Plastics (Malaysia) Sdn. Bhd.
284	Swift Bridge Technologies (M) Sdn Bhd
285	Syarikat Kilang Rempa Jaya Sakti Sdn Bhd
286	Syarikat Perusahaan Jooi Bersaudara Sdn Bhd
287	Symbiotica Speciality Ingredients Sdn Bhd
288	Symmetry Medical Malaysia Sdn Bhd
289	SYZ Food & Beverage Industries Sdn Bhd
290	T.H. Hin Home Tech Sdn Bhd
291	Tai Hin & Son (Pg) Sdn Bhd
292	Tekun Asas Sdn Bhd
293	Teleplan Technology Services Sdn Bhd
294	Telestructure Industries Sdn Bhd
295	Teri Towel Manufacturing Sdn Bhd
296	Texchem Corporation Sdn Bhd
297	TF AMD Microelectronics (Penang) Sdn Bhd
298	TGIF Export Sdn Bhd
299	The Cups Corporation Sdn Bhd
300	Thurgas Industries Sdn Bhd
301	Thye Heng Engineering Sdn Bhd
302	Thye Heng Technology Sdn Bhd
303	TM Air Conditioning Sdn Bhd
304	Tong Heer Aluminium Industries Sdn. Bhd.
305	Toray Plastics (Malaysia) Sdn Bhd
306	TPC (Malaysia) Sdn Bhd
307	Trio Paper Mills Sdn Bhd
308	Tropical Canning Corporation Sdn Bhd
309	United Malayan Flour (1996) Sdn Bhd
310	Universal Kith & Kin (M) Sdn Bhd
311	UWC Resources (M) Sdn Bhd
312	Vigilenz Medical Devices Sdn Bhd
313	Vitrox Technologies Sdn Bhd
314	Waftech Sdn Bhd
315	Widetech Manufacturing Sdn Bhd
316	Winchem (Malaysia) Sdn Bhd
317	Winchester Electronics (M) Sdn. Bhd.
318	Winwa Medical Sendirian Berhad
319	Wits Engineering Sdn Bhd
320	Woodview Products Sdn Bhd
321	Yanta Plastic Industry Sdn Bhd
322	Yew Lean Foundry & Co Sdn Bhd
323	Yiwol Engineering Sdn. Bhd.

324	Yollink Industries Sdn Bhd
325	Zestron Precision Cleaning Sdn Bhd
326	Zhulian Jewellery Manufacturing Sdn Bhd
327	Aalborg Portland Malaysia Sdn Bhd
328	ACME Ferrite Products Sdn Bhd
329	AEL Engineering Sdn Bhd
349	Asia Printed Circuit Sdn Bhd
352	Bestcan Food Technological Industry Sendirian Berhad
330	Bidor Kwong Heng Sdn Bhd
331	Camfil Malaysia Sdn Bhd
332	Chek Hup Sdn Bhd
353	Comfort Rubber Gloves Industries Sdn Bhd
354	Eco Medi Glove Sdn Bhd
333	Everwin Plastic Sdn Bhd
351	Hasrat Meranti Sdn Bhd
334	Latexx Manufacturing Sdn Bhd
335	MSBB Engineering Sdn Bhd
336	Nam Pharma Sdn Bhd
347	Ngan Yin Food Industries Sdn Bhd
348	Nutri Action Sdn Bhd
337	OKA Concrete Industries Sdn Bhd
338	PMW Concrete Industries Sdn Bhd
339	Sheng Foong Plastic Industries Sdn Bhd
346	Sidney Industries Sdn Bhd
340	Stoneworks Technologies Sdn Bhd
341	Tan Kor Seng & Sons Rubber Works Sdn Bhd
350	Toyo Plastic (M) Sdn Bhd
342	Toyobo Textile (Malaysia) Sdn Bhd
343	UAC Berhad
344	Uniko Calcium Carbonate Industry Sdn Bhd
345	Yee Lee Edible Oils Sdn Bhd

Source: FMM Directory

Appendix B: Determining Sample Size

N	S	N	S	N	S
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	100000	384

N – population
S – sample size
Source: Krejcie & Morgan (1970)

Appendix C: Result of Content Validity

	ITEM	1	2	3	4	5	6	7
1	SURVEY CODE	N	N	N	N	N	N	N
2	GENDER	E	E	E	E	E	E	E
3	OWNERSHIP	E	E	E	E	E	E	E
4	POSITION	E	E	E	E	E	E	E
5	EMAIL	N	N	N	E	N	N	N
6	NAME OF COMPANY	N	N	N	E	N	N	N
7	NO EMPLOYEES	E	E	E	E	E	E	E
8	INDUSTRY	E	E	E	E	E	E	E
9	PRODUCT	E	E	E	E	N	E	N
10	TOTAL CAPITAL INVESTMENT	E	E	E	E	E	E	E
11	TOTAL NET PROFIT	E	E	E	E	E	E	E
12	ISO 14000	E	E	E	E	E	E	E
13	R&D DEPARTMENT	E	E	E	E	E	E	E
14	NO EMPLOYEES (R&D)	E	E	E	E	E	E	E
15	ENGINEER	E	E	E	E	E	E	E
16	FIELD EXPERIENCE	U	U	U	N	N	U	N
17	R&D EXPERIENCE	U	U	U	N	N	U	N
18	FIELD EXPERIENCE (TECHNICIAN)	N	N	N	N	N	N	N
19	R&D EXPERIENCE (TECHNICIAN)	N	N	N	N	N	N	N
20	LOCAL ENGINEER	N	N	N	N	N	N	N
21	FOREIGN ENGINEER	N	N	N	N	N	N	N
22	SALES TURNOVER	E	E	E	E	E	E	E
23	PERFORMANCE BENCHMARK	E	E	E	E	E	E	E
24	PFP1	E	E	E	E	E	E	E
25	PFP2	E	E	E	E	E	E	E
26	PFP3	E	E	E	E	E	E	E
27	PFP4	E	E	E	E	E	E	E
28	PFP5	E	E	E	E	E	E	E
29	PFP6	E	E	E	E	E	E	E
30	PFP7	E	E	E	E	E	E	E
31	PFP8	E	E	E	E	E	E	E
32	PFP9	E	E	E	U	E	E	E
33	TI10	E	U	E	E	E	E	E
34	TI11	E	U	E	U	E	E	E
35	TI12	E	U	E	E	E	E	E
36	TI13	E	U	E	U	E	E	E
37	TI14	E	U	E	U	E	E	E
38	TI15	E	U	E	U	E	E	E
39	TI16	E	U	E	U	E	E	E
40	TI17	E	U	E	E	E	E	E
41	IPU18	E	E	E	U	E	E	E
42	IPU19	E	E	E	E	E	E	E
43	IPU20	E	E	E	E	E	E	E
44	IPU21	E	E	E	E	E	E	E
45	IPU22	E	E	E	U	E	E	E
46	IPU23	E	E	E	U	E	E	E
47	ETS24	E	U	E	E	E	E	E
48	ETS25	E	U	E	E	E	E	E
49	ETS26	E	U	E	U	E	E	E
50	ETS27	E	U	E	E	E	E	E
51	PPT28	E	E	E	E	E	E	E

52	PPT29	E	E	E	E	E	E	E
53	PPT30	E	E	E	E	E	E	E
54	PPT31	E	E	E	U	E	E	E
55	PPT32	E	E	E	E	E	E	E
56	PPT33	E	E	E	U	E	E	E
57	DC1	E	U	E	U	E	E	E
58	DC2	E	U	E	E	E	E	E
59	DC3	E	U	E	E	E	E	E
60	DC4	E	U	E	E	E	E	E
61	IS1	E	E	E	U	E	E	E
62	IS2	E	E	E	U	E	E	E
63	IS3	E	E	E	U	E	E	E
64	IS4	E	E	E	U	E	E	E
65	ET1	E	E	E	U	E	E	E
66	ET2	E	E	E	E	E	E	E
67	ET3	E	E	E	E	E	E	E
68	ET4	E	E	E	E	E	E	E
69	SA1	E	U	E	U	E	E	E
70	SA2	E	U	E	E	E	E	E
71	SA3	E	U	E	E	E	E	E
71	SA4	E	U	E	U	E	E	E
73	SA5	E	U	E	U	E	E	E
74	SA6	E	U	E	E	E	E	E
75	PN1	E	E	E	E	E	E	E
76	PN2	E	E	E	U	E	E	E
77	PN3	E	U	E	U	E	E	E
78	PN4	E	U	E	U	E	E	E
79	F1	E	E	E	U	U	E	E
80	F2	E	E	E	U	U	E	E
81	F3	E	E	E	E	U	E	E
82	F4	E	E	E	E	U	E	N
83	F5	E	E	E	E	U	E	E
84	F6	E	E	E	E	U	E	N
85	F7	N	N	N	N	E	N	E
86	F8	E	E	E	N	E	E	E
87	NF1	E	E	E	U	E	E	E
88	NF2	E	E	E	U	E	E	E
89	NF3	N	N	N	U	U	N	U
90	NF4	N	N	N	U	U	N	U
91	NF5	E	E	E	U	U	E	U
92	NF6	N	N	N	U	U	N	U
93	NF7	N	N	N	U	U	N	U
94	NF8	N	N	N	U	U	N	U
95	NF9	N	N	N	U	U	N	U
96	NF10	N	N	N	U	U	N	U
97	NF11	N	N	N	U	U	N	U
98	NF12	N	N	N	U	U	N	U
99	NF13	N	N	N	U	U	N	U
100	NF14	N	N	N	U	U	N	U

Appendix D1: Cover Letter for Validation Questionnaire

Dear Dato'/Sir/Madam,

IN CONCERN: VALIDATION OF QUESTIONNAIRES BY THE EXPERTS.

SURVEY ON THE MODERATING EFFECTS OF EXTERNAL ENVIRONMENT ON THE RELATIONSHIP BETWEEN TECHNOLOGY STRATEGY AND ORGANIZATIONAL PERFORMANCE

My name is Suriani Binti Sukri and I am currently enrolled at Universiti Utara Malaysia as a PhD candidate in management. I am currently conducting research on the moderating effects of the external environment, technology strategy, and organizational performance on manufacturing firms in Malaysia.

The aim of this research is to provide valuable insight into the manufacturing sector, and the findings will be extremely beneficial to the management of these companies, particularly in the subsectors petroleum, chemical, rubber and plastic, non-metallic mineral products, basic metal and fabricated metal products, machinery and equipment, and electrical, electronic, and computing machinery and equipment. As a result, this study will highlight many research objectives that are related to the primary objectives.

1. To examine the relationship between pioneer-follower posture and organizational performance in manufacturing companies.
2. To examine the relationship between technological investments and organizational performance in manufacturing companies.
3. To investigate the relationship between intensity of product upgrades and organizational performance in manufacturing companies.
4. To investigate the relationship between external technology sources and organizational performance in manufacturing companies.
5. To assess the relationship between product and process technology and organizational performance in manufacturing companies.
6. To analyze the moderating effect of external environments on the relationship between technology strategies and organizational performance in manufacturing companies.

In addition, the organizations should ensure which successful technology strategies contribute best to the organizational performance and have a positive effect. Technology strategy in this study is defined as a long-term plan that led companies to utilize the committed resources to technology in order to achieve competitive advantage for manufacturing companies.

Therefore, I would like to invite you as Subject Matter Experts (SMEs) to measure the content validity of each item based on Lawshe's scale, 1975 which he rated the item based on the three scales:

1. **Essential**
2. **Useful, but not essential**
3. **Not necessary**

Moreover, I would like to ask your wise opinion and suggestion related to these selected variables.

1. **Technology strategies**
2. **External environment factors**
3. **Organizational performance**

Finally, I appreciate your cooperation and consideration. I wish to express my profound appreciation for your assistance with this matter.

Sincerely,
Suriani Binti Sukri
Ph.D. Scholar
Othman Yeop Abdullah
Graduate School of Business
Universiti Utara Malaysia

Appendix D2: Validation of Questionnaire

SECTION A: GENERAL INFORMATION

Please tick the item using the scale of ***essential, useful but not essential*** and ***not necessary*** based on the following information below:

1. Survey Code No. _________________

Essential	Useful, but not essential	Not necessary

2. Your gender

☐ Male
☐ Female

Essential	Useful, but not essential	Not necessary

3. Nature of your company

☐ Multinational Corporation Subsidiary (MNC)
☐ Joint Venture
☐ Locally-owned
☐ Purely Foreign Company
☐ Other (Please specify) _________________________________

Essential	Useful, but not essential	Not necessary

4. Your current position in the organization:

☐ Chief Executive Officer
☐ Division or Group General Manager
☐ R&D/Technology Manager
☐ Financial Officer
☐ Strategist or Planner
☐ Human Resource Manager
☐ Managing Director
☐ Deputy Managing Director
☐ Factory Manager
☐ Other (Please specify) ________________________________

Essential	Useful, but not essential	Not necessary

5. Email Address:

____

Essential	Useful, but not essential	Not necessary

SECTION B: YOUR ORGANIZATION

Please tick the item using the scale of ***essential, useful but not essential*** and ***not necessary*** based on the following information below:

6. Name of company:

____

Essential	Useful, but not essential	Not necessary

7. The number of employees in the organization:

- [ ] Less than 50
- [ ] Between 50 and 300 employees
- [ ] Between 301 and 1000 employees
- [ ] Between 1001 and 3000 employees
- [ ] More than 3000 employees
- [ ] Other (Please specify) ___________________________________

Essential	Useful, but not essential	Not necessary

8. The main industry (listed in FMM) or activity of your company

- [ ] Manufacture of food products, beverages and tobacco
- [ ] Textile, wearing apparel, leather and footwear
- [ ] Wood, furniture, paper products and printing
- [ ] Petroleum, chemical, rubber and plastic
- [ ] Non-metallic mineral products, basic metal and fabricated metal products, machinery and equipment
- [ ] Electrical, electronic, computing machinery parts
- [ ] Transport equipment and other manufacturers
- [ ] Other manufacturing activities not elsewhere classified and recycling

Essential	Useful, but not essential	Not necessary

9. Name of your major products:

____

Essential	Useful, but not essential	Not necessary

10. The approximate value of total capital investment in the past 3 years:

- [ ] Less than RM100 million
- [ ] Between RM101 million and RM200 million
- [ ] Between RM201 million and RM500 million
- [ ] Between RM501 million and RM1000 million
- [ ] Between RM1001 million and RM2000 million
- [ ] Greater than RM2000 million

Essential	**Useful, but not essential**	**Not necessary**

11. Your corporation's average Total Net Profit for the last 3 years:

- [ ] Less than RM100 million
- [ ] Between RM101 million and RM200 million
- [ ] Between RM201 million and RM500 million
- [ ] Between RM501 million and RM1000 million
- [ ] Between RM1001 million and RM2000 million
- [ ] Greater than RM2000 million

Essential	**Useful, but not essential**	**Not necessary**

12. Has your corporation been involved in the ISO 14000 activities?

- [ ] Yes
- [ ] No

Essential	**Useful, but not essential**	**Not necessary**

13. Do you have R&D Department/Section?

- [ ] Yes
- [ ] No   Skip Qs 14 to 21 and Go directly to Qs.22

Essential	Useful, but not essential	Not necessary

14. The number of workers in your R&D Department

- [ ] Less than 5
- [ ] Between 5 and 10
- [ ] Between 11 and 20
- [ ] Between 21 and 50

Essential	Useful, but not essential	Not necessary

15. Do you have fresh engineers in your R&D Department?

- [ ] Yes
- [ ] No

Essential	Useful, but not essential	Not necessary

16. Do you have engineers in your R&D Department having lot of field experience?

- [ ] Yes
- [ ] No

Essential	Useful, but not essential	Not necessary

17. Do you have engineers in your R&D Department having lot of R&D experience?

☐ Yes
☐ No

Essential	Useful, but not essential	Not necessary

18. Do you have technicians in your R&D Department having lot of field experience?

☐ Yes
☐ No

Essential	Useful, but not essential	Not necessary

19. Do you have technicians in your R&D Department having lot of R&D experience?

☐ Yes
☐ No

Essential	Useful, but not essential	Not necessary

20. Do you have Local engineers in your R&D Department?

☐ Yes
☐ No

Essential	Useful, but not essential	Not necessary

21. Do you have foreign engineers in your R&D Department?

☐ Yes
☐ No

Essential	Useful, but not essential	Not necessary

22. Your corporation's average sales turnover for the last 3 years:

☐ Less than RM25 million
☐ Between RM25 million and RM100 million
☐ Between RM101 million and RM500 million
☐ Between RM501 million and RM1000 million
☐ Between RM1001 million and RM2000 million
☐ Other (Please specify) ___________________________________

Essential	Useful, but not essential	Not necessary

23. Your major performance benchmark (Tick one only)

- [ ] Return on sales (ROS = Profit ÷ Revenue)
- [ ] Revenue growth (or sales growth)
- [ ] Market share growth
- [ ] Return on shareholders equity
- [ ] Return on assets
- [ ] JIT
- [ ] New process and product development
- [ ] Quality/Yield improvement
- [ ] Other (Please specify) ________________________________

Essential	**Useful, but not essential**	**Not necessary**

SECTION C: TECHNOLOGY STRATEGY

Please tick the item using the scale of ***essential, useful but not essential*** and ***not necessary*** based on the following statement about technology strategy.

TECHNOLOGY STRATEGY				
Lawshe scale				
Pioneer-Follower Posture Indicate your company's inclination in the use of technology as a means to strategically position itself:		**Essential**	**Useful, but not essential**	**Not necessary**
PFP1	Pursue high technical risk, break-through technologies.			
PFP2	Have reputation for technological innovation.			
PFP3	Strive for dominance in key technologies.			
PFP4	Build a reputation for being the first in the industry to try new methods and technologies.			
PFP5	Become an industry leader in innovation efforts.			
PFP6	Become an early industry entrant on innovation efforts.			
PFP7	Become the first in discovering new technologies.			
PFP8	Become the first in introducing new innovative products.			
PFP9	Become the first in introducing low-cost products.			
Technological Investments: Internal R&D Indicate the extent to the methods by which firms are sponsoring their R&D activities and are of focus to achieve desired return on investment:		**Essential**	**Useful, but not essential**	**Not necessary**
TI10	Maintaining a high level of R&D investment in relation to sales revenue.			
TI11	Ensure R&D investments provide predefined return (estimated profit).			
TI12	Acquire external funding for R&D projects.			
The Intensity of Product Upgrades Intensity of product upgrades refers to the frequency and the number of new products being introduced. Indicate the extent of which each of these statements describe your firm's intensity of product upgrades:		**Essential**	**Useful, but not essential**	**Not necessary**
IPU13	Reduce product development cycle time.			
IPU14	Increase the total number of products offered.			
IPU15	Continuously improve existing products.			
IPU16	Emphasize on new product development.			

IPU17	Increase the rate of new product introductions to the market.			
IPU18	Offer a number of new products.			
External Technology Sources Indicate the extent your firm use strategic alliances, licensing agreements, acquisitions and outright purchase of technology from the third party or external sources:		**Essential**	**Useful, but not essential**	**Not necessary**
ETS19	Use joint ventures for R&D.			
ETS20	Engage heavily in strategic alliances.			
ETS21	Collaborate with universities and research centres in R&D.			
ETS22	Contract out a major portion of its R&D activities.			
Product and Process Technology Indicate the extent new technology is integrated into the firm's manufacturing plants and processes:		**Essential**	**Useful, but not essential**	**Not necessary**
PPT23	Have unique product manufacturing capability (use technology to manufacture unique products).			
PPT24	Use technology to reduce manufacturing cost.			
PPT25	Use technology to improve production flexibility and reduce lead-times.			
PPT26	Achieve high level of automation of plants and facilities.			
PPT27	Use the latest technology in production (up-to-date technological infrastructure).			
PPT28	Apply capital investment in new equipment and machinery.			
R&D Spending Indicate the extent the company is willing to invest in their own R&D activities in the last three years:		**Essential**	**Useful, but not essential**	**Not necessary**
RND29	Allocate average annual spending on R&D as a percent of company sales.			
RND30	Have one of the largest R&D groups in the industry.			
RND31	Have one of the most productive R&D groups in the industry.			
RND32	Spend more on R&D than the competition.			
RND33	Spend more on R&D than the industry average.			
Copyrights and Other Means of Intellectual Capital Protection Indicate the measure company would take in ensuring their right over the intellectual property is protected in the last three years:		**Essential**	**Useful, but not essential**	**Not necessary**

CIC34	Hold important patent rights.			
CIC35	Have more patents than its key competitors.			
CIC36	Use licensing agreements extensively to sell its products.			
CIC37	Increase its patenting efforts.			

SECTION D: EXTERNAL ENVIRONMENT

Please tick the item using the scale of ***essential, useful but not essential*** and ***not necessary*** based on the following statement about external environment.

EXTERNAL ENVIRONMENT				
Lawshe scale				
Dysfunctional competition Indicate the extent to which your firm has experienced the dysfunctional competition in the last three years:		**Essential**	**Useful, but not essential**	**Not necessary**
DC1	Deal with unlawful competitive practices such as illegal copying of new products			
DC2	Endure counterfeit products of your firm and trademarks by other firms			
DC3	Endure ineffective market competitive laws which can protect your firm's intellectual property			
DC4	Deal with the increase of unfair competitive practices by other firms in the industry			
Institutional support Indicate the measures taken by the government and its agencies for the past three years:		**Essential**	**Useful, but not essential**	**Not necessary**
IS1	Implement policies and programmes that are beneficial to your firm's operations			
IS2	Provide needed technology information and technical support to your firm			
IS3	Play a significant role in providing financial support for your firm			
IS4	Help your firm to obtain licenses for imports of technology, manufacturing and other equipment			
Environmental turbulence Rate the degree of your firm's environment/principal industry in the last three years:		**Essential**	**Useful, but not essential**	**Not necessary**
ET1	Deem actions of local and foreign competitors as highly unpredictable			
ET2	Consider market demand and consumer tastes as unpredictable			
ET3	Forecast the impact of technology on the industry as difficult			

ET4	Have changed the product market conditions to be very fast			
Strategic alliance for product development To what extent do these statements describe your firm in the last three years relative compared to your competitors?		**Essential**	**Useful, but not essential**	**Not necessary**
SA1	Have entered into cooperative agreements with other firms to design and manufacture new products			
SA2	Have collaborated with other firms to market new products			
SA3	Have joined other firms to introduce new products			
SA4	Have jointly promoted new product lines with other firms			
SA5	Have jointly distributed and provided support services for new products with other firms			
SA6	Have established cooperative agreements with other firms and institutions for R&D			
Political networking strategy Rate the senior management of your firm over the last three years have:		**Essential**	**Useful, but not essential**	**Not necessary**
PN1	Spend much effort in cultivating personal connections with officials of the government and its agencies			
PN2	Maintain good relationships with officials of state banks and other government financial agencies			
PN3	Devote substantial resources to maintain good relationships with officials of governments and their agencies.			
PN4	Spend a lot of money in developing a relationship with the top officials in the government.			

SECTION F: ORGANIZATIONAL PERFORMANCE

Please tick the item using the scale of ***essential, useful but not essential*** and ***not necessary*** based on the following statement about organizational performance.

Lawshe scale				
ORGANIZATIONAL PERFORMANCE Rate the performance of your organization against your competitors in the last three years:		**Essential**	**Useful, but not essential**	**Not necessary**
F1	Focus on organizational performance measured based on return on assets (ROA).			
F2	Focus on organizational performance measured based on return on equity (ROE).			
F3	Focus on organizational performance measured based on return on sales (ROS).			
F4	Focus on organizational performance measured based on return on investment (ROI).			
F5	Focus on the organization market shares of its main products and markets.			
F6	Focus on the growth of sales of its main products and markets.			
F7	Focus on cash flow margin			
F8	Focus on better organization's profit than its competitor			
NF1	Focus on the number of new products to be launch			
NF2	Focus on the time to market launch			
NF3	Focus on the quality of product performance			
NF4	Focus on material and labour efficiency or productivity			
NF5	Focus on improvement and re-engineering process			
NF6	Focus on employee development and training			
NF7	Focus on customer satisfaction			
NF8	Focus on on-time delivery			
NF9	Focus on relationships with suppliers			
NF10	Focus on workplace relations			
NF11	Focus on employee health and safety			
NF12	Focus on warranty repair cost			

NF13	Focus on customer response time			
NF14	Focus on employee satisfaction			

THANK YOU FOR YOUR TIME AND EFFORTS IN COMPLETING THIS QUESTION

Correspondence details:

Suriani Sukri
PhD Research Candidate
No 2 Taman Seri Meranti
06010, Changlun
Kedah Darul Aman
(E-mail: surianisukri@hotmail.com)
(Phone: 019-5603997)

Appendix E1: Cover Letter for Data Collection

To:

SURVEY ON THE MODERATING EFFECTS OF EXTERNAL ENVIRONMENT ON THE RELATIONSHIP BETWEEN TECHNOLOGY STRATEGY AND ORGANIZATIONAL PERFORMANCE

The objective of this survey is to collect information about the important of technology strategy issues in relation to the performance of Malaysian manufacturing companies. The results will be extremely useful to the management and policy makers of these companies. The survey has been designed and conducted by Suriani Binti Sukri, a PhD student in the field of Management supervised by Professor Dr. Rushami Zien Yusoff of Universiti Utara Malaysia.

Technology strategy in this study is a long-term plan that leads companies to utilize the committed resources toward technology in order to achieve competitive advantage for the manufacturing companies.

Ten minutes of your valuable time in completing this questionnaire would be highly appreciated. Please tick on the most correct or appropriate answer.

Note: Please provide only one response to the question, unless otherwise specified.

All information provided will be treated in strictly with utmost confidentiality and shall be used solely for academic research only.

Thank you very much for your response. May I extend my most sincere gratitude to you for providing the necessary information.

Suriani Binti Sukri
Ph.D. Scholar
Othman Yeop Abdullah
Graduate School of Business
Universiti Utara Malaysia

Appendix E2: Data Collection Letter

OTHMAN YEOP ABDULLAH GRADUATE SCHOOL OF BUSINESS
Universiti Utara Malaysia
06010 UUM SINTOK
KEDAH DARUL AMAN
MALAYSIA

UUM
Universiti Utara Malaysia

Tel.: 604-928 7101/7113/7130
Faks (Fax): 604-928 7160
Laman Web (Web): www.oyagsb.uum.edu.my

UUM/OYAGSB/R-4/4/1
28 July 2019

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

LETTER OF RECOMMENDATION FOR DATA COLLECTION AND RESEARCH WORK

This is to certify that **Suriani Bt. Sukri (Matric No: 901257)** is a student of Othman Yeop Abdullah Graduate School of Business, Universiti Utara Malaysia persuing her Doctor of Philosophy (PhD). She is conducting a research entitled ***"The Moderating Effect of External Environment on The Relationship Between Technology Strategy and Organizational Performance"*** under the supervision of Prof. Dr. Rushami Zien Yusoff.

In this regard, we hope that you could kindly provide assistance and cooperation for her to successfully complete the research. All the information gathered will be strictly used for academic purposes only.

Your cooperation and assistance is very much appreciated.

Thank you.

"BERKHIDMAT UNTUK NEGARA"
"KEDAH AMAN MAKMUR – HARAPAN BERSAMA MAKMURKAN KEDAH"
"ILMU, BUDI, BAKTI"

Yours faithfully

ROZITA BINTI RAMLI
Assistant Registrar
for Dean
Othman Yeop Abdullah Graduate School of Business

c.c - Supervisor
- Student's File (901257)

Universiti Pengurusan Terkemuka
The Eminent Management University

Appendix E3: Survey Questionnaire

SURVEY ON THE MODERATING EFFECTS OF EXTERNAL ENVIRONMENT ON THE RELATIONSHIP BETWEEN TECHNOLOGY STRATEGY AND ORGANIZATIONAL PERFORMANCE

Research Leading to a PhD in Management Conducted by

SURIANI SUKRI

Under the Supervision of

PROFESSOR DR. RUSHAMI ZIEN BIN YUSOFF

UNIVERSITI UTARA MALAYSIA

CONFIDENTIALITY
The views expressed in this questionnaire will be treated as confidential. Information identifying the respondents and their organizations will not be disclosed under any circumstances

SECTION A: GENERAL INFORMATION
Please fill in the following information below and tick (/) at the response that best reflects your background:

1. Company Name

____

2. Your gender

☐ Male
☐ Female

3. Nature of your company

☐ Multinational Corporation Subsidiary (MNC)
☐ Joint Venture
☐ Locally-owned
☐ Purely Foreign Company
☐ Other (Please specify) ___________________________

4. Your current position in the organization:

☐ Chief Executive Officer
☐ Division or Group General Manager
☐ R&D/Technology Manager
☐ Financial Officer
☐ Strategist or Planner
☐ Human Resource Manager
☐ Managing Director
☐ Deputy Managing Director
☐ Factory Manager
☐ Other (Please specify) ___________________________

SECTION B: BACKGROUND

Please fill in the necessary information and tick (/) the most appropriate option that represents your organization:

5. The number of employees in the organization:

- [ ] Less than 50
- [ ] Between 50 and 300 employees
- [ ] Between 301 and 1000 employees
- [ ] Between 1001 and 3000 employees
- [ ] More than 3000 employees
- [ ] Other (Please specify) ________________________________

6. The main industry (listed in FMM) or activity of your company

- [ ] Manufacture of food products, beverages and tobacco
- [ ] Textile, wearing apparel, leather and footwear
- [ ] Wood, furniture, paper products and printing
- [ ] Petroleum, chemical, rubber and plastic
- [ ] Non-metallic mineral products, basic metal and fabricated metal products, machinery and equipment
- [ ] Electrical, electronic, computing machinery parts
- [ ] Transport equipment and other manufacturers
- [ ] Other manufacturing activities (Please specify) ____

7. Name of your major products:

____

_

8. The approximate value of total capital investment in the past 3 years:

- [ ] Less than RM100 million
- [ ] Between RM101 million and RM200 million
- [ ] Between RM201 million and RM500 million
- [ ] Between RM501 million and RM1000 million
- [ ] Between RM1001 million and RM2000 million
- [ ] Greater than RM2000 million

9. Your corporation's average Total Net Profit for the last 3 years:

- [ ] Less than RM100 million
- [ ] Between RM101 million and RM200 million

☐ Between RM201 million and RM500 million
☐ Between RM501 million and RM1000 million
☐ Between RM1001 million and RM2000 million
☐ Greater than RM2000 million

10. Has your corporation been involved in the ISO 14000 activities?
☐ Yes
☐ No

11. Do you have R&D Department/Section?

☐ Yes
☐ No Skip Qs 12 to 14 and Go directly to Qs.15

12. The number of workers in your R&D Department

☐ Less than 5
☐ Between 5 and 10
☐ Between 11 and 20
☐ More than 21

13. Do you have engineers in your R&D Department?

☐ Yes
☐ No

14. Do you have engineers in your R&D Department having lot of field/R&D experience?

☐ 1 – 3 years
☐ 3 – 5 years
☐ More than 5 years

15. Your corporation's average sales turnover for the last 3 years:
☐ Less than RM25 million
☐ Between RM25 million and RM100 million
☐ Between RM101 million and RM500 million
☐ Between RM501 million and RM1000 million

☐ Between RM1001 million and RM2000 million
☐ Other (Please specify) ____________________________

16. Your major performance benchmark (Tick one only)

☐ Return on sales (ROS = Profit ÷ Revenue)
☐ Revenue growth (or sales growth)
☐ Market share growth
☐ Return on shareholders equity
☐ Return on assets
☐ JIT
☐ New process and product development
☐ Quality/Yield improvement
☐ Other (Please specify) ____________________________

17. What do you consider as the three most important factors affecting share of your major market in the past 3 years? Please rank the first, second and third factors against the correct response.

Rank
(1, 2 & 3)
☐ Changes in target market
☐ Changes in technology
☐ Changes in product features or performance
☐ Changes in manufacturing methods
☐ Acquisitions/divestures of business or product lines
☐ External changes
☐ Cost comparison
☐ Other (Please specify) ____________________________

SECTION C: TECHNOLOGY STRATEGY

Please *circle* at the most appropriate level in relation to the statement provided.

Items	Statements	Level					
Pioneer-Follower Posture Indicate your company's inclination in the use of technology as a means to strategically position itself:							
		Low					High
PFP1	Pursue high technical risk, break-through technologies.	1	2	3	4	5	6
PFP2	Have reputation for technological innovation.	1	2	3	4	5	6
PFP3	Strive for dominance in key technologies.	1	2	3	4	5	6
PFP4	Build a reputation for being the first in the industry to try new methods and technologies.	1	2	3	4	5	6
PFP5	Become an industry leader in innovation efforts.	1	2	3	4	5	6
PFP6	Become an early industry entrant on innovation efforts.	1	2	3	4	5	6
PFP7	Become the first in discovering new technologies.	1	2	3	4	5	6
PFP8	Become the first in introducing new innovative products.	1	2	3	4	5	6
PFP9	Become the first in introducing low-cost products.	1	2	3	4	5	6
Technological Investments: Internal R&D Indicate the extent to the methods by which firms are sponsoring their R&D activities and are of focus to achieve desired return on investment:							
		Low					High
TI10	Maintaining a high level of R&D investment in relation to sales revenue.	1	2	3	4	5	6
TI11	Ensure R&D investments provide predefined return (estimated profit).	1	2	3	4	5	6
TI12	Acquire external funding for R&D projects.	1	2	3	4	5	6
TI13	Allocate average annual spending on R&D as a percent of company sales.	1	2	3	4	5	6
TI14	Have one of the largest R&D groups in the industry.	1	2	3	4	5	6
TI15	Have one of the most productive R&D groups in the industry.	1	2	3	4	5	6

TI16	Spend more on R&D than the competition.	1	2	3	4	5	6
TI17	Spend more on R&D than the industry average.	1	2	3	4	5	6

The Intensity of Product Upgrades
Intensity of product upgrades refers to the frequency and the number of new products being introduced. Indicate the extent of which each of these statements describe your firm's intensity of product upgrades:

		Low					High
IPU18	Reduce product development cycle time.	1	2	3	4	5	6
IPU19	Increase the total number of products offered.	1	2	3	4	5	6
IPU20	Continuously improve existing products.	1	2	3	4	5	6
IPU21	Emphasize on new product development.	1	2	3	4	5	6
IPU22	Increase the rate of new product introductions to the market.	1	2	3	4	5	6
IPU23	Offer a number of new products.	1	2	3	4	5	6

External Technology Sources
Indicate the extent your firm use strategic alliances, licensing agreements, acquisitions and outright purchase of technology from the third party or external sources:

		Low					High
ETS24	Use joint ventures for R&D.	1	2	3	4	5	6
ETS25	Engage heavily in strategic alliances.	1	2	3	4	5	6
ETS26	Collaborate with universities and research centres in R&D.	1	2	3	4	5	6
ETS27	Contract out a major portion of its R&D activities.	1	2	3	4	5	6

Product and Process Technology
Indicate the extent new technology is integrated into the firm's manufacturing plants and processes:

		Low					High
PPT28	Have unique product manufacturing capability (use technology to manufacture unique products).	1	2	3	4	5	6
PPT29	Use technology to reduce manufacturing cost.	1	2	3	4	5	6

PPT30	Use technology to improve production flexibility and reduce lead-times.	1	2	3	4	5	6
PPT31	Achieve high level of automation of plants and facilities.	1	2	3	4	5	6
PPT32	Use the latest technology in production (up-to-date technological infrastructure).	1	2	3	4	5	6
PPT33	Apply capital investment in new equipment and machinery.	1	2	3	4	5	6

SECTION D: EXTERNAL ENVIRONMENT

Please _circle_ at the most appropriate level in relation to the statement provided.

Items	Statements	Level					
Dysfunctional competition Indicate the extent to which your firm has experienced the dysfunctional competition in the last three years:							
		Strongly disagree					Strongly agree
DC1	Deal with unlawful competitive practices such as illegal copying of new products	1	2	3	4	5	6
DC2	Endure counterfeit products of your firm and trademarks by other firms	1	2	3	4	5	6
DC3	Endure ineffective market competitive laws which can protect your firm's intellectual property	1	2	3	4	5	6
DC4	Deal with the increase of unfair competitive practices by other firms in the industry	1	2	3	4	5	6
Institutional support Indicate the measures taken by the government and its agencies for the past three years:							
		Low					High
IS1	Implement policies and programmes that are beneficial to your firm's operations	1	2	3	4	5	6
IS2	Provide needed technology information and technical support to your firm	1	2	3	4	5	6
IS3	Play a significant role in providing financial support for your firm	1	2	3	4	5	6
IS4	Help your firm to obtain licenses for imports of technology, manufacturing and other equipment	1	2	3	4	5	6

Environmental turbulence
Rate the degree of your firm's environment/principal industry in the last three years:

		Strongly disagree					Strongly agree
ET1	Deem actions of local and foreign competitors as highly unpredictable	1	2	3	4	5	6
ET2	Consider market demand and consumer tastes as unpredictable	1	2	3	4	5	6
ET3	Forecast the impact of technology on the industry as difficult	1	2	3	4	5	6
ET4	Have changed the product market conditions to be very fast	1	2	3	4	5	6

Strategic alliance for product development
To what extent do these statements describe your firm in the last three years relative compared to your competitors?

		Strongly disagree					Strongly agree
SA1	Have entered into cooperative agreements with other firms to design and manufacture new products	1	2	3	4	5	6
SA2	Have collaborated with other firms to market new products	1	2	3	4	5	6
SA3	Have joined other firms to introduce new products	1	2	3	4	5	6
SA4	Have jointly promoted new product lines with other firms	1	2	3	4	5	6
SA5	Have jointly distributed and provided support services for new products with other firms	1	2	3	4	5	6
SA6	Have established cooperative agreements with other firms and institutions for R&D	1	2	3	4	5	6

Political networking strategy
Rate the senior management of your firm over the last three years have:

		Low					High
PN1	Spend much effort in cultivating personal connections with officials of the government and its agencies	1	2	3	4	5	6
PN2	Maintain good relationships with officials of state banks and other government financial agencies	1	2	3	4	5	6
PN3	Devote substantial resources to maintain good relationships with officials of governments and their agencies.	1	2	3	4	5	6
PN4	Spend a lot of money in developing a relationship with the top officials in the government.	1	2	3	4	5	6

SECTION E: ORGANIZATIONAL PERFORMANCE

Please *circle* at the most appropriate level in relation to the statement provided.

Items	Statements	Level					
ORGANIZATIONAL PERFORMANCE Rate the performance of your organization against your competitors in the last three years:		Low					High
F1	Focus on organizational performance measured based on return on assets (ROA).	1	2	3	4	5	6
F2	Focus on organizational performance measured based on return on equity (ROE).	1	2	3	4	5	6
F3	Focus on organizational performance measured based on return on sales (ROS).	1	2	3	4	5	6
F4	Focus on organizational performance measured based on return on investment (ROI).	1	2	3	4	5	6
F5	Focus on the organization market shares of its main products and markets.	1	2	3	4	5	6
F6	Focus on the growth of sales of its main products and markets.	1	2	3	4	5	6
F7	Focus on better organization's profit than its competitor	1	2	3	4	5	6
NF1	Focus on the number of new products to be launch	1	2	3	4	5	6
NF2	Focus on the time to market launch	1	2	3	4	5	6
NF3	Focus on improvement and re-engineering process	1	2	3	4	5	6

THANK YOU FOR YOUR TIME AND EFFORTS IN COMPLETING THIS QUESTIONNAIRE

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Appendix E4: Malay Version of Questionnaire

Kepada:

KAJIAN TERHADAP KESAN PENYEDERHANAAN PERSEKITARAN LUAR TERHADAP HUBUNGAN ANTARA STRATEGI TEKNOLOGI DAN PRESTASI ORGANISASI

Objektif tinjauan ini adalah untuk mengumpulkan maklumat mengenai pentingnya isu strategi teknologi yang berkaitan dengan prestasi syarikat pembuatan Malaysia. Hasilnya akan sangat berguna bagi pengurusan dan pembuat dasar syarikat-syarikat ini. Tinjauan ini telah dirancang dan dijalankan oleh Suriani Binti Sukri, seorang pelajar doktor falsafah dalam bidang Pengurusan yang diselia oleh Profesor Dr. Rushami Zien Yusoff dari Universiti Utara Malaysia.

Strategi teknologi dalam kajian ini adalah rencana jangka panjang yang mendorong perusahaan untuk menggunakan sumber daya yang komited terhadap teknologi untuk mencapai kelebihan daya saing bagi perusahaan pembuatan.

Sepuluh minit masa berharga anda dalam mengisi soal selidik ini akan sangat dihargai. Sila tandakan jawapan yang paling betul atau sesuai.

Catatan: Berikan hanya satu jawapan untuk soalan itu, kecuali dinyatakan sebaliknya.

Semua maklumat yang diberikan akan dilayan dengan penuh kerahsiaan dan harus digunakan hanya untuk penyelidikan akademik sahaja.

Terima kasih banyak atas jawapan anda. Saya mengucapkan jutaan terima kasih yang tidak terhingga kepada anda kerana memberikan maklumat yang diperlukan.

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BAHAGIAN A: MAKLUMAT AM

Sila isikan maklumat berikut dan tandakan (/) pada jawapan yang paling tepat mengenai latar belakang diri anda:

1. Nama syarikat

____

2. Jantina anda

- [ ] Lelaki
- [ ] Female

3. Sifat syarikat anda

- [ ] Anak Syarikat Perbadanan Multinasional (MNC)
- [ ] Usaha sama
- [ ] Milikan tempatan
- [ ] Syarikat Milikan Asing sepenuhnya
- [ ] Lain-lain (Sila nyatakan) ___________________________

4. Jawatan anda dalam organisasi sekarang:

- [ ] Ketua Pegawai Eksekutif
- [ ] Pengurus Besar Bahagian atau Kumpulan
- [ ] Pengurus R&D/Teknologi
- [ ] Pegawai Kewangan
- [ ] Pakar Strategi atau Perancang
- [ ] Pengurus Sumber Manusia
- [ ] Pengarah Urusan
- [ ] Timbalan Pengarah Urusan
- [ ] Pengurus Kilang
- [ ] Lain-lain (Sila nyatakan) ___________________________

BAHAGIAN B: LATAR BELAKANG

Sila isikan maklumat yang berkenaan dan tandakan (/) pada pilihan yang sesuai mengenai organisasi anda:

5. Jumlah pekerja dalam organisasi:

- [ ] Kurang daripada 50
- [ ] Antara 50 dan 300 pekerja
- [ ] Antara 301 dan 1000 pekerja
- [ ] Antara 1001 dan 3000 pekerja

☐ Lebih daripada 3000 pekerja
☐ Lain-lain (Sila nyatakan) ____________________________________

6. Industri utama (tersenarai dalam FMM) aktiviti syarikat anda

☐ Pembuatan produk makanan, minuman dan tembakau
☐ Tekstil, pakaian, kulit dan kasut
☐ Produk kayu, perabot, kertas dan percetakan
☐ Petroleum, bahan kimia, getah dan plastik
☐ Produk mineral bukan logam, produk logam asas dan logam fabrikasi, mesin dan peralatan
☐ Bahagian mesin elektrik, elektronik, perkomputeran
☐ Peralatan pengangkutan dan pembuatan lain
☐ Aktiviti-aktiviti pembuatan lain (Sila nyatakan)
____

7. Nama produk utama anda:

____
_

8. Anggaran nilai jumlah pelaburan modal dalam 3 tahun kebelakangan:

☐ Kurang daripada RM100 juta
☐ Antara RM101 juta and RM200 juta
☐ Antara RM201 juta and RM500 juta
☐ Antara RM501 juta and RM1000 juta
☐ Antara RM1001 juta and RM2000 juta
☐ Lebih daripada RM2000 juta

9. Purata jumlah untung bersih syarikat anda bagi tiga tahun terakhir:

☐ Kurang daripada RM100 juta
☐ Antara RM101 juta and RM200 juta
☐ Antara RM201 juta and RM500 juta
☐ Antara RM501 juta and RM1000 juta
☐ Antara RM1001 juta and RM2000 juta
☐ Lebih daripada RM2000 juta

10. Pernahkah syarikat anda terlibat dengan aktiviti-aktiviti ISO 14000?

☐ Ya
☐ Tidak

11. Adakah anda mempunyai Jabatan/ Bahagian R&D?

- [ ] Ya
- [ ] Tidak   Langkau soalan 12 hingga 14 dan terus ke soalan 15

12. Jumlah pekerja dalam Jabatan R&D

- [ ] Kurang daripada 5
- [ ] Antara 5 dan 10
- [ ] Antara 11 dan 20
- [ ] Lebih daripada 21

13. Adakah anda mempunyai jurutera di Jabatan R&D?

- [ ] Yes
- [ ] No

14. Adakah jurutera di Jabatan R&D mempunyai banyak pengalaman dalam bidang R&D?

- [ ] 1 – 3 tahun
- [ ] 3 – 5 tahun
- [ ] Lebih daripada 5 tahun

15. Perolehan purata jualan syarikat anda bagi tiga tahun terakhir:

- [ ] Kurang daripada RM25 juta
- [ ] Antara RM25 juta dan RM100 juta
- [ ] Antara RM101 juta dan RM500 juta
- [ ] Antara RM501 juta dan RM1000 juta
- [ ] Antara RM1001 juta dan RM2000 juta
- [ ] Lain-lain (Sila nyatakan) ___________________________________

16. Penanda aras prestasi utama anda (Tanda satu sahaja)

- [ ] Pulangan jualan (ROS = Untung ÷ Pendapatan)
- [ ] Pertumbuhan pendapatan (atau pertumbuhan jualan)
- [ ] Perumbuhan pasaran saham

	Pulangan ekuiti pemegang saham
	Pulangan aset
	JIT
	Proses baharu dan pembangunan produk
	Peningkatan kualiti / hasil
	Lain-lain (Sila nyatakan) ___________________________________

17. Apakah faktor yang anda anggap sebagai tiga faktor utama yang mempengaruhi pasaran utama saham syarikat bagi 3 tahun terakhir? Sila nilaikan faktor pertama, kedua dan ketiga pada jawapan yang betul.

Nilai
(1, 2 & 3)

	Perubahan dalam sasaran pasaran
	Perubahan dalam teknologi
	Perubahan dalam ciri-ciri atau prestasi produk
	Perubahan dalam kaedah pembuatan
	Perolehan / penjualan perniagaan atau barisan produk
	Perubahan luaran
	Perbandingan kos
	Lain-lain (Sila nyatakan) ___________________________________

BAHAGIAN C: STRATEGI TEKNOLOGI

Sila *bulatkan* pada tahap yang paling sesuai berdasarkan penyataan yang diberikan.

Butiran	Penyataan	Tahap					
Postur Perintis-Pengikut Nyatakan kecenderungan syarikat anda dalam penggunaan teknologi sebagai kaedah untuk meletakkan dirinya secara strategik:		Rendah					Tinggi
PFP1	Mengejar risiko teknikal tinggi, teknologi ulung (*break-through technologies*).	1	2	3	4	5	6
PFP2	Mempunyai reputasi untuk inovasi teknologi	1	2	3	4	5	6
PFP3	Berusaha untuk menguasai teknologi utama	1	2	3	4	5	6
PFP4	Membina reputasi sebagai syarikat yang pertama dalam industri untuk mencuba kaedah dan teknologi baharu	1	2	3	4	5	6
PFP5	Menjadi peneraju industri dalam usaha inovasi.	1	2	3	4	5	6

PFP6	Menjadi pesaing industri awal dalam usaha inovasi.	1	2	3	4	5	6
PFP7	Menjadi syarikat yang pertama dalam penemuan teknologi baharu	1	2	3	4	5	6
PFP8	Menjadi syarikat yang pertama dalam memperkenalkan produk inovatif baharu	1	2	3	4	5	6
PFP9	Menjadi syarikat yang pertama dalam memperkenalkan produk kos rendah	1	2	3	4	5	6

Pelaburan Teknologi: R&D Dalaman

Nyatakan sejauh mana kaedah dengan syarikat yang menaja aktiviti R&D mereka dan yang memberi tumpuan untuk mencapai pulangan pelaburan yang diinginkan:

		Rendah					Tinggi
TI10	Mengekalkan pelaburan tinggi dalam R&D tinggi yang berkaitan dengan hasil jualan.	1	2	3	4	5	6
TI11	Memastikan pelaburan R&D memberikan pulangan yang ditentukan (anggaran keuntungan).	1	2	3	4	5	6
TI12	Mendapatkan dana luar untuk projek R&D.	1	2	3	4	5	6
TI13	Memperuntukkan purata perbelanjaan untuk R&D sebagai peratus jualan syarikat.	1	2	3	4	5	6
TI14	Mempunyai salah satu kumpulan R&D terbesar dalam industri.	1	2	3	4	5	6
TI15	Mempunyai salah satu kumpulan R&D paling produktif dalam industri.	1	2	3	4	5	6
TI16	Berbelanja lebih ke atas R&D berbanding persaingan.	1	2	3	4	5	6
TI17	Berbelanja lebih ke atas R&D berbanding purata industri.	1	2	3	4	5	6

Keamatan Peningkatan Produk

Keamatan peningkatan produk merujuk kepada kekerapan dan jumlah produk baharu yang diperkenalkan. Nyatakan sejauh mana setiap penyataan berikut menggambarkan keamatan peningkatan produk syarikat anda:

		Rendah					Tinggi
IPU18	Mengurangkan masa kitaran perkembangan produk.	1	2	3	4	5	6
IPU19	Meningkatkan jumlah produk yang ditawarkan.	1	2	3	4	5	6
IPU20	Menambah baik produk sedia ada secara berterusan.	1	2	3	4	5	6
IPU21	Memberi tumpuan kepada perkembangan produk baharu.	1	2	3	4	5	6
IPU22	Meningkatkan kadar pengenalan produk baharu kepada pasaran.	1	2	3	4	5	6

IPU23	Menawarkan sejumlah produk baharu.	1	2	3	4	5	6
	Sumber Teknologi Luar Nyatakan sejauh mana syarikat anda menggunakan pakatan strategik, perjanjian perlesenan, pemerolehan dan pembelian teknologi secara langsung dari pihak ketiga atau sumber luaran:						
		Rendah					Tinggi
ETS24	Mengadakan usaha sama untuk R&D.	1	2	3	4	5	6
ETS25	Terlibat dalam pakatan strategik.	1	2	3	4	5	6
ETS26	Bekerjasama dengan universiti dan pusat penyelidikan dalam R&D.	1	2	3	4	5	6
ETS27	Mendapatkan sebahagian besar kontrak aktiviti R&D.	1	2	3	4	5	6
	Produk dan Proses Teknologi Nyatakan sejauh mana teknologi baharu yang disatukan ke dalam kilang dan proses pembuatan:						
		Rendah					Tinggi
PPT28	Mempunyai keupayaan pembuatan produk yang unik (menggunakan teknologi untuk pembuatan produk yang unik).	1	2	3	4	5	6
PPT29	Menggunakan teknologi untuk mengurangkan kos pembuatan.	1	2	3	4	5	6
PPT30	Menggunakan teknologi untuk meningkatkan fleksibiliti pengeluaran dan mengurangkan masa menunggu.	1	2	3	4	5	6
PPT31	Mencapai automasi kilang dan kemudahan yang tinggi. / pada tahap yang tinggi.	1	2	3	4	5	6
PPT32	Menggunakan teknologi terbaru dalam pengeluaran (insfrastruktur teknologi terkini)	1	2	3	4	5	6
PPT33	Menerapkan pelaburan modal dalam peralatan dan jentera baharu.	1	2	3	4	5	6

BAHAGIAN D: PERSEKITARAN LUARAN

Sila <u>*bulatkan*</u> pada tahap yang paling sesuai berdasarkan penyataan yang diberikan.

Butiran	Penyataan	Tahap					
Persaingan Tidak Berfungsi Nyatakan sejauh mana syarikat anda mengalami persaingan tidak berfungsi dalam tiga tahun terakhir: Sangat tidak setuju Sangat setuju							
DC1	Menangani amalan persaingan yang menyalahi undang-undang seperti peniruan haram produk baharu.	1	2	3	4	5	6
DC2	Berhadapan dengan produk tiruan syarikat dan tanda dagangan oleh syarikat lain.	1	2	3	4	5	6
DC3	Berhadapan dengan undang-undang pasaran yang tidak berkesan yang dapat melindungi harta intelek syarikat.	1	2	3	4	5	6
DC4	Menangani peningkatan amalan persaingan tidak adil oleh syarikat lain dalam industri.	1	2	3	4	5	6
Sokongan Institusi Nyatakan langkah-langkah yang diambil oleh kerajaan dan agensinya bagi tiga tahun terakhir: Rendah Tinggi							
IS1	Melaksanakan dasar dan program yang bermanfaat kepada operasi syarikat anda.	1	2	3	4	5	6
IS2	Menyediakan maklumat teknologi dan sokongan teknikal yang diperlukan kepada syarikat anda.	1	2	3	4	5	6
IS3	Memainkan peranan penting dalam menyediakan sokongan kewangan kepada syarikat anda.	1	2	3	4	5	6
IS4	Membantu syarikat anda untuk mendapatkan lesen mengimport teknologi, pembuatan dan lain-lain peralatan.	1	2	3	4	5	6
Pergolakan Persekitaran Nilai tahap persekitaran syarikat / industri utama syarikat anda dalam tiga tahun terakhir: Sangat Tidak Setuju Sangat setuju							
ET1	Menyifatkan tindakan pesaing tempatan dan asing sebagai sangat tidak boleh diramal.	1	2	3	4	5	6
ET2	Menganggap permintaan pasaran dan citarasa pengguna tidak dapat diramalkan.	1	2	3	4	5	6
ET3	Meramalkan kesan teknologi ke atas industri sebagai sukar.	1	2	3	4	5	6

ET4	Telah mengubah keadaan pasaran produk menjadi sangat pantas.	1	2	3	4	5	6
Pakatan strategik untuk pembangunan produk Sejauh mana penyataan berikut menggambarkan syarikat anda dalam tiga tahun terakhir ini berbanding pesaing anda?		Sangat Tidak Setuju					Sangat setuju
SA1	Telah membuat perjanjian kerjasama dengan syarikat lain untuk mereka dan mengeluarkan produk baharu.	1	2	3	4	5	6
SA2	Telah bekerjasama dengan syarikat lain untuk memasarkan produk baharu.	1	2	3	4	5	6
SA3	Telah bergabung dengan syarikat lain untuk memperkenalkan produk baharu.	1	2	3	4	5	6
SA4	Telah bersama-sama mempromosikan barisan produk baharu dengan syarikat lain.	1	2	3	4	5	6
SA5	Telah bersama-sama mengedarkan dan memberikan perkhidmatan sokongan untuk produk baharu dengan syarikat lain.	1	2	3	4	5	6
SA6	Telah mempunyai perjanjian kerjasama dengan syarikat dan institusi lain untuk R&D	1	2	3	4	5	6
Strategi Rangkaian Politik Nilaikan pengurusan kanan syarikat anda dalam tiga tahun terakhir yang:		Rendah					Tinggi
PN1	Banyak berusaha dalam menjalinkan hubungan peribadi dengan pegawai kerajaan dan agensinya.	1	2	3	4	5	6
PN2	Menjaga hubungan baik dengan pegawai bank negara dan agensi kewangan kerajaan lain.	1	2	3	4	5	6
PN3	Memberi tumpuan kepada sumber yang banyak untuk mengekalkan hubungan yang baik dengan pegawai kerajaan dan agensi mereka.	1	2	3	4	5	6
PN4	Membelanjakan wang yang banyak untuk membina hubungan dengan pegawai atasan dalam kerajaan.	1	2	3	4	5	6

BAHAGIAN E: PRESTASI SYARIKAT

Sila *bulatkan* pada tahap yang paling sesuai berdasarkan penyataan yang diberikan.

Butiran	Penyataan	Tahap					
PRESTASI ORGANISASI Nilai prestasi syarikat anda berbanding pesaing dalam tiga tahun terakhir:		Rendah					Tinggi
F1	Memberi tumpuan kepada pengukuran prestasi organisasi berdasarkan pulangan aset (ROA).	1	2	3	4	5	6
F2	Memberi tumpuan kepada pengukuran prestasi organisasi berdasarkan pulangan ekuiti (ROE).	1	2	3	4	5	6
F3	Memberi tumpuan kepada pengukuran prestasi organisasi berdasarkan pulangan jualan (ROS).	1	2	3	4	5	6
F4	Memberi tumpuan kepada pengukuran prestasi organisasi berdasarkan pulangan pelaburan (ROI).	1	2	3	4	5	6
F5	Memberi tumpuan kepada pasaran saham organisasi dari produk utama dan pasaran.	1	2	3	4	5	6
F6	Memberi tumpuan kepada pertumbuhan jualan produk utama dan pasaran.	1	2	3	4	5	6
F7	Memberi tumpuan kepada keuntungan syarikat yang lebih baik berbanding pesaing.	1	2	3	4	5	6
NF1	Memberi tumpuan kepada jumlah produk baharu yang akan dilancarkan.	1	2	3	4	5	6
NF2	Memberi tumpuan terhadap masa pelancaran pasaran	1	2	3	4	5	6
NF3	Memberi tumpuan terhadap proses penambahbaikan dan perekayasaan	1	2	3	4	5	6

TERIMA KASIH KERANA SUDI MELUANGKAN MASA UNTUK MELENGKAPKAN SOAL SELIDIK INI

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