EFFECT OF THE MANUFACTURING PRACTICES AND TECHNOLOGICAL CAPABILITY ON MANUFACTURING PERFORMANCE IN MALAYSIA

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ABSTRACT

Presently, despite the notably enhanced performance, there is a concern about low implementation on technological incorporation and insufficient technological capabilities (TCs) in manufacturing companies in Malaysia. There is also a loophole in aligning the firm's manufacturing strategies, its objectives and its capabilities. This research aimed to analyze the TC moderating effect on practices and performance relationship. A quantitative research with stratified random sampling procedure was employed to gather responses from 175 manufacturers in Malaysia. Hierarchical regression analyses revealed that two levels of TC, namely technological acquiring capability (TAC) and technological upgrading capability (TUC) have impacted the practices-performance relationships very minimally. TAC moderated the relationship between: strategic supplier partnership (SSP) and setup-time reduction with quality; information technology (IT), SSP, and quality culture (QC) with flexibility; QC with cost; and customer relationship (CR), information sharing, SSP, and QC with delivery. TUC moderated the relationship between IT and QC with cost; and between CR, QC, and production layout with delivery. However, TUC did not influence the relationships between manufacturing practices dimensions and, both quality and flexibility. The study contributes firstly, to the body of knowledge by examining the moderating roles of TC. Secondly, it complements the resource-based view (RBV) theory regarding the interconnection between firm resources, routines, capabilities, and performance. Thirdly, it particularly benefits the industrial practitioners, where the study provides the latest practical information and reveals the current status of the industry. Fourthly, the practitioners are also at an advantage when they are aware of the strategies, highlighted in this study, of overcoming the anticipated challenges in the business. Finally, the study supports the idea that every practice and capability implemented within the company will eventually affect a certain area of performance.

Keywords: manufacturing performance, technological capability, manufacturing practices

ABSTRAK

Pada masa kini, terdapat kebimbangan tentang kekurangan pelaksanaan penggabungan teknologi dan keupayaan teknologi (TC) yang tidak mencukupi dalam syarikat-syarikat pembuatan di Malaysia walaupun prestasinya telah dipertingkatkan. Di sampimg itu, terdapat juga kelemahan dalam penjajaran antara strategi pembuatan syarikat, objektif dan keupayaan. Tujuan kajian ini dilakukan adalah untuk menganalisis kesan penyederhana TC terhadap hubungan amalan dan prestasi. Satu penyelidikan kuantitatif dengan prosedur persampelan rawak berstrata telah digunakan untuk mengumpul jawapan daripada 175 pengilang di Malaysia. Analisis regresi hierarki mendedahkan bahawa terdapat dua tahap TC iaitu; keupayaan memperoleh teknologi (TAC) dan keupayaan peningkatan teknologi (TUC), yang telah memberi kesan kepada hubungan amalan-prestasi paling minimum. TAC menyederhana hubungan antara; pembekal strategik (SSP) dan persediaan-pengurangan masa dengan kualiti; teknologi maklumat (IT), SSP, dan budaya kualiti (QC) dengan fleksibiliti; QC dengan kos; dan hubungan pelanggan (CR), perkongsian maklumat, SSP, dan QC dengan penghantaran. Manakala, TUC menyederhana hubungan antara; IT dan QC dengan kos; dan antara CR, QC, dan susun atur pengeluaran dengan penghantaran. Walau bagaimanapun, TUC tidak mempengaruhi hubungan antara dimensi amalan pengilangan dengan kedua-dua kualiti dan fleksibiliti. Terdapat beberapa sumbangan yang telah diberikan oleh kajian ini. Sumbangan yang pertama ialah kepada khazanah ilmu dengan mengkaji peranan penyederhana TC. Kedua, kajian ini melengkapkan teori pandangan berasaskan sumber (RBV) berkaitan saling hubungan antara sumber dalam syarikat, rutin, keupayaan, dan prestasi. Sumbangan ketiga ialah kepada pengamal industri, kerana kajian ini menyediakan maklumat praktikal yang terkini dan mendedahkan status semasa tentang industri. Sumbangan keempat ialah memberi kelebihan kepada pengamal kerana telah mengetahui strategi bagi mengatasi cabaran-cabaran yang dijangkakan dalam perniagaan. Akhir sekali, kajian ini menyokong idea bahawa setiap amalan dan keupayaan yang dilaksanakan dalam syarikat akan mempengaruhi prestasi tertentu.

Kata kunci: prestasi pembuatan, keupayaan teknologikal, amalan pengilangan

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سبحان الله والحمد لله ولا إله إلا الله والله أكبر

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LIST OF ABBREVIATION

Abbreviation	**Description of Abbreviation**
10MP	Tenth Malaysia Plan
BNM	Bank Negara Malaysia
CR	Customer Relationship
FDI	Foreign Direct Investment
GCI	Global Competitiveness Index
GDP	Growth Domestic Product
GMRG	Global Manufacturing Research Group
HRM	Human Resource Management
IMP	Industrial Master Plan
IS	Information Sharing
IT	Information Technology
JIT	Just-in-Time
MIDA	Malaysian Investment Development Authority
MITI	Ministry of International Trade and Industry
MP	Manufacturing Performance
MPC	Malaysia Productivity Corporation
NEP	New Economic Policy
NPD	New Product Development
OECD	Organization of Economic Corporation Development
OUM	Open University Malaysia
PL	Production Layout
QC	Quality Culture
RBV	Resource-Based View
SCM	Supply Chain Management
SME	Small and Medium Enterprise
SSP	Strategic Supplier Partnership
STR	Setup-Time Reduction
TAC	Technological Acquiring Capability
TC	Technological Capability
TESL	Teaching English as a Second Language
TQM	Total Quality Management
TUC	Technological Upgrading Capability
UNCTAD	United Nations Conference on Trade and Development
WCM	World Class Manufacturing

CHAPTER ONE

INTRODUCTION

1.1 Introduction

In the introductory chapter, the thesis will be presenting eight main subsections. The thesis starts with a brief introduction on background of the study and followed by the problem statements. After that, the researcher will forward a set of research questions that lead to the development of research objectives. Theoretical and practical contributions in pursuing the research will be discussed later on followed by the research scope and limitation. Consequently, the definition of the key concepts will be stated accordingly before arriving at the final subsection which concludes overall thesis arrangement.

1.2 Background of the Study

Manufacturing sector has become the driving force for the industrial development in late-industrializing economies (Lall, 1995). Manufacturing propels Malaysian growth and industrialization since the launched of the New Economy Policy (NEP) in 1971. Manufacturing sector was known for its dynamic roles which contributed to the expansion of its own growth and also other sectors (Rasiah, 1996). The government of Malaysia is highly committed in improving and enhancing its manufacturing sector to be one of the key sector for industrial development of the country through series of strategic government plans such as the Malaysian Plan (MP) and the more specific indicative plan of Industrial Master Plan (IMP). About twenty years ago, the government of Malaysia started to concentrate on the development and improvement in the manufacturing sector. This sector is considered as the leading catalyst to the world economic and contributed to the economic growth mostly in the developing countries (Islam, Hamid, & Karim, 2007). In the early stage, the growth of manufacturing shows a rapid increase in exports as compared to other sectors. It started sluggish in early to late 1960's, and grew stronger when foreign firms started to expand local export processing operations (Rasiah, 1996).

Serious attention has been given to the manufacturing sector as indicated in the Tenth Malaysian Plan (10MP), alongside other sectors of agriculture, construction, mining and quarrying, and services to accelerate the national economic growth that is driven by knowledge and high technology based industries that would contribute in the Gross Domestic Product (GDP). In the mission to achieve greater global competitiveness, the government aims to expand the economic growth in manufacturing sector at 5.6 percent annually and contributes 28.5 percent to GDP in the year 2020 with the total investments of RM412.2 billion or RM27.5 billion annually (IMP3, 2006). Table 1.1 represents the national GDP growth since 2005 until 2013, where there was somewhat a decrease from 5.6 percent in 2012 to 4.7 percent in 2013.

Table 1.1
Malaysia Gross Domestic Product Growth

Year	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
GDP	n.a.	5.6	6.3	4.8	-1.5	7.4	5.2	5.6	4.7

Source: Adopted from Gross Domestic Product Reports 2005-2013, Department of Statistics Malaysia (2014), *p. VI*

Although it appears a slight decrease on the percentage of contribution to GDP of the country over the last three years, manufacturing sector continues to compete and remained resilient, represents 24.5 percent of GDP in 2013 behind the services sector as depicted in Table 1.2. As the growing contribution of manufacturing sector to the national GDP, total exports and employment are all on an upward trend reported by

Karim, Smith, Halgamuge, and Islam (2008b), however, it showed the opposite trend of contribution to GDP of manufacturing sector from four years back.

Table 1.2
Malaysia's GDP Percentage Share

Year	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Agriculture	8.3	8.3	7.9	7.8	7.9	7.6	7.6	7.3	7.1
Construction	3.0	2.8	2.9	2.8	3.1	3.2	3.2	3.5	3.8
Manufacturing	27.5	28.0	27.2	26.1	24.2	25.2	25.0	24.8	24.5
Mining and quarrying	13.3	12.4	11.9	11.1	10.5	9.8	8.8	8.4	8.1
Services*	46.8	47.5	49.1	50.9	53.2	53.2	54.2	54.6	55.2

Source: Adopted from Gross Domestic Product Reports 2005-2013, Department of Statistics Malaysia (2014), *p. V*
Note: * = Include utilities and government services

The 2005 until 2013 GDP Report from Malaysia Department of Statistics had revealed that manufacturing sector's share of national GDP had gone downturn since 2010 until 2013 as can be seen in the Table 1.2 and depicted in Figure 1.1. Even though the GDP shares had slightly reduced from the previous years, manufacturing sector remain significance and relevant as the contributor to the national GDP (Arkib Ekonomi, 2013).

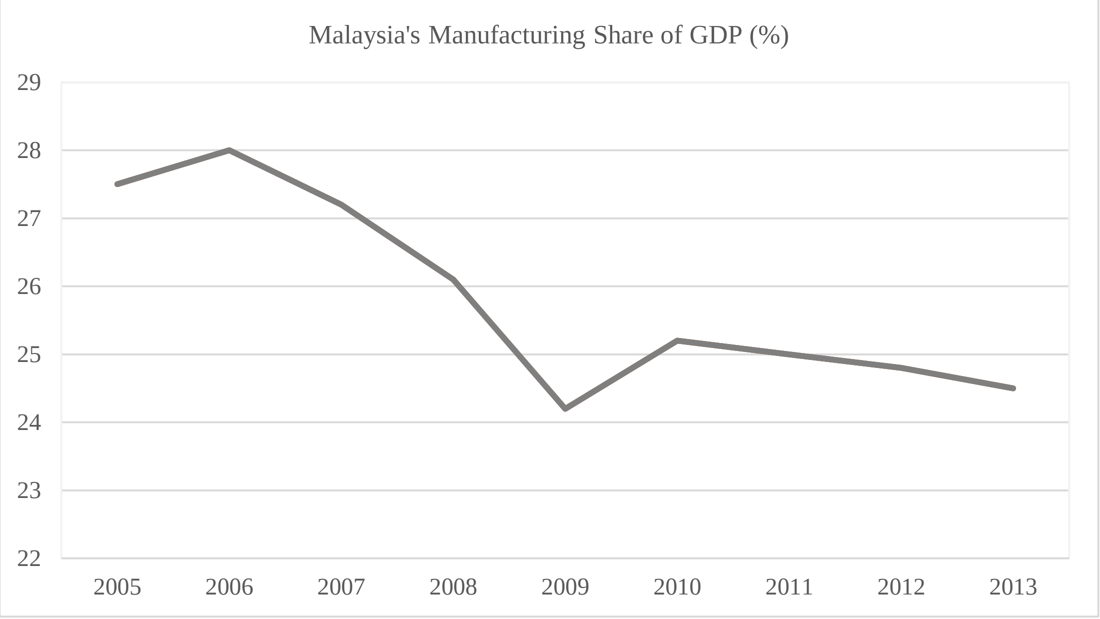


Figure 1.1
Malaysia's manufacturing share of GDP

According to the latest Malaysia Investment Performance Report (2013) by Malaysia Investment Development Authorities (MIDA) agency which is the main agency in promoting the investment in manufacturing sector, manufacturing continues to be the largest contributor to foreign direct investment (FDI) inflows of RM 14,572.00 million, with a total of 787 approved projects, an increase of 27 percent investment with fund amounting RM 52.1 billion. Manufacturing sector had offered 94,000 vacancies ranging from general workers to skilled workers, whereby a 73.9 percent of high income employment occupied in 2013 from projects approved between 2009 until 2013.

The growth and contribution of the manufacturing sectors to the national GDP is fundamentally related to its productivity performance. Productivity is defined as how the people working intelligently in finding effective and efficient ways to produce goods and services with available resources. With the achievement of 58 percent of a national productivity growth in 2010, Malaysia is registered as the highest productivity growth compared to 15 others Organization of Economic Corporation Development (OECD) as reported by the Economic Reports, Ministry of Finance. Among the selected Asian countries, it showed that Malaysia's productivity growth had left far behind Singapore; the strongest economic performer and Taiwan; the highest productivity performer. While in 2012, Malaysia has outstripped the productivity growth of most advanced countries such as South Korea, Japan, the United States, Singapore and Finland (MPC, 2013). Nevertheless, comparing Malaysia to the industrially advanced countries such as Japan, the USA and the United Kingdom, the country is struggling to build its industry and lift the economy level in achieving the status of high-income economy and productivity. Similarly, with emerging economies such as China, Thailand, Indonesia and India, Malaysia's productivity growth is recorded lower than these countries (MPC, 2013).

1.2.1 Industrial Master Plan

Malaysia is competing towards high-income economy in a mission to achieve Vision 2020. The country is striving to compete globally and sustaining the local market at the same time. Due to the volatility of the market condition, it is a big challenge for the country to sustain and boost local industries for the vision to be realized. The focus has shifted from agriculture-based to industrial-based sector which cover the areas of manufacturing, construction, mining and quarry, and utilities (Idris, Wahid, Nor, Mohamed, & Kechot, 2004); refer to Figure 1.2 which depicts the timeline of Malaysia's economy development. To achieve Vision 2020, the government stimulates the industries by involving in high impact projects through the Economic Transformation Programme (ETP) and developing strategic cluster-based industries in manufacturing and services through the National Key Economic Areas (NKEAs) as well as non-NKEAs sectors and services sectors. The potential ability of NKEAs in enhancing the Gross National Income (GNI) allows a priority support from the Government (PEMANDU, 2013). Indeed, manufacturing sector plays the most important and dynamic sector as compared to the others.

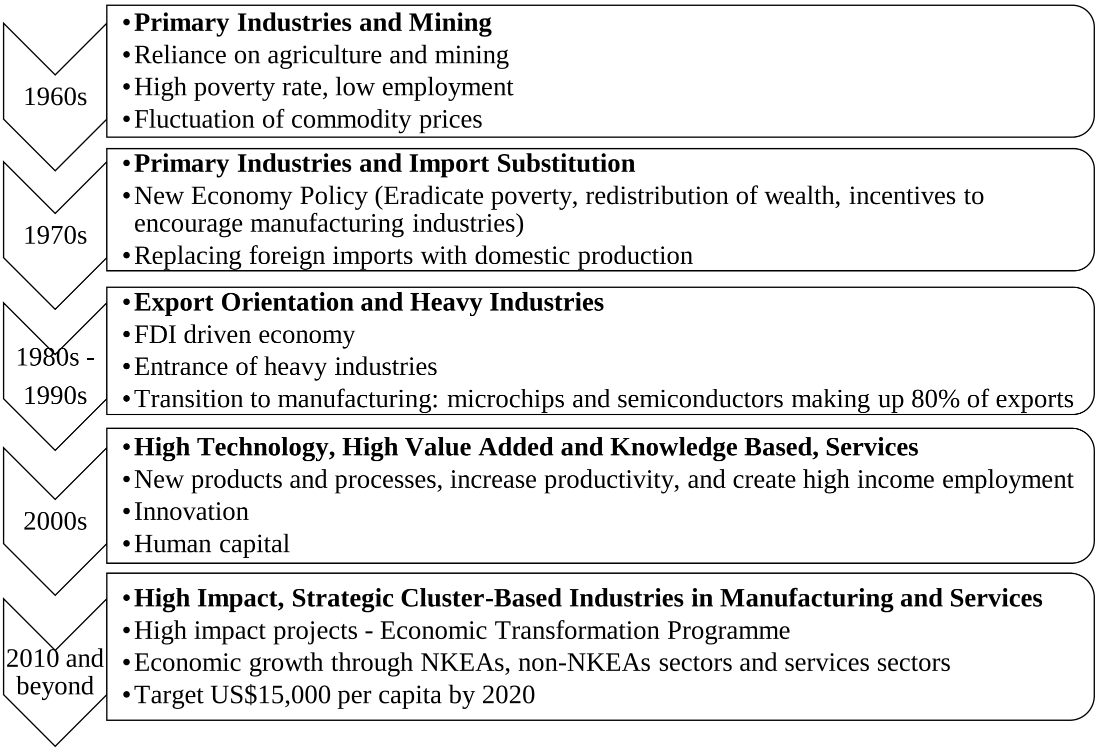


Figure 1.2
The Malaysia's economy development journey
Source: Adopted from MIDA (2013)

Manufacturers are facing immense challenges due to their dynamic business nature, fluctuating market conditions, and volatile environmental conditions. Industrial development in Malaysia is carried out in accordance with the indicative planning of the IMP series; IMP1 (1986–1995); IMP2 (1996–2005); and IMP3 (2006–2020), supported by the Action Plan for Industrial Technology Development in 1990 (Idris et al., 2004). The IMP1 was prepared to steer the progress of the manufacturing sector in Malaysia during 1986 to 1995 period. One of the IMP1's main objectives for manufacturing development is the implementation of indigenous technological capability and competitiveness as a basis for leapfrogging towards a highly developed industrial economy (Ali, 1992). As depicted in Figure 1.3, the first and second phases are basically focusing on export and import orientation business. The third and fourth phases were marked as the evolution of Malaysia's industrial development (Asid, 2010). It is highlighted in the final phase that manufacturing sector is going to be transformed and innovated to move towards a super advanced global competitiveness.

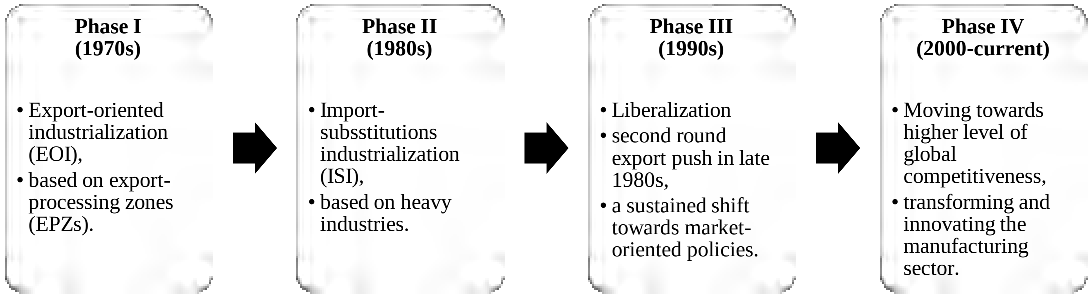


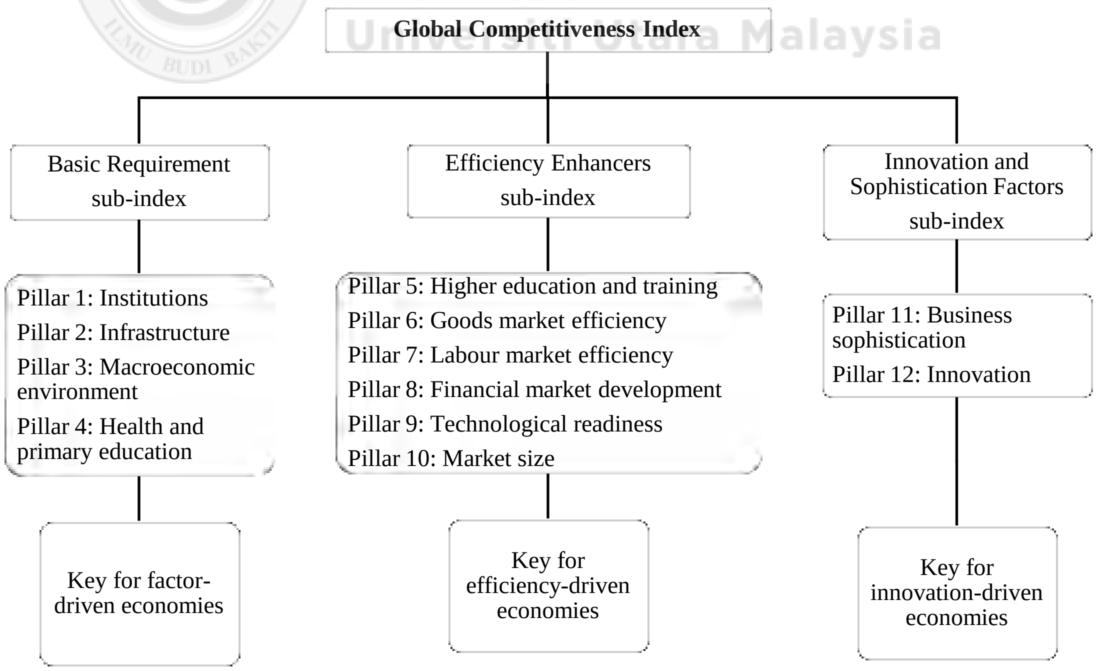
Figure 1.3
The evolution of industrialization in Malaysia
Source: Adopted from Asid (2010), *p. 100*

During the IMP2, strategies have been developed to help manufacturers in adapting to the changing global environments. Industrial relation intensifies where productivity improvement, value-added activities escalation and competitiveness advances are the areas which greatly emphasized. Moreover, the government also made an effort to enhance overall economic efficiency by vertically integrate the manufacturers' supply chains.

Later, the government has widened the scope in the effort to support the domestic enterprises by outlining strategies in the IMP3 which are the integration and rationalization towards the competitive edge to reach the outward bound international arena. Emphasis is given on the importance of information and communication technology, cohesive and supportive framework, and nurturing the services sector. Therefore, the transformation and innovation of the manufacturing sector of the country will result in the achievement of advanced global competitiveness and a developed nation (IMP3, 2006).

1.2.2 Manufacturing Sector Competitiveness

Basically, the assessment of global competitiveness index were based on three classification sub-indexes; i.e i) basic requirements, ii) efficiency enhancers, and iii) innovation and sophistication factors. These indexes were a composition of 12 key competitive pillars as illustrated in Figure 1.4. The framework clarifies that for a country to achieve the innovation-driven economies, firstly, one must assess the innovation factors; technology, the know-how, skills, and working conditions that are cultured within the companies to enhance the standards of living. Secondly, one must assess the business sophistication factors which are in the form of the quality of the firms' operations and strategies, and the country's overall business networks. As such, it is an essential move in choosing suitable manufacturing strategies and operations to achieve specific level of performance. The firms need to decide whether to reorganize the capabilities of a company or to invest in specific practices of



manufacturing.

Figure 1.4
The Global Competitiveness Index framework
Source: Adopted from Global Competitiveness Report, MPC (2013-2014), *p. 5*

Figure 1.5 describes where Malaysia had positioned itself (highlighted in the dotted box) among the ASEAN countries on all the 12 pillars of competitiveness in 2013.

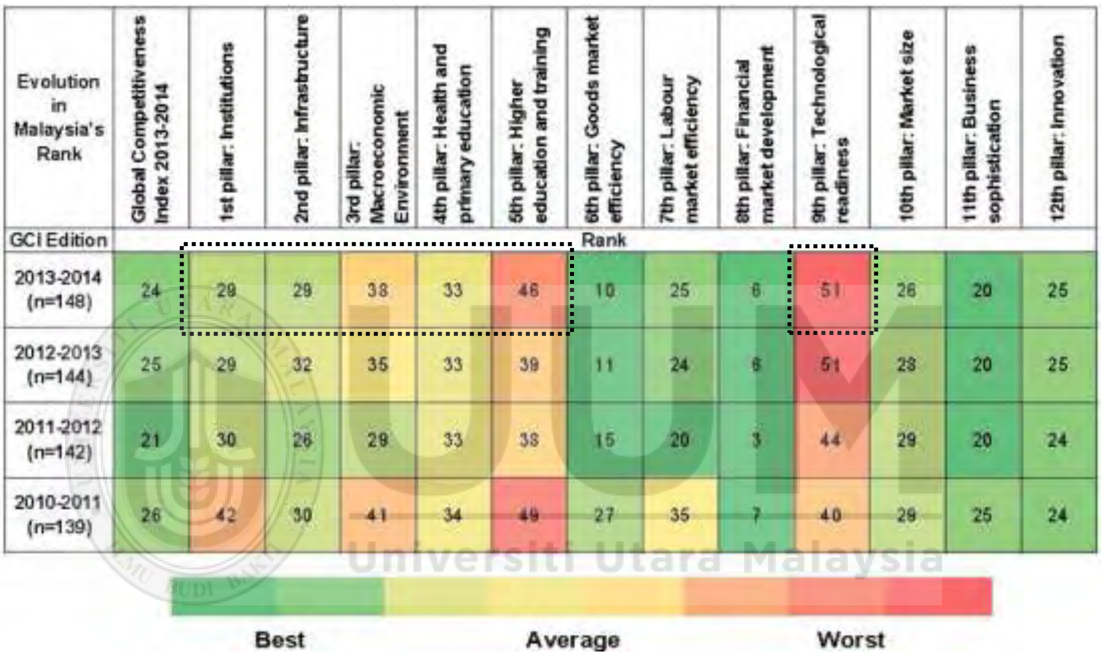
Country/Economy	Global Competitiveness Index	Basic Requirements: 1st pillar: Institutions	2nd pillar: Infrastructure	3rd pillar: Macroeconomic environment	4th pillar: Health and primary education	Efficiency Enhancers: 5th pillar: Higher education and training	6th pillar: Goods market efficiency	7th pillar: Labour market efficiency	8th pillar: Financial market development	9th pillar: Technological readiness	10th pillar: Market size	Innovation and Sophistication Factors: 11th pillar: Business sophistication	12th pillar: Innovation
	Rank												
Malaysia	24	29	29	38	33	46	10	25	6	51	26	20	25
Singapore	2	3	2	18	2	2	1	1	2	7	34	17	9
Brunei Darussalam	26	25	58	1	23	55	42	10	56	71	131	56	59
Thailand	37	78	47	31	81	66	34	62	32	78	22	40	66
Indonesia	38	67	61	26	72	64	50	103	60	75	15	37	33
Philippines	59	79	96	40	96	67	82	100	48	77	33	49	69
Vietnam	70	98	82	87	67	95	74	56	93	102	36	98	76
Lao PDR	81	63	84	93	80	111	54	44	91	113	122	78	68
Cambodia	88	91	101	83	99	116	55	27	65	97	92	86	91
Myanmar	139	141	141	125	111	139	135	98	144	148	79	146	143

Best **Median** **Worst**

Figure 1.5
Performance of ASEAN Members in the 2013-2014 GCI, Rank Out of 148 Economies
Source: Adopted from Global Competitiveness Report, MPC (2013-2014), *p. 41*

When assessed upon the technological readiness pillars of global competitiveness index that measure of how swift an economy adjust to the current technologies to upgrade the industries productivity, Malaysia did not perform to standard (MPC, 2013). Comparatively low technological readiness (ranked 51st) stand out as

Malaysia's major competitive weaknesses (Global Competitiveness Report 2013-2014, 2013). Figure 1.6 illustrates on the achievement of Malaysia's rank from 2010 onwards, assessed to the competitiveness pillars which proof there are so much rooms (highlighted in the dotted box) for improvements in the area of factor-driven and efficiency-driven phase even though Malaysia has been reported to have executed the transition phase into innovation-driven economies.



Evolution in Malaysia's Rank	Global Competitiveness Index 2013-2014	1st pillar: Institutions	2nd pillar: Infrastructure	3rd pillar: Macroeconomic Environment	4th pillar: Health and primary education	5th pillar: Higher education and training	6th pillar: Goods market efficiency	7th pillar: Labour market efficiency	8th pillar: Financial market development	9th pillar: Technological readiness	10th pillar: Market size	11th pillar: Business sophistication	12th pillar: Innovation
GCI Edition	Rank												
2013-2014 (n=148)	24	29	29	38	33	46	10	25	6	51	26	20	25
2012-2013 (n=144)	25	29	32	35	33	39	11	24	6	51	28	20	25
2011-2012 (n=142)	21	30	26	29	33	38	15	20	3	44	29	20	24
2010-2011 (n=139)	26	42	30	41	34	49	27	35	7	40	29	25	24

Figure 1.6
Evolution in Malaysia's competitiveness performance by rank
Source: Adopted from Global Competitiveness Report, MPC (2013-2014), *p. 31*

In the Malaysia's Productivity Report of 2012-2013, the corporation had highlighted on the strategies action that must be taken by the local firms to counter manufacturing sector's business challenges (MPC, 2013). Based on survey report, the five most challenges for manufacturing sector are influenced by i) corporate brand and reputation, ii) global expansion, iii) customer relationship, iv) sustainability, and v) operational excellence. It revealed that these business challenges are included in the list as depicted in Table 1.3 and these strategies must be implemented by manufacturers to overcome the business challenges (MPC, 2013) and will contribute a great invaluable return to the company and achieve sustainability in business.

Table 1.3
Strategies to Address Business Challenges for Manufacturing Sector

Business challenges	**Strategies**
Corporate brand and reputation	1. Promote a "green" or environmentally friendly image for corporation 2. Improve alignment of business practices or management behavior with corporate values 3. Enhance quality of products and processes 4. Strengthen compliance with regulatory requirements 5. Enhance corporate brand awareness and understanding across different cultures.
Global expansion	1. Acquire companies in target geographic markets 2. Enter new geographic markets with existing products or services 3. Introduce new "localized" products or services for customer or clients in new geographic markets 4. Expand and diversify supply chain geographically 5. Transfer labor-intensive operations to low-wage cost locations.
Customer relationships	1. Increase speed of products and services to market 2. Engage personally with key customer or clients 3. Broaden range of products or services 4. Use competitive intelligence to better understand customer or client needs 5. Enhance quality of products or services.
Sustainability	1. Improve speed to market 2. Focus on reduction of baseline cost 3. Raise employee engagement and productivity 4. Secure lowers cost for materials and other input resources 5. Ensure supply chain integrity.
Operational excellence	1. Encourage improvements in sustainability performance from suppliers and other business partners 2. Engage with local communities to enable sustainable growth and manage expectations 3. In corporate sustainability initiatives and results into corporate branding and communication strategies 4. Ensure sustainability is part of the corporate brand, identify and culture of the organization 5. Reduce consumption of energy, water and other scarce resources

Source: Adopted from Malaysia's Productivity Report 2012/2013 (2013), *p. 119*

MPC had come up with the summary on the business challenges ranking of one to ten among Malaysian business leaders as illustrated in Table 1.4. The response revealed that the global business leaders had placed human capital and operational excellences as the top two challenges while Malaysian business leaders are more concerned with customer relationship issues. It is important for Malaysian business to enhance product quality, personally engage with key customers, and apply competitive intelligence to better understand the customers' requirement.

Table 1.4

Malaysia Business Leaders: Survey on Challenges and Strategies

Business challenges	Global (N=729)	Malaysia (N=27)	Manufacturing	Service	Agriculture	Construction
1. Human capital	1	2	6	2	1	10
2. Operational excellence	2	4	5	4	4	3
3. Innovation	3	9	8	9	3	4
4. Customer relationship	4	1	3	1	8	5
5. Global political/ Economic risk	5	7	7	7	7	1
6. Government regulation	6	6	9	6	5	2
7. Global expansion	7	8	2	10	6	7
8. Corporate brand and reputation	8	5	1	5	9	6
9. Sustainability	9	3	4	3	2	8
10. Trust in business	10	10	10	8	10	9

Source: Adopted from Malaysia's Productivity Report 2012/2013 (2013), *p. 10*

Likewise, operational excellence is the only that scores the most business challenge from both global and local business leaders including all four sectors in Malaysia. The issue becomes interesting where five critical strategies must be executed to overcome the operational excellence challenges. The strategies are listed as below (MPC, 2013);

a. *Raising an employee engagement and productivity.*

b. *Focusing on the reduction of baseline cost.*

c. *Making continual improvement through practices such as six sigma, total quality, etc.*

d. *Seeking a better alignment between strategy, objectives and organization capabilities.*

e. *Improving capital investment decision process.*

1.3 Problem Statement

Manufacturing sector is vital to the economy. To excel, the firms must firstly need to identify and determine their manufacturing performance. Secondly, they should aware that critical manufacturing practices will generate superior performance (Leachman, Pegels, & Shin, 2005). Strategies, objectives, and capabilities must be re-aligned and upgraded to encounter the existing business challenges, outrival competitors and endure global competitiveness. The present sustainable manufacturing practices are not soundly mapped, thus the justification and mechanism for improvements and their impacts are remained unclear (Despeisse, Mbaye, Ball, & Levers, 2012). The performance depends heavily on the manufacturing and business strategies alignment (Butt, 2009). When aligned, manufacturing performance will improves and reflects the business performance (Sun & Hong, 2002). Manufacturing strategy must be well addressed and implemented, failing which will misdirect objectives and goals (Sun & Hong, 2002). Producing high quality end products is trending nowadays. Competitiveness is achieved by optimizing the productivity in satisfying the shifting requirements from the internal and external customers. However, there are only limited local companies that only focusing on the advancement of production operations (Anuar & Yusuff, 2011). Studies of the practical implementation of the concepts and performance assessment in conventional manufacturing and operations research ideology remained to be resolved in the actual world (Chun & Bidanda, 2013). It means an empirical study on common manufacturing practices is still required and much needed.

Technological capability (TC) is an intangible asset of the firms due to its restriction for imitation by competitors. Because of its restriction, the capability become valuable that can lead to improvements in products and processes (Coombs & Bierly III, 2006). One study had highlighted on the need for complementary analysis between competitive strategies and TC towards firm performance since hypothesis testing of the TC is limited to a direct effect on firm performance measures (chepkemboi Limo, 2016; Ortega, 2010; Shan & Jolly, 2010; Tzokas, Kim, Akbar, & Al-Dajani, 2015). Substantial literatures, see for examples; (Chantanaphant, Nabi, & Dornberger, 2013; Kylaheiko, Jantunen, Puumalainen, Saarenketo, & Tuppura, 2011; Su, Peng, Shen, & Xiao, 2013; Tzokas et al., 2015; Voudouris, Lioukas, Iatrelli, & Caloghirou, 2012) reveal the significant of TC accumulation for industrial development. Future researches are suggested on the occurrence of moderating variables of the complexity of production process and the complexity of the technology into the relationship between manufacturing practices and manufacturing performance (Lazim & Ramayah, 2010). These complexities should be expressed and measured in a form of firm technological capability. There are limited and no effort given from previous literatures, i.e. (Isobe, Makino, & Montgomery, 2008; Lazim & Ramayah, 2010; Orr, 1999; Sethi, Khamba, & Kiran, 2007; Zou, Liu, & Ghauri, 2010) in bringing up the alignment between TC and manufacturing strategy.

In a point where researchers started to argue and consider TC to play as a moderating roles besides being a predictor, most of them reached the conclusion that TC moderated the relationship between predictor variables and varies criterion variables such as; new product success (de Almeida Guerra & Camargo, 2016), new product development (Haeussler, Patzelt, & Zahra, 2012), product innovation performance (Wu, 2014), firm productivity (García, Avella, & Fernández, 2012), technological innovation (Perdomo-Ortiz, Gonzalez-Benito, & Galende, 2009; Srivastava, Gnyawali, & Hatfield, 2015), and financial performance (Ortega, 2010).

Unfortunately, none of them examined the TC moderating effect within the focus of manufacturing performance, even though there are studies i.e. (Isobe et al., 2008; Khan & Haleem, 2008; Peng, Schroeder, & Shah, 2008; Shan & Jolly, 2010) which had proven that TC had a significant impact on manufacturing performance. Thus, this study is about to investigate how TC gives an impact towards the relationship between manufacturing practices and manufacturing performance.

Going from the issues in academic literatures to the current practical situation, as lined out by the Manufacturing Productivity Corporation, there are important items of manufacturing performance to be considered namely; cost, quality, delivery, and flexibility; and next, the issues relating to the improvement and alignment of business practices that range from human resource management, materials and other input resources, quality and supply chain management are in deep concern as the key business strategies (MPC, 2013). As predicted by Rakwan (2014), global economic uncertainties, higher production costs and slower increase in sales showed sluggish business beyond year 2015. As such, manufacturers in Malaysia have expected domestic and export sales and capital investment to decline. Hence, the strategies are inextricably linked with customer relationships, company's reputation, operational excellence and sustainability. Table 1.5 displays the critical research areas. The analysis was done by evaluating each manufacturing strategies that were highlighted by the MPC in overcoming the business challenges to match the area of focus relevant to the operations management. The majority of the strategies have shown that they were focusing most on the practices and performance of manufacturers. But, there is a loophole in aligning between firm's manufacturing strategies, the objectives and its' capabilities.

Table 1.5
Potential Research Areas Related to Manufacturing Sector Global Business Challenges Strategies

No.	Strategies (MPC, 2013)	Potential research areas		
		Manufacturing performance	**Manufacturing practices**	**Technological capability**
1	Broaden range of products.	X		
2	Improve speed to market	X		
3	Increase speed of products to market.	X		
4	Focus on reduction of baseline cost.	X		
5	Secure lowers cost for materials and other input resources.	X		
6	Transfer labor-intensive operations to low-wage cost locations.	X		
7	Continual improvement (six sigma, total quality, etc.).		X	
8	Encourage improvements in sustainability performance from suppliers and other business partners.		X	
9	Engage personally with key customers or clients.		X	
10	Ensure supply chain integrity.		X	
11	Expand and diversify supply chain geographically.		X	
12	Improve alignment of business practices with corporate values.		X	
13	Enhance quality of products and processes.	X	X	
14	Raise employee engagement and productivity.	X	X	
15	Use competitive intelligence to better understand customer or client needs.	X	X	
16	Seek better alignment between strategy, objectives and organization capabilities.	X	X	X

Source: Author's own analysis

During the period of first IMP, the performance of Malaysian manufacturing industries are at below par (Asid, 2010) but more encouraging in the consecutive IMP plans. There is a concern on the low adoption of TCs despite the notably enhanced performance (Murad & Thomson, 2011) which impede development and expansion (Anuar & Yusuff, 2011). SMEs manufacturers in Malaysia encounter low level of TCs and limited skilled human capital resources (Saleh & Ndubisi, 2006), scarcity of resources, limited managerial capabilities, obsolete product life cycle and rapid changing in market requirement and competition while large industries are widely known for their highly competitive and constantly under cost optimization (Yang, 2013). The development of TCs is still at low to moderate consideration among the manufacturers (Govindaraju & Wong, 2011), and insufficient among the manufacturing companies (Murad & Thomson, 2011). These pressures are aggravated with the critical issue of an urging to achieve 28.5 percent of GDP's share for manufacturing sector by the year 2020 as had been targeted and highlighted by the government in the IMP3, since the share had shown a serious declining trend in 2013 from previous year, and not much years are left for the target's realization.

A success manufacturing strategy must consider the inter-relationship amongst the firm's strategy, its' objectives and organizational routines namely manufacturing practices and technological capability. By addressing manufacturing performance as a critical issue, it shows how significance this research is, since there are scarce empirical studies on the effect of TC towards the manufacturing practices and performance relationship, provided by the low development of TC among local manufacturers and the yet to realized achievement of practices that beat business challenges. Upon thorough observations and researches, most of them argued on the significant effect of TCs but somehow, there are almost none studies that have tested on the moderating effect of TC, thus, a study to uncover the TC impact is more than needed.

1.4 Research Questions

The researcher recommends the research is important based on the discussed problem statements, and therefore, two research questions will be put forward accordingly:

1. Do manufacturing practices have significant effect on manufacturing performance in Malaysian manufacturing companies?
2. Does technological capability moderates the relationship between manufacturing practices and manufacturing performance in Malaysian manufacturing companies?

1.5 Research Objectives

After reviewing literatures in the areas of manufacturing performance, manufacturing practices, and technological capability, this study is aimed to clarify the following objectives:

1. To determine the effect of manufacturing practices on manufacturing performance of Malaysian manufacturing companies; and
2. To examine the moderating effect of technological capability on the relationship between manufacturing practices and manufacturing performance of Malaysian manufacturing companies.

1.6 Significance of the Study

This study is going to be very significant as it is attempted to make several theoretical contributions and a number of practical managerial solutions. The results and findings are expected to benefit the existing bodies of knowledge in a particular way where the study extends the line of research in two important areas; manufacturing strategy (manufacturing performance and manufacturing practices) and firm capability (technological capability). This study also disperses the manufacturing strategy knowledge as it will address the most significance non-financial measures of manufacturing performance and manufacturing practices in the context of Malaysian manufacturers. At the same time, it will provide an insight on firm capability as it will address and introduces technological capability as a new moderator variable. It will clarify on strengthening or weakening relationships between the manufacturing practices and manufacturing performance.

In examining the firm's manufacturing performance, the ability to align manufacturing practices and technological capability will construct the knowledge of performance-practices-capability developments. Previously, studies have mostly covered a significant direct effect either manufacturing practices (Lee, Rho, & Yoon, 2015; Vivares-Vergara, Sarache-Castro, & Naranjo-Valencia, 2016) or technological capability (Kafetzopoulos & Psomas, 2015; Khan & Haleem, 2008; Wang, Lo, Zhang, & Xue, 2006) have on firm performance generally. Very few of them, i.e. (Haeussler et al., 2012; Ortega, 2010) had research on the roles of technological capability's moderating effect. As this study will be among these limited empirical works that studied on the unforeseen event of technological basis on significance impact relationship between performance measures and manufacturing practices, this paper will fills a very important gap in the manufacturing strategy and technological capability literatures. Indeed, this study will exclusively employ the well-developed resource-based view (RBV) theory. As a result, it will build an idiosyncratic strategy for a company which cannot be easily duplicated and have no ready substitutes, while arming the company with highly competitive weapon. It also provides a theoretical strength on each of the variables relationship that supports each other in improving performance of a company.

Practically, this study is expected to supply information and provide a recommendation to relevant key individuals; the researchers in the similar field of study, the managerial and operational teams of organization, the organization particularly manufacturing companies, the manufacturing industry, and ultimately, the country. This research will facilitate manufacturers to identify important factors that have proven to either cause to an impediment or an improvement in the plant's operation. This study is expected to provide insights for local manufacturers (specifically the mass producers and mass customization producers), where they will be provided with a critical analysis on manufacturing performance, manufacturing practices, and technological capability implementation effects and the strategic direction they should take into consideration to secure the firm's survival. The information and assessment of manufacturing performance will assist the company on the success implementation of firm strategic planning. A greater performance gained by local manufacturers will eventually result on a greater national economic performance as well.

This research provides an alternative solution to a problem, recommendations to improve from the situations such as low performance to a long-term survival for an organization. This study is expected to provide insights to the current problem statements by providing a detailed analysis on the manufacturing operations, its performances, practices and capability's status of development and strategic direction that should be taken into account to ensure the continuity existence of the companies in the global market. This study is expected to ease the manufacturers' burden in identifying vital factors internally by way of benchmarking which will improve the performance of the companies from past achievements. Successfully determined factors that influence the manufacturing performance would help the firms evaluate how successful they have implemented the specified manufacturing practices and whether the low or excessive technological effort will determined the attainment of higher level of performance realization. Thus, the availability of technological capability should then help the manufacturers in critically mapping an excellent future manufacturing strategic decision.

1.7 Scope and Limitations of the Study

The scope of this research will covers the context, respondents, activities, and factors involved in the manufacturing performance issues. The context of the study will be the manufacturing companies registered under the Federation of Malaysia Manufacturers (FMM). This research will particularly focus on the studies of manufacturing practices effect on firm manufacturing performance and the moderating effect of technological capability between practices and performance. The main purpose of this study is to determine and investigate whether level of technological capability of Malaysia's industrial economics particularly in the area of manufacturing will improve or detriment firms' manufacturing performance. The details of population and sampling will be further elaborated in the third chapter of research methodology.

There are a few reasons that limit the generalizability of this study. Firstly, this research will only be carried out in the local context of Malaysia. Secondly, the study limits specifically to only four industries of manufacturing sector which had the most contribution to GDP's shares of manufacturing sector. However, the replication of the proposed study into various industries and sectors in the future will expand the comprehension of practices-capability-performance relationship in an organization. Thirdly, this study presumes that every selected company has developed their own technological capability. Subsequently, this study only address the commonly implemented manufacturing practices in the context of local manufacturers. Then, the proposed study will only focus on practices implemented in manufacturing companies and excludes any practices in the areas of construction, services and other sectors. Finally, a self-reported questionnaire generates chances for the responses to be perceived as desirable or acceptable rather than the fact experienced or believed by the respondents. Hence, this limitation suggests an indicative result instead of being definitive.

1.8 Definition of Key Terms

Manufacturing Performance:

A consistent set of goals and actual level of achievement on manufacturing performance dimensions of; cost, quality, delivery and flexibility (Leong, Snyder, & Ward, 1990; Peng, Schroeder, & Shah, 2011).

Quality:

The elements that critically and purposely measured to satisfy the customer requirements in terms of its performance, features, reliability, conformance, durability, serviceability, aesthetics, or perceived quality (Garvin, 1984).

Cost:

A measurement that basically relating to the internal production costs, productivity, capacity utilization, and inventory reduction, where products were targeted to be produce at low cost possible (Grünberg, 2004; Ward, McCreery, Ritzman, & Sharma, 1998).

Delivery:

A dimension that always referring to the ability to deliver the finished products on-time and according to a promised schedule (Ward et al., 1998).

Flexibility:

A situation where a company reacts and capable to any uncertainty and shifting in customers demand or changing factors in the general environment (Gerwin, 1993; Grünberg, 2004).

Manufacturing Practices:

A highly planned sets of activities across the firms and industries by which support the people in operation management to identify related manufacturing difficulties (Wu, Melnyk, & Swink, 2012a).

Total Quality Management:

A collective interlinked system of practices to manage quality that encompasses the whole organization from supplier to customer which is associated with the firm performance (Bayazit, 2003; Valmohammadi & Roshanzamir, 2015).

Just-In-Time:

A manufacturing program with the primary goal of continuously reducing and ultimately eliminating all forms of waste through JIT production and involvement of the workforce (Cua, McKone, & Schroeder, 2001).

Human Resource Management:

A complex and multidimensional decision area of managing the firm's human capital development, utilization and behavior (Abdullah, Ahsan, & Alam, 2009; Urtasun-Alonso, Larraza-Kintana, García-Olaverri, & Huerta-Arribas, 2012).

Supply Chain Management:

A set of activities undertaken in an organization with a simultaneous integration of customers, internal processes and suppliers to promote effective management of its supply chain (Li, Rao, Ragu-Nathan, & Ragu-Nathan, 2005; Tan, Kannan, Handfield, & Ghosh, 1999).

Technological Capability:

The capability to carry out any related organizational technological task together with the capability to invent new items and processes and to efficiently running the facilities (Teece, Pisano, & Shuen, 1997).

Manufacturing Strategy:

A systematic decisions and effective use of manufacturing structure, infrastructure and set of capabilities as a competitive weapon in achieving the business and corporate goals (Moran & Meso, 2011).

1.9 Organization of the Thesis

This thesis consists of five chapters. The first chapter introduces the background of the research, the extant research problem regarding theoretical and practical issues and gaps, a set of questions that need to be answered along with the completion of the study, the objectives in fulfilling the study, significance to pursue the current study which contribute values to the academicians, researchers, practitioners, and the field of knowledge itself. Next, the discussion on the scope which limits some of the aspect on this research and later on, the chapter ends with a statement of key terms' definition and organization of the thesis. In summary, Chapter One presents the general idea of the whole research.

The second chapter provides a review of literatures in the field of manufacturing performance, manufacturing practices, technological capability and the underpinning theory that acts as the foundation of the theoretical framework. Every key concept is being thoroughly researched and discussed. The discussions and arguments on past empirical studies, its definitions and dimensions involved will be systematically synthesized to be able to fit the research into the existing body of knowledge. A recapitulated of research gaps will be presented at the end of the chapter. In brief, Chapter Two critically reviewed and synthesized the important relevant literatures of the selected variables and theory.

In the third chapter, the details of theoretical framework and hypotheses developments are discussed. The framework is presented right after literatures discussions and arguments in previous chapter. In regards to the hypotheses statements development, it is based on the findings and results from past literatures. A recapitulated of linkages on research questions, research objectives and hypotheses statements are presented afterward. Next, the proposition and clarification on methods that were being occupied throughout this research are presented. The overview of how the whole research process will be carried out afterward. It is followed by the discussions on the research design employed. Statements on the chosen unit of analysis will be mentioned. The sampling design which consists of population, sampling frame, sample size and sampling techniques are being clarified. The operationalization of each key variable will be discussed and followed by the instrumentation of variables and questionnaires design. The procedures of data collection and statistical techniques that were used for data analysis are discussed in the final two sections. To sum up, Chapter Three focused specifically on the research framework, hypotheses development, research design methods and approaches that are appropriate for quantitative research.

Further, Chapter Four presents the details of data analysis and findings. IBM Statistical Package for Social Science (SPSS) Version 22 was employed in the analyses of the entire study. The occupied data was first cleaned and screened for any missing or straight lining data. The response rate, demographic profiles and non-response bias were presented afterward. Followed by the analysis of goodness of measures. The revised framework and restatement of hypotheses are presented. Next, the analysis proceeded with descriptive analysis, correlation analysis, testing of fundamental statistical assumptions and ended with the testing of hypotheses using hierarchical regression analysis.

In the final chapter, a recapitulation of research findings were presented at the beginning. Then, the research outcomes were discussed accordingly and followed by the discussions of research implications on the theoretical and practical views. The discussions of research limitations and some suggestions for potential future research are presented at the end of this chapter. Overall, Chapter Five concludes the whole thesis by discussing on the findings, study implications, limitations and suggestions for future research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter discusses on the concept of manufacturing performance, manufacturing practices and technological capability in depth. The details of each variable were discussed thoroughly through references from past empirical literatures. Linkages that existed between manufacturing performance and manufacturing practices in regard with the implemented technological capabilities in manufacturing perspective were identified and discussed. With regard to the underpinning theory, an explanation of the resource-based view (RBV) and how the theory connected to the study will be presented. The chapter ends with the description of gaps analysis.

2.2 Manufacturing Performance (MP)

Professor Skinner (1969) in his seminal paper, had considered manufacturing as the most influential competitive advantage weapon and acted as the essential element in assuring the achievement of the overall business strategy of an organization (Rangone, 1996). Many researchers were inspired to further researches in the wide areas of manufacturing and its components. Knowledge on manufacturing has been substantially studied by various researchers. Specifically, research on manufacturing strategy has increased rapidly and still on-going; see for examples (Boyer & Lewis, 2002; Gagnon, 1999; Hallgren, 2007; Ketokivi & Schroeder, 2004a; Narasimhan, Swink, & Kim, 2005; Voss, 1995).

Ketokivi and Schroeder (2004a) highlighted that manufacturing performance is a firm's critical component in manufacturing strategy. Meanwhile, manufacturing strategy plays as an essential element to identify the priorities of manufacturing performance (Karim, Smith, & Halgamuge, 2008a). Whilst a firm benefits a competitive advantage when it has a higher and upgraded level of manufacturing performance (Sakakibara, Flynn, Schroeder, & Morris, 1997), it is absolutely critical for a manufacturer to assess and determine its performance status to stay ahead competitively.

Table 2.1
Ranking of Performance Measure Categories

Category	**Mean of FU**	**Rank**	**Mean of PV**	**Rank**	**Mean of EA**	**Rank**
A. Financial	3.85	1	3.82	1	4.15	1
B. Product quality and customer satisfaction	3.50	2	3.65	2	3.62	4
G. Human resource management	3.48	3	3.65	3	3.67	3
C. Process efficiency	3.44	4	3.61	4	2.68	2
H. Social responsibility	3.00	5	3.25	5	3.07	8
E. Competitive environment	3.00	6	3.24	6	3.10	6
F. Quality/independence of management	2.92	7	3.22	7	3.35	5
D. Product and process innovation	2.73	8	3.01	8	3.10	7

Source: Adopted from Gomes et al. (2011), *p. 17*
Note: FU = frequency of use; PV = predictive value; EA = ease of information acquisition

Based on the existing literatures on manufacturing performance in an organizational context, it was written that the evolution of manufacturing performance measurement have moved from closed to open systems and incessantly upgraded over time (Gomes, Yasin, & Lisboa, 2004). Traditionally, it was based on the account management system. Over a century, studies on manufacturing performance had researched on the relationships with various aspects such as projects, organizational systems and practices, machines, and also people. Ever since, the focus had shifted from solely emphasizing on financial measures (i.e.: profit, return on investment) phase to the next phase of highlighting on multidimensional strategic priorities such as quality, flexibility, time, and delivery (Ghalayini & Noble, 1996). Table 2.1 depicted the observed ranking on multidimensional firms' performance measures on three categories; frequency of use, predictive value, and ease of information acquisition (Gomes, Yasin, & Lisboa, 2011), where financial measure had ranked remarkably in all categories. Even though financial measures ranked first and was most used in organizational research, there were some others mentioned on the non-financial aspect. A few researches had also emphasized on both perspectives, thus created argument on how the perspective measures were focused.

The first perspective is deemed as financial measures which are incredibly popular among previous researchers who considered this perspective as commonly measuring the firm's performance. It has been covered greatly to observe the progress status of the business. However, in the context of manufacturing business, it was discovered that financial measures are not straightforwardly related to manufacturing strategy itself (Maskell, 1991). Ghalayini, Noble, and Crowe (1997) indicated that financial assessments are irrelevant to the new management procedures that assign the floor operators the authority and liberty. Bititci (1994) affirmed that financial assessments disregard over-production and do not sufficiently classify quality worth. Despite being experts in accounting, these professionals noticed that the method they employed in computing the performance for several decennials were incompatible in the current manufacturing standard that is more towards focusing the customer needs. There are literatures by some professionals in accounting and manufacturing that recommend the application of non-finance assessments to be inculcated in today's manufacturing firms (Mathur, Dangayach, Mittal, & Sharma, 2011).

An additional evidence; a study conducted by Kathuria and Porth (2003) mentioned on the difficulty in evaluating the financial objectives of performance measures particularly from private companies. It is an arduous task to obtain financial information because firms are reluctant to declare and reveal their financial figures since these information are much more confidential than non-financial measures (Gomes, Yasin, & Lisboa, 2007a). There is a strong argument that the objective of financial measures are irrelevant to determine the objectives of manufacturing performance since it is fundamentally cost centered as contrast to profit centered mechanisms (Youndt, Snell, Jr Dean, & Lepak, 1996). Furthermore, the financial performance measure that is based on traditional cost-accounting system is incapable to explain the significant performance issues in today's manufacturing environment (Chen, 2008), unspecific to manufacturing operational scope (Hallgren, 2007), and most importantly its focuses depend on factors beyond the control of manufacturing unit (Kathuria & Porth, 2003).

To conclude, Uyar (2009) had highlighted the limitations of financial or so called traditional performance measure as follows: being too retrospective; absent of predictive capability to enlighten outlook performance; satisfying short-term or inaccurate behavior; providing slight information on root causes or solutions to the problems; did not capture the key business changes; being too aggregated and summarized to guide managerial action; and it reflects to only functions, not cross-functional processes, within a company.

Come to the second perspective; the used of non-financial performance in the study of modern manufacturing is coherent with the argument of Mathur et al. (2011), where it is multidimensional instead of using the traditional performance on a single business accounting perspective particularly financial performance. It is stressed that relying on the assumption that the unchanging characteristic and specification of a standard product in the older cost accounting system is no longer relevant in the forthcoming manufacturing atmosphere (Kaplan, 1983).

The development of non-financial performance will displace the petty thought of financial performance stipulations (Thrulogachantar & Zailani, 2011). Furthermore, an enhancement in the non-financial measures such as; quality, inventory, productivity, flexibility, and innovation are necessary to deal with the challenges in developing a new in-house accounting system that will improve the company's new manufacturing strategy (Kaplan, 1983). Additionally, non-financial measures bring a significant value to the company in controlling and inspiring the human factor progress (Santori & Anderson, 1987). In this regards, non-financial performance measures are applied not only to the manufacturing strategy and processes but also to the human resource management factor.

Regarding the business confidentiality, non-financial performance is as secretive as the financial perspective. The non-financial data is restricted and protected for only internal management purposes, due to the potential of revealing the firm's information on effectiveness and competitiveness aspects (Klassen & Whybark, 1999). For example, see (Gomes et al., 2007a), regarding information flows between executive and financial analyst in manufacturing company showed that executive perception on non-financial performance disclosure will be detrimental to the company's competitive position. Fortunately, on the other hand, there were researchers who successfully getting feedbacks from the respondents by using the self-reported perceptual measures of non-financial performance relative to the competitors, see for example; (Flynn, Sakakibara, & Schroeder, 1995; Klassen & Whybark, 1999; Swamidass & Newell, 1987; Youndt et al., 1996). In light of this, as opposed to the financial measures, it is thus much easier to gather information of manufacturing perspectives on non-traditional measures.

Finally, on the third perspective, it is very possible that Choe (2004) had seen from a different angle than the previous two perspectives, whereby firm strategic advantages should be measured by both perspectives since the financial performance alone only indicates the consequence of previous undertakings and not necessarily improves future performance. Comprehensibly, to achieve a firm's strategic advantages, a constant workings among strategies, actions and measures through the incorporation between financial and non-financial performance measures must be accomplished (Tuanmat & Smith, 2011).

Ghalayini and Noble (1996) synopsized the contrast between traditional and non-traditional performance in Table 2.2. It supports the current study in applying non-traditional measures which is mainly non-financial measures and also accommodates access to the traditional and non-traditional measures of all the companies involved.

Table 2.2
A Comparison between Traditional and Non-Traditional Performance Measures

Traditional performance measure	**Non-traditional performance measures**
Mainly financial measures	Mainly non-financial measures
Based on obsolete conventional accounting system	Based on firm strategy
Intended for middle and high managers	Intended for all employees
Lagging metrics (weekly or monthly)	On-time metrics (hourly, or daily)
Difficult, confusing and misleading	Simple, accurate and easy to use
Lead to employee frustration	Lead to employee satisfaction
Neglected at the shopfloor	Frequently used at the shopfloor
Have a fixed format	Have no fixed format (depends on needs)
Do not vary between locations	Vary between locations
Do not change over time	Change over time as the need change
Intended mainly for monitoring performance	Intended to improve performance
Not applicable for manufacturing practices such as; JIT, TQM, CIM, FMS, RPR, OPT, etc.	Applicable for manufacturing practices
Hinders continuous improvement	Help in achieving continuous improvement

Source: Adopted from Ghayalini and Noble (1996), *p. 68*

White (1996) had emphasized that the chosen performance perspective was subjected to local competitive strategy setting of the manufacturing companies. Moreover, perceptual manufacturing performance was considered as bias and low internal consistency (Ketokivi & Schroeder, 2004b), however, manufacturing performance could not be recognized flawlessly with a single fixed assessment (Brown, Squire, & Blackmon, 2007). Plant managers are very secretive in revealing competitive information in objective data although it was considered as the most recommended method. The perceptual measures which are gained from self reporting in assessing the performance as against to competitors are widely employed in the literatures with fruitful outcomes (Klassen & Whybark, 1999). Even though perceptual measures are intuitive, these methods are found in many instances in literatures, particularly caused by the set backs in compiling the performance's comparable and objective data (Hallgren, Olhager, & Schroeder, 2011).

Various arguments unveiled that the study goal itself reflects the significance of the perspectives selection between financial and non-financial measures. Nevertheless, to evade numerous avoidable measures and to ensure that each key variable is calculated precisely, an accurate measure must be adopted (White, 1996). Decisively, since the purpose of this research is to study and examine the effect of technological capability on manufacturing practices and performance, the use of perceptual non-financial measures is acceptable and will be constantly adopted in this research setting. This method will be used throughout the research because it is highly relevant in order to explain manufacturing's performance.

2.2.1 Definition of Manufacturing Performance

A manufacturing performance will provide indication whether organizations optimally utilize their resources, capabilities, productions and operations to deliver clients' order and achieve the market request or else, they strive on pointless hesitation and inaccurate strategies. In manufacturing, manufacturing performance is an unswerving set of objectives (Leong et al., 1990). It is also referred to as the real rate of accomplishment within the five performance dimensions of cost, quality, delivery, flexibility and innovation (Peng et al., 2011). Thus, it is best described as a point of reference that contains a set of strategic manufacturing objectives.

Essentially, the term manufacturing performance is sometimes referred differently by previous researchers such as competitive priorities (Laosirihongthong & Dangayach, 2005; Mady, 2008; Ward et al., 1998), competitive capabilities (Hallgren et al., 2011; Miller & Roth, 1994), competitive performance (Abdallah & Matsui, 2007; Flynn, Schroeder, & Flynn, 1999; Phan, Abdallah, & Matsui, 2011), manufacturing goal (Yang, 2013), manufacturing success (Roth & Miller, 1992), manufacturing capability (Mukerji, Fantazy, Kumar, & Kumar, 2010), strategic manufacturing capabilities (Größler, 2010a, 2010b), operations performance (Robb, Xie, & Arthanari, 2008), and operational performance (Boyer & Lewis, 2002; Cagliano & Spina, 2002; Christiansen, Berry, Bruun, & Ward, 2003; Grünberg, 2004; Kaydos, 1999; Machuca, Jime´nez, Garrido-Vega, & de los Rı´os, 2011; Madapusi & D'Souza, 2012; Parkan & Wu, 1999; Rahman, Laosirihongthong, & Sohal, 2010; Shah & Ward, 2003). Even though semantically different, nevertheless all of these terms are reflecting the equivalent measurements and explanation of manufacturing performance.

2.2.2 Dimensions of Manufacturing Performance

Manufacturing performance dimensions are important to be closely scrutinized by each manufacturing firms for the improvement of operational and production performance. Five major reasons acknowledged by Kaydos (1999) in a book titled "O*perational performance measurement: increasing total productivity"*, on why performance must be measured are mentioned below;

a. To improve control; because response and feedback are the key tasks in any of a system.

b. To explain the responsibilities and objectives; a good performance measurement will designate the people who is responsible for any of the achievement gained or problem occurred.

c. To function as a strategic alignment of objectives; performance measurement is proven as the best way to describe the company's strategies.

d. To understand the business processes; an understanding of manufacturing processes is required for data to be measured.

e. To determine process capability; it is easier to determine a specific capability when the process involved is fully understood.

There are huge numbers of competitive manufacturing performance measures that had been studied and applied in the past studies. From all the literatures available, an analysis has been done and the author had identified a list of non-financial performance measures and classified them into 14 dimensions. Table 2.3 listed the studies on non-financial performance measures and indicates the top four dimensions during the ten years period since 2004 until 2014 are quality, cost, delivery, and flexibility.

Table 2.3

Summary of Manufacturing Performance Dimensions Found in the Literature Survey

Author (Year)	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**
Belay, Kasie, Helo, Takala & Powell (2014)										X				
Yang (2013)	X	X	X											
Ooi, Lee, Chong & Lin (2013)										X				
Nawanir, Lim & Othman (2013)	X	X	X				X	X	X					
Brown & Vondracek (2013)			X			X								
Wu, Melnyk & Swink (2012)	X	X	X	X										
Urtasun-Alonso, Larraza-Kintana, Garcia-Olaverri & Huerta-Arribas (2012)				X										
Ooi, Lin, Teh & Chong (2012)					X									
Ng & Jee (2012)	X	X			X	X								
Mendes (2012)	X													
Madapusi & D'souza (2012)	X		X					X						
Kim, Kumar & Kumar (2012)					X									
Agarwal, Green, Brown, Tan & Randhawa (2012)							X							
Wiengarten, Fynes, Pagell & Burca (2011)	X	X	X	X										
Tuanmat & Smith (2011)	X		X	X										
Thrulogachantar & Zailani (2011)	X	X	X	X	X	X								
Psomas, Fotopoulos & Kafetzopoulos (2011)	X													
Phan, Abdallah & Matsui (2011)	X	X	X	X	X	X		X	X					
Peng, Schroeder & Shah (2011)	X	X	X	X	X			X						
Machuca, Jimenez, Garrido-Vega & de los Rios (2011)	X	X	X	X										
Liu, Roth & Rabinovich (2011)	X	X	X	X										
Islam & Karim (2011)	X		X											
Hung, Lien, Yang, Wu & Kuo (2011)					X									
Hallgren, Olhager & Schroeder (2011)	X	X	X	X										
Gaur, Vasudevan & Gaur (2011)	X	X	X	X										
Demeter & Matyusz (2011)								X						
Dan & Yuxin (2011)	X	X	X	X	X	X	X	X	X				X	X
Chong, Chan, Ooi & Sim (2011)					X									
Rahman, Laosirihongthong & Sohal (2010)		X	X				X		X					
Mackelprang & Nair (2010)	X	X	X	X		X		X						

Table 2.3 (*Continued*)

Author (Year)	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**
Kathuria, Partovi & Greenhaus (2010)	X					X	X		X		X			
Größler (2010a)	X	X	X	X										
Größler (2010b)	X	X		X		X								
da Silveira & Souza (2010)	X	X	X	X										
Chi (2010)	X	X	X	X										
Amrina & Yusof (2010)	X	X	X			X				X				
Abdel-Maksoud, Cerbioni, Ricceri & Velayutham (2010)										X				
Uyar (2009)	X													
Salaheldin (2009)	X	X	X	X										
Perdomo-Ortiz, Gonzalez-Benito & Jesus Galende (2009)					X									
Miltenburg (2009)	X	X	X	X	X									
Macher & Mowery	X					X								
Hallgren & Olhager (2009a)	X	X	X											
Hallgren & Olhager (2009b)	X	X	X	X										
Fabi, Raymond & Lacoursiere (2009)	X	X		X										
Boyle & Scherrer-Rathje (2009)				X										
Bayraktar, Demirbag, Koh, Tatoglu & Zaim (2009)		X				X	X	X			X			
Vachon & Klassen (2008)	X	X	X	X										
Robb, Xie & Arthanari (2008)	X	X	X	X	X									
Naor, Goldstein, Linderman & Schroeder (2008)	X	X	X	X										
Mady (2008)	X	X	X	X	X									
Karim, Smith, Halgamuge & Islam (2008)	X		X				X							
Karim, Smith & Halgamuge (2008)	X		X				X							
Molina-Azorin, Tari, Claver-Cortes & Lopez-Gamero (2008)	X													
Banker, Bardhan & Chen (2008)	X	X				X								
Arumugam, Ooi & Fong (2008)	X													
Ahuja & Khamba (2008a)	X	X	X				X			X		X		
Ahuja & Khamba (2008b)	X	X	X				X			X		X		
Ungan (2007)	X	X				X								
Prajogo, Laosirihongthong, Sohal & Boon-itt (2007)					X									
Islam, Hamid & Karim (2007)	X		X				X							
Hallgren (2007)	X	X	X	X										

Table 2.3 (*Continued*)

Author (Year)	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**
Brown, Squire & Blackmon (2007)	X				X			X						
Amoako-Gyampah & Meredith (2007)	X	X	X	X										
Watson (2006)	X	X				X								
Wacker & Sheu (2006)	X	X	X	X	X									
Tu, Vonderembse, Ragu-Nathan & Sharkey (2006)									X					
Prajogo & Sohal (2006)	X				X									
Montoya-Torres (2006)						X		X			X			
Lakhal, Pasin & Limam (2006)	X	X				X	X							
Dangayach & Deshmukh (2006)	X	X	X	X	X									
Boyle (2006)				X										
Swink, Narasimhan & Kim (2005)		X		X										
Raymond & St-Pierre (2005)	X	X		X										
Narasimhan, Swink & Kim (2005)				X	X				X		X			
Leachman, Pegels & Shin (2005)	X													
Laugen, Acur, Boer & Frick (2005)	X	X		X		X								
Laosirihongthong, Dangayach (2005)	X	X	X	X	X									
Challis, Samson & Lawson (2005)		X	X			X			X	X				
Beaumont (2005)	X	X		X	X	X								
St-Pierre & Raymond (2004)							X							
Ketokivi & Schroeder (2004a)	X	X	X	X	X	X	X							
Ketokivi & Schroeder (2004b)	X	X	X	X		X	X							
Husseini & O'Brien (2004)	X	X	X		X				X					
N	**84**	**84**	**84**	**84**	**84**	**84**	**84**	**84**	**84**	**84**	**84**	**84**	**84**	**84**
Number of occurrences	**61**	**49**	**44**	**39**	**23**	**21**	**15**	**10**	**9**	**7**	**4**	**2**	**1**	**1**
Overall percentages (%)	**73**	**58**	**52**	**46**	**27**	**25**	**18**	**12**	**11**	**8**	**5**	**2**	**1**	**1**

Source: Author’s own analysis

Note: (1) = Quality; (2) = Cost; (3) = Delivery; (4) = Flexibility; (5) = Innovation; (6) = Time; (7) = Productivity; (8) = Inventory management; (9) = Customer satisfaction; (10) = Employees; (11) = Efficiency; (12) = Safety; (13) = Employee/ Job/ Career satisfaction; (14) = Environmental

Knowingly that manufacturing company existence is not only to produce and deliver products to customers but also to focus on important facets of manufacturing performance; cost, quality, flexibility, and delivery (Skinner, 1969). The selection of measures in this study is based on two items outlined by Gomes et al. (2004). First, the environmental and contextual factors of industry it involved. As this study will be conducted in the manufacturing industry setting which is contextually and environmentally involves a production floor's operation by its business nature, hence, the selection of non-financial dimensions are in accordance towards the manufacturing business objectives. This indirectly brings to the second outline of the measures selection which is organizational objectives. Manufacturing organization is facing a hard time in formulating their firm strategies. To gain competitive advantages, firm must reconcile between competitive strategy, structure and environment and manufacturing strategy (Ward, Bickford, & Leong, 1996), thus the choice of non-financial performance dimensions will support the company with strategically long term competitive weapon.

Peng et al. (2011) and Lee et al. (2015) had measured manufacturing performance along five dimension of cost, quality, delivery, flexibility and innovation. In fact, it is a broad agreement that manufacturing performance can be described clearly in term of at least four basic elements of cost, quality, flexibility, and delivery (Chavez, Yu, Gimenez, Fynes, & Wiengarten, 2015; Dangayach & Deshmukh, 2001), which regarded the most frequent accepted dimensions in manufacturing performance studies (Hayes & Wheelwright, 1984; Khanchanapong et al., 2014; Lin & Tseng, 2016; Miller & Roth, 1994), which can also be seen in Table 2.3. Accordingly, these four widely accepted and recognized non-financial performance measures that strategically related to manufacturing studies were employed and exclusively examined in this study (Dangayach & Deshmukh, 2001; Vivares-Vergara et al., 2016; White, 1996). These dimensions are chosen to counterpart the current operational organization's competitive strategy, where it will mostly resolve whether or not a firm be able to win in achieving its strategic goal (Ang, Shimada, Quek, & Lim, 2015; White, 1996).

Additionally, it was proven that the four constructs of quality, low cost, delivery and flexibility were account for the most variance in firm competitive strategies (Chi, 2010), and that production efficiency and cost, quality and delivery performance are essential elements to attain competitive success (Cagliano & Spina, 2002). Based from the result of predictive validity of performance measures, it showed that cost and flexibility substance fit so well in the context of manufacturing strategy theory (Ward et al., 1998). Thus, for companies to success in the global competition, it demands them to make improvement in quality, flexibility, delivery and minimize costs.

It is consistent in light of today's manufacturing competitive atmosphere where firms are no longer compete solely on the price but on customer-focused and quality-related performance (Gomes, Yasin, & Lisboa, 2007b; Islam & Karim, 2011; Mathur et al., 2011). Additionaly, a critical review on the manufacturing strategies and operational practices that lead to firm competitive advances demonstrated that the danger posed by the competition among manufacturers world widely to become the world class manufacturers relies on the quality as viewed from the customer's perspective as the top priority (Sukarma, Azmi, & Abdullah, 2014). Another view, the stagnation of manufacturing sector in Malaysia and the movement towards service sector to become the new engine of the country's growth recently, have urged the country to develop its technological capabilities in manufacturing by offering high quality input in terms of well-trained engineers, highly-skilled employees, and high-quality infrastructure through sustained investments in machinery, education, training, and research and development (Ha, 2012). Thus, the selection of four dimensions of manufacturing performance proves that it is most appropriate and relevant that meets the long-term manufacturing strategy, while providing a competitive edge to the firm. Accordingly, these set of non-financial dimensions will conceptualize and make up the construct of manufacturing performance variable. The aspects of each dimension will be elaborated further in the following subsections.

2.2.3 Quality

Producing well and high quality final products is the basic criterion for companies to achieve the world-class manufacturing status. Quality is seen as a key component in producing goods, for instance, Japanese firms have totally rejected the strategy adopted by manufacturing firms in the U.S., when U.S. firms have set that there is a level of a certain percentage of acceptance defects. Until now, Japanese firms are always targeting zero defects so far, and becomes as a model and practice to most of manufacturing firms across the globe (Kaplan, 1983). Quality measure is a critical element to every manufacturing firm as it purposely to meet the customer requirements.

As some evidences have proved that product quality and reliability are the main competitive factors for manufacturers (Karim et al., 2008a). Quality was also indicated as the most important dimension of manufacturing performance besides cost (Jayaram, Droge, & Vickery, 1999). Furthermore, quality is becoming important due to its progressively being noticed as a main indicator for firm's market share and profit margins improvement (Kaplan, 1983). As an example, a study result suggested that even when companies which have not yet received an award-winning are showing a greater performance trace which constantly improving their quality of product will benefit a superior achievement of sales and financial performance over the rivals (Zhang & Xia, 2013).

White (1996) highlighted that previous studies had focused more on conformance quality as compared to the other seven classifications of quality measure which are performance, features, reliability, durability, serviceability, aesthetics, and perceived quality (Garvin, 1984). Most of the quality measures falls under the first six categories of Garvin's list, excluded the perceived quality and aesthetics due to its naturally complicated to assess in the context of manufacturing (Ward et al., 1998). Researchers lately have mostly been using measures of quality performance such as conformance to product specifications (Bortolotti, Boscari, & Danese, 2015; Chavez et al., 2015; Chi, 2010; Hallgren et al., 2011; Wu et al., 2012a), high performance product features or design (Boyer & Pagell, 2000; Chi, 2010; Koufteros et al., 2014; Wong, Boon-Itt, & Wong, 2011), and product quality reliability (Chavez et al., 2015; Chi, 2010; Khanchanapong et al., 2014; Wu et al., 2012a). These measures reflect specifically towards customers' requirements which is the key focus in today's competitive manufacturing in order to satisfy their needs.

Table 2.4 shows a list of measurement captured in the previous studies where product quality reliability, consistency of product quality and product conformance are among the most item used for measuresuring quality construct. Product quality reliability refers to the ability of a product to execute the designated function in a specified time and condition. Conformance to product specification is the term used to describe how a product could comply the projected design standards that are derived by the demands from the customers. Customer return rate is calculating the returning rate (percentage) of failed product over a specified time. Product durability is defined to the guarantee or prospect a product could withstand functioning in an extended life span. Defect rates is the percentage rate of product defects in ratio to one hundred units. After-sale service is a compliance by the manufacturers or suppliers during and after the specified warranty period to repair the product or provide maintenance and service when the needs arise. Product features is a term used to describe the special product character that is beneficial and could satisfy the requirements of the customers. First passed yields or throughput yield, refers to the quantity of exact perfect units that could be produced within a specific time divided by the actual proposed quantity at the first line of production.

Table 2.4
Summary of Quality Performance Measurements Found in Literature Survey

Performance Measurements	Literatures Supported
Product quality reliability	7, 8, 10, 12, 14, 16, 19, 20, 22
Consistent product quality performance	3, 4, 10, 13, 16, 19, 20, 21
Conformance to product specification	3, 10, 11, 12, 18, 20, 21
Customer return rate	2, 5, 6, 9, 14, 17
Quality durability	10, 14, 16, 20, 22
Defect rates	2, 6, 7, 9, 22
After-sale service	12, 16, 18, 21
Quality of final product	1, 15, 17, 22
Product features quality	3, 20, 22
First passed yields	9, 21

Source: Author's own analysis
Note: 1 = Youndt, Snell, Dean & Lepak (1996); 2 = Beaumont & Schroder (1997); 3 = Flynn, Schroeder & Flynn (1999); 4 = Jayaram, Droge & Vickery (1999); 5 = Sohal, Gordon, Fuller & Simon (1999); 6 = Samson & Ford (2000); 7 = Cagliano, Blackmon & Voss (2001); 8 = Cagliano & Spina (2002); 9 = Christiansen, Berry, Bruun & Ward (2003); 10 = Prajogo & Sohal (2003); 11 = Ketokivi & Schroeder (2004); 12 = Laugen, Acur, Boer & Frick (2005); 13 = Raymond & St-Pierre (2005); 14 = Lakhal, Pasin & Limam (2006); 15 = Khan & Haleem (2008); 16 = Robb, Xie & Arthanari (2008); 17 = Islam & Karim (2011); 18 = Phan, Abdallah & Matsui (2011); 19 = Ng & Jee (2012); 20 = Wu, Melnyk & Swink (2012); 21 = Nawanir, Lim & Othman (2013); 22 = Yang (2013)

2.2.4 Cost

Cost measures have always been used as the prime manufacturing performance measures as it is considered as commonly accepted competitive priority measure.

Through the field of cost accounting, cost has historically been well developed and used as a main performance measure (White, 1996). A result indicated that top management judged cost measure to be the most important dimension of manufacturing performance together with quality and followed by flexibility and time (Jayaram et al., 1999). In 1983, there was a research on the missing measurements of manufacturing performance which had highlighted quality, cost and productivity as the basis for competition among firms who produce mature goods (Kaplan, 1983). The cost minimization it was discussed about was on the inventory level which limited to the estimation of cost within the existing manufacturing systems parameters. Yang (2013) however, used four items to measure cost performance. They are low price products which achieved economic profit goals, products with competitive prices in the market, low production cost, and low inventory cost.

Table 2.5 provides a list of cost performance items found in the literature survey. Unit manufacturing cost is commonly derived when a company produces a large number of identical products. The cost is derived from the variable costs and fixed costs incurred by a production process, divided by the number of units produced. Product costs refers to the costs used to create a product. These costs include direct labour, direct materials, consumable production supplies, and factory overhead. Product cost can also be considered the cost of the labour required to deliver a service to a customer. Production costs is the cost to produce a product which includes raw materials, labour, petty supplies and overhead costs. Overhead cost refers to all operation costs except for direct items such as material, labour, and direct expenses. Relative labour costs is the labour cost per unit of output would contribute to an economy in term of output-wages relationship.

Table 2.5
Summary of Cost Performance Measurements Found in Literature Survey

Performance measurements	Literatures supported
Unit manufacturing cost	4, 9, 11, 12, 15, 16, 17, 18, 19
Product costs	1, 5, 6, 7, 9, 14, 17
Production costs	2, 3, 8, 13, 20
Overhead cost	1, 5, 10, 11, 18
Relative labour costs	1, 5
Relative marketing, distribution, administration costs per unit	1, 5
Relative material costs	1, 5
Total cost (acquisition, setup, maintenance, service, etc.)	10, 18

Source: Author's own analysis
Note: 1 = Beaumont & Schroder (1997); 2 = Flynn, Schroeder & Flynn (1999); 3 = Jayaram, Droge & Vickery (1999); 4 = Sohal, Gordon, Fuller & Simon (1999); 5 = Samson & Ford (2000); 6 = Cagliano, Blackmon & Voss (2001); 7 = Cagliano & Spina (2002); 8 = Ketokivi & Schroeder (2004); 9 = Challis, Samson & Lawson (2005); 10 = Laugen, Acur, Boer & Frick (2005); 11 = Narasimhan, Swink & Kim (2005); 12 = Khan & Haleem (2008); 13 = Robb, Xie & Arthanari (2008); 14 = Rahman, Laosirihongthong & Sohal (2010); 15 = Peng, Schroeder & Shah (2011); 16 = Phan, Abdallah & Matsui (2011); 17 = Ng & Jee (2012); 18 = Wu, Melnyk & Swink (2012); 19 = Nawanir, Lim & Othman (2013); 20 = Yang (2013)

2.2.5 Delivery

Delivery is a frequently accepted strategy-related performance measures for manufacturing (Ward et al., 1998). Fast delivery is required besides its reliability in order to win order and to cater some different customers (Ward et al., 1998). Yang (2013) used five dimensions to measure delivery performance of project manufacturing which are; the deliverables project were delivered quickly, the reliable delivery of goods, the deliverables project were delivered in good condition, the customer order was fulfilled on time, and the project was delivered on schedule.

Table 2.6 exhibits a list of delivery performance measures commonly used in the past literatures. On-time delivery is an efficiency measure of process and supply chain to deliver finished product on time. Delivery reliability calculates the number of error-free deliveries as compared to total number of deliveries to customers within a particular time frame. Delivery dependability refers to on how the manufacturers deliver the product as promised. Delivery lead time is the time taken to deliver the product beginning from the initial order until to the delivery of the product. Delivery in full on time calculates the frequency of how often the on time delivery is successfully executed to meet the customer's request.

Table 2.6
Summary of Delivery Performance Measurements Found in Literature Survey

Performance Measurements	Literatures Supported
On-time delivery	1, 3, 5, 8, 14, 15, 16, 18, 19
Fast delivery	9, 13, 16, 18, 19
Delivery reliability	6, 7, 11, 19
Delivery dependability	4, 12, 17
Delivery lead time	2, 12, 18
Delivery in full on time	2, 10

Source: Author’s own analysis
Note: 1 = Youndt, Snell, Dean & Lepak (1996); 2 = Beaumont & Schroder (1997); 3 = Sakakibara, Flynn, Schroeder & Morris (1997); 4 = Flynn, Schroeder & Flynn (1999); 5 = Sohal, Gordon, Fuller & Simon (1999); 6 = Cagliano, Blackmon & Voss (2001); 7 = Cagliano & Spina (2002); 8 = Christiansen, Berry, Bruun & Ward (2003); 9 = Ketokivi & Schroeder (2004); 10 = Challis, Samson & Lawson (2005); 11 = Laugen, Acur, Boer & Frick (2005); 12 = Robb, Xie & Arthanari (2008); 13 = Rahman, Laosirihongthong & Sohal (2010); 14 = Islam & Karim (2011); 15 = Peng, Schroeder & Shah (2011); 16 = Phan, Abdallah & Matsui (2011); 17 = Wu, Melnyk & Swink (2012); 18 = Nawanir, Lim & Othman (2013); 19 = Yang (2013)

2.2.6 Flexibility

Flexibility is a situation that is capable to be responsive to any uncertainty in the environment or adjustable to any customers’ shifting requirement (Gerwin, 1993). The discussion on flexibility has first established by Browne, Dubois, Rathmill, Sethi, and Stecke (1984) on the flexibility types taxonomy and has becomes as the groundwork of the majority subsequent research. They have explained and justified eight types of flexibility namely; machine, process, product, routing, volume, expansion, operation, and production flexibility. There are seven dimensions of flexibility developed by Gerwin (1993), which are mix, changeover, modification, volume, rerouting, material, and sequencing.

Table 2.7 presented five measures found in the literature survey, commonly used by past researchers to measure the flexibility performance. Volume flexibility is the capability to manufacture above or below the assigned product capacity to be able to increase or decrease the volume of production. Product mix flexibility or product/resource flexibility refers to the production mix capability. Modification flexibility is the ability to quickly perform minor changes in the design of the product. Production changeover refers to the modification of a product line or machine from manufacturing one product to the production of other product.

Table 2.7
Summary of Flexibility Performance Measurements Found in Literature Survey

Performance Measurements	**Literatures Supported**
Volume flexibility	1, 3, 4, 5, 7, 9, 10, 11
Product mix flexibility	1, 4, 5, 7, 9, 10, 11
Modification flexibility	3, 4, 7
Production changeover	2, 6, 8
Dependability service	1, 5

Source: Author's own analysis
Note: 1 = Flynn, Schroeder & Flynn (1999); 2 = Sohal, Gordon, Fuller & Simon (1999); 3 = Ketokivi & Schroeder (2004); 4 = Laugen, Acur, Boer & Frick (2005); 5 = Narasimhan, Swink & Kim (2005); 6 = Raymond & St-Pierre (2005); 7 = Robb, Xie & Arthanari (2008); 8 = Peng, Schroeder & Shah (2011); 9 = Phan, Abdallah & Matsui (2011); 10 = Urtasun-Alonso, Larraza-Kintana, Garcia-Olaverri & Huerta-Arribas (2012); 11 = Wu, Melnyk & Swink (2012)

2.2.7 Past Studies on Manufacturing Performance

Previous studies had proposed a high manufacturing performance model which covered a broad range of practices. One of the early model of high performance manufacturing was from Hayes and Wheelwright (1984). They had suggested and identified six areas of practices which are; i) building the workforces' skills and capabilities, ii) building technical competence through management, iii) competing through quality, iv) developing real worker participation, v) rebuilding manufacturing engineering, and vi) developing breakthroughs and continuous improvement.

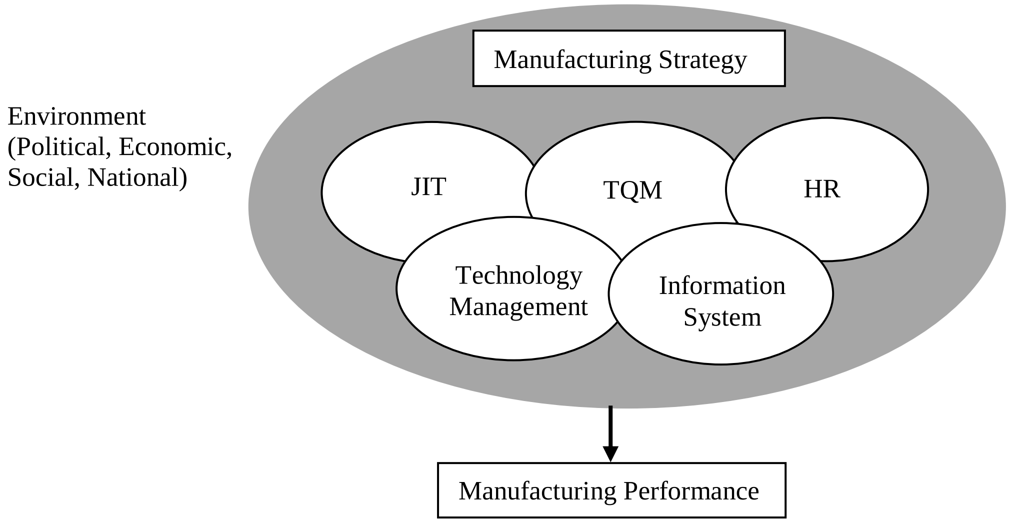


Figure 2.1
High performance manufacturing model
Source: Adopted from Schroeder and Flynn (2001), *p. 9*

A further example of high performance manufacturing was proposed by Schonberger (1986) cited in Schroeder and Flynn (2001), who suggested that just-it-time, total quality management, employee involvement and total productive maintenance are contributing towards high manufacturing performance. Schroeder and Flynn (2001) later had broadened Schonberger's model by including additional practices and added manufacturing strategy and information systems. The high performance manufacturing model of Schroeder and Flynn is illustrated in Figure 2.1. In this model, they were suggesting on how critical is to achieve high performance in manufacturing companies is depending on how well the companies implement the initiatives or so called the practices in the factory. The model also suggested that plant competitive high performance dimensions are considering the cost, quality, delivery and flexibility. By overlooking the multiple dimensions of manufacturing performance and manufacturing objectives leads to an incomplete understanding and modeling of the practice-performance relationships (Ketokivi & Schroeder, 2004a).

Therefore, failed to correlate practices with performance will derail the company to achieve high manufacturing performance.

2.3 Manufacturing Practices

Manufacturing practices is a recognized method or activities which is in a form of well-known manufacturing models implemented with an aim to attain essential objectives of a company (Lee et al., 2015). It reflected transferable and highly planned sets of activities across the organizations and industries by which support the people in operation management to identify related operational difficulties (Wu et al., 2012a). It is also described as a well-established processes adopted and implemented by a company to enhance the way company manages its manufacturing operations (Wiengarten, Fynes, Pagell, & de Búrca, 2011).

Quite a number of studies have been done on practices in manufacturing companies. These practices covered various aspects of operation management area as depicted in Figure 2.2. There are basically ten operation decisions involved in an operation system. They are; product, quality, process, location, layout, human resource, supply chain, inventory, scheduling, and maintenance (Heizer & Render, 2011). It is very important to understand the line of efforts and works that have been done previously on manufacturing practices, for it will easily assist academicians and practitioners to comprehend the extent of current practices and disseminate it (Despeisse et al., 2012). As suggested by Quesada-Pineda and Gazo (2007), it is the human resource, product operations, quality control and supply chain that considered as among the key areas in manufacturing.

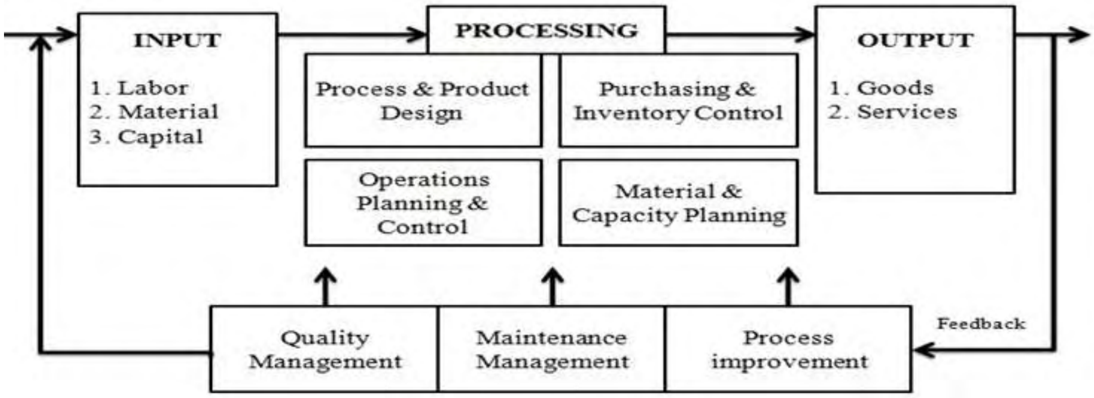


Figure 2.2
A system perspective of operation management
Source: Adopted from Heizer and Render (2011)

Table 2.8 listed the available studies of manufacturing practices in two decades. It provides a list of manufacturing practices that are still valid and remained important as it is implemented in the company as a strategic weapon throughout so many years and until recent. QM, JIT, HRM and SCM are seen to have received the most attention among past researchers. Managers work through practices to realize organizational improvements. Manufacturing practices do have a significant influence on manufacturing performance measures, see for examples; (Cagliano, Blackmon, & Voss, 2001; Challis, Samson, & Lawson, 2005; Christiansen et al., 2003; Flynn et al., 1999; Islam et al., 2007; Islam & Karim, 2011; Karim et al., 2008a; Ketokivi & Schroeder, 2004a; MacDuffie, 1995; Narasimhan et al., 2005; Sakakibara et al., 1997; Ungan, 2007).

For instance, a study of manufacturing practices in micro, small to medium sized enterprises showed a significant link but very low explanatory power (R^2 = 0.095) between manufacturing practices and performance (Cagliano et al., 2001). Later, Cagliano and Spina (2002) further researched on the comparison of practice-performance models between small manufacturers and sub-contractors and found that both advanced general management practices and production management practices

Table 2.8

Summary of Manufacturing Practices Found in the Literature Survey and Number of Studies by Year

Manufacturing Practices	**2013**	**2012**	**2011**	**2010**	**2009**	**2008**	**2007**	**2006**	**2005**	**2004**	**2003**	**2002**	**2001**	**2000**	**1999**	**1998**	**1997**	**1996**	**1995**	**1994**	**1992**	**Total**
Quality management	2	5	4	2	1	3	1	3	3	3	4	1	2	1	3	2	2		1		1	**44**
Just-in-time		1	4	5		1	1	1	5	3	2		1		3	1	2				1	**31**
Supply chain management	1	1	3	1	1	3	1		2	3	2	1	2	1	3	1	1		1			**28**
Total quality management	1	3	3	1	1	1	1	1	3		5	1	1	1	2	1	1				1	**28**
Customer focus	1	5	2	1	1	1		2	3	1	2	1		2	2		2		1			**27**
Human resource management	2	6	1		1	1		1	1	1	2		1	2	3			2	2	1		**27**
Leadership	1	4	2	2	1	2		2	1	2	2	2		1	2				1			**25**
Planning and strategy	1	4	2	1	1			1	2	1	3	1	1	1		2	1	1				**23**
Training		3	2	1				1	2		1	1	1		5			1			1	**19**
Kanban	1			3		1	1	1	1		2		3		1		1				1	**16**
Data management and information analysis	1	2			1	2	1	2	1		1				3	1						**15**
Advanced manufacturing technology				1	2			2	3	1				1	1	1	2					**14**
Employee involvement	1	3	2	1				1				1			3		2					**14**
Total productive maintenance	1	2	1	2		1	1	1			2		1		1		1					**14**
Management practice		1	3				1	1				2	1			2	2					**13**
Technology and product innovation			1	1	1	1			4	1		1					2					**12**
Benchmarking		1		2		1	1		2			1	1		2							**11**
Innovation			2			1		1	1	2	1	1			2							**11**
New product development			1						1		1	1			3	1						**8**
Product design		2	1			1									2		1		1			**8**
Automation technology									2						2	2	1					**7**
Cost management		2	1	1				1							1						1	**7**
Lean manufacturing		3	1	1						1	1											**7**
Teamwork		1		1									1			3					1	**7**
Computerization		1			1				1					1	1	1						**6**
Flexibility				2				1		1					1		1					**6**
Information communication technology		1							1					1	1							**4**
Kaizen							1						1								1	**3**

explained the achievement in competitive advantage by both types of firm. Another survey and analysis show that the adoption of advanced quality practices, failure analysis and prediction, supplier relationship, and product and field data management significantly effects manufacturing performance (Islam & Karim, 2011).

A study conducted among Malaysia's manufacturers by Islam et al. (2007) shows that manufacturing practices significantly influenced company performance on three critical factors i.e. product development, customer return rate and on-time delivery. Furthermore, Islam and Karim (2011) studied on the comparison between small-medium industries and large industries on the similar study setting, and the result showed a significance difference between both size of companies, and that product quality and reliability is a basic competitive factor for SME. However large industries considered the reputation of company as the most important competitive dimension.

Every firm must emphasized on specific practices when they are already targeting on specific performance gain (Narasimhan et al., 2005). Davies and Kochhar (2000) concerned on the refinement of relationship between practices and performance and the elimination of unnecessary practices. It is most important to identify the particular factors that have a huge impact on performance in order to enhance performance successfully (Grünberg, 2004).

2.3.1 Selection of Manufacturing Practices

For the purpose of the current study, the researcher focuses on four well-established practices. The practices considered for analysis are total quality management, just-in-time, human resource management and supply chain management practices. These practices have received a lot of empirical attention in the literatures survey and they are practices that likely have potential of providing value as they are knowledge-intensive (Kogut & Zander, 1992; Ooi, 2012), system-wide (Porter, 1996) and often cross-functional practices and are developed within the firm or even the specific manufacturing plant (Maritan & Brush, 2003). Furthermore, Hong et al. (2012) had also described that lean practices and SCM practices as sustainable practices. So as the JIT and TQM practices that are among the most sustainable management methods of insight to have been acknowledged for a considerable length of time and still keep on adding worth to organization accomplishment (Khanchanapong et al., 2014).

Among others available practices in the same field of study, why these practices are chosen and not others, are due to the contribution of these practices as a key driver towards the achievement of advanced manufacturing performance of the company (Abdel-Maksoud, Dugdale, & Luther, 2005). The researcher did not claimed the set as a comprehensive set of practices neither it is the best nor conclusive, however, the tetralogy are seen to have mutual complementary. Christiansen et al. (2003) had suggested, instead of investigating only one or two of these individuals' influence on non-financial measures of manufacturing performance, research should be focusing on examining these four factors in combination. However, only a few had investigated on the combinations among these four practices.

For instance, Kannan and Tan (2005) had investigated on the trilogy of just-in-time, total quality management and supply chain management practices on their impact towards business performance. The study had highlighted the contribution of investigation on three practices on two points of view. First, at a strategic level, there are connections between JIT, TQM, and SCM. There is also a potential exists to add value and to better position a company to counter to competitive forces by explicitly and efficiently integrating JIT, TQM, and SCM practices into manufacturing strategy. Moreover, while some companies may appreciate the intrinsic relationships between the three and aggressively make use of their synergy, those that do not maybe inadvertently achieving the synergistic benefits. Second, at an operational level, JIT, TQM, and SCM practices can be deployed together to create value to the company. The extent to which various practices correlate with each other and with performance is evidence that while the three may have distinct characteristics and objectives, there are components of each that are common and which can be successfully reinforced by each other.

Another case, Challis et al. (2005) had investigated on the integrated manufacturing facets consisting of TQM, JIT and advanced manufacturing technology together with various firm improvement approaches such as HRM, leadership and etc. on their impact on employee and manufacturing performance. The results indicated that organizational and human resource practices, together with two integrated manufacturing facets of JIT and TQM, explain significantly more variance in manufacturing performance (25 percent) than JIT and TQM alone (20 percent). The results also proved that TQM, leadership and HRM are account as the key drivers for both employee and manufacturing performance.

Shah and Ward (2003) had studied on the relationship between the bundles of TQM, JIT and HRM on manufacturing performance by taking into account the effect of different type of industries. The results suggested by applying synergistic bundles of these practices concurrently appear to make a substantial contribution to manufacturing performance. A further study by Dal Pont, Furlan, and Vinelli (2008) took JIT, TQM and HRM as the main lean manufacturing practices and investigated the relationship between all three of these practices on performance. The findings suggested all of three practices have a significant impact on manufacturing performance, while TQM and JIT are claimed to be the pillars and cornerstone for lean manufacturing. Meanwhile, a study by Brown and Vondráček (2013) highlighted the combination between JIT and TQM formed a time-based manufacturing practices to cater a customer-product driven. These practices were practically focusing on the customer and it was also applied beyond the manufacturing system which linking to suppliers and customers.

Taking into consideration of these findings and discussions, an effort must be taken to investigate onto the results of manufacturing performance will have by implementing TQM, JIT, HRM and SCM practices altogether and examine their impact towards contributing to the firm's advanced competitive advantage. Apart from referring to the reasons that have been discussed, the selection of these four manufacturing practices in this study have also meet the three guidelines by (Ketokivi & Schroeder, 2004a). The practices must;

a. *have been theoretically or empirically associated with one or more specific dimensions of manufacturing performance,*
b. *have been linked to superior performance in the extant literature, and*
c. *be likely to satisfy the criteria that resource-based view sets for valuable resources.*

Many studies have been carried out in accordance of the area of manufacturing practice and shows how it evolves as depicted in Table 2.9. The growing studies and debates on success implementation of practices toward the achievement of an outstanding performance had motivated researchers and practitioners to dig deeper on its effect of implementation and how it contributes to performance and its integration with firm

Table 2.9
Summary of Past Key Empirical Studies on Manufacturing Practices

Source	Practices	Key discussion
Sohal and Ritter (1995)	Leadership and planning, customer focus, people management, process management.	Western companies are in contrast to Asian companies in operating their business where Asian companies were proved to be working with a firm total quality management philosophy whereas the westerners survived with only a few practices implemented.
Morita and Flynn (1997)	Strategic adaptation, technological adaptation, management practices, production system, production control system, organizational system for quality, operational system for quality, human resource development, commitment, pride in work, working on the floor.	A consistent adoption and development of manufacturing practices promising an improved performance and a successful manufacturing strategy as well as becoming a component of building plant competency.
Flynn et al. (1999)	Employee development, management technical competence, design for customer needs, worker participation, proprietary equipment, continuous improvement, process control, feedback of information, pull system, just-in-time supplier practices.	An enhanced competitive performance results from the implementation of world class manufacturing, alone and together with other new practices.
Davies and Kochhar (2002)	Just-in-time practices, total quality management practices.	Identified the methodological issues on the manufacturing practice and performance relationship studies.
Ketokivi and Schroeder (2004a)	Cross-functional co-cooperation, cross-training, designs for manufacturability, just-in-time manufacturing, proprietary equipment, statistical process control, supply chain relationship.	The results showed a significant effects of some manufacturing practices on performance such as fast deliveries, cost, cycle time, quality and etc.
Yusuff (2004)	Management commitment and employee involvement, customer focus, quality practices, vendor and material management, global competitiveness, operation flexibility, innovation and technology, facility control.	It is at an acceptable level of the implementation of some practices, while some others are still improving among the Malaysian electric and electronic companies. No significant correlation between particular practice and performance was found. However, majority companies are towards implementing WCM practices.

Table 2.9 (*Continued*)

Source	**Practices**	**Key discussion**
Laugen, Acur, Boer, and Frick (2005)	Process focus, pull production, equipment productivity, environmental compatibility, quality management, ICT, e-business, new product development, supplier strategy, outsourcing, process equipment, manufacturing capacity, process automation, workplace development.	Manufacturing practices significantly related to performance measures of quality, flexibility, speed and cost.
Narasimhan et al. (2005)	Advanced manufacturing technology, integrated technology development, strategic supply management, statistical process control, quality culture, just-in-time, customer oriented manufacturing.	Broadened and deepened the studies on the relationship between practices and performance, and developed the capability progression concept and its implication.
Beaumont (2005)	Leadership, management of people, customer focus, quality of process and product, benchmarking, technology.	Clarified the terms and components of manufacturing practices used between practitioners and researchers in the Australian manufacturing companies.
Ungan (2007)	Best practice factors, organizational factors, external factors.	A discussion on the key determinant of manufacturing practices implementation and its contribution towards performance.
Asrofah, Zailani, and Fernando (2010)	Manufacturing process factors, organizational factors, and environmental factors.	The contribution of manufacturing practices towards the efficacy of benchmarking.
Anuar and Yusuff (2011)	Customer focus, quality, management, supply chain management, human resource development, marketing strategy, production process, technology and product innovation.	A survey questionnaire on the Malaysian SMEs provides a list of current practices implemented among the manufacturers. Manufacturing practices practiced and its influence towards performance continuity improvement have been highlighted.

Source: An author’s compilation from several literatures capabilities. Even though there were enormous researches have been done on practices and performance, there are reasons why this particular study is still needed. First, firms should identify their manufacturing performance together with manufacturing practices since it is the key element in the manufacturing strategy studies (Karim et al., 2008a; Ward et al., 1998). Second, in order to develop a comprehensive world class manufacturing (WCM) paradigm, ones study must encompass both sets of dimensions on manufacturing practices and manufacturing performance (Narasimhan et al., 2005; Phan et al., 2011). Furthermore, only a few studies have covered on the effect of manufacturing practices towards four major competitive priorities of manufacturing performance dimensionally (Bortolotti, Danese, Flynn, & Romano, 2015; Chen, 2015), and such investigation on the effects so far only stopped at the phase of meta-analytic and critical review (Mackelprang & Nair, 2010; Sukarma & Azmi, 2015). Thus, for that reason, these statements strengthen the need for empirical analysis investigation on manufacturing practices and manufacturing performance dimensions.

2.3.2 Total Quality Management (TQM)

Total quality management (TQM) is implemented to improve the quality of products, services and internal operations to increase the competitiveness and value to customers (Chin, Tummala, & Chan, 2002) and has been studied by academicians and practitioners over the last two decades. TQM fosters continuous improvement through internal and external quality improvements (Eng & Yusof, 2003). More companies practice TQM to generate competitive advantage (Bayazit, 2003; El Shenawy, Baker, & Lemak, 2007).

Managements outline the quality goals, quality policies and quality plans and employees are constantly reminded that the customer, not the product, is the top priority. ISO 9000 is the established standards for quality and companies have their own set of ISO standards. SIRIM (Standards and Industrial Research Institute Malaysia) certifies management systems and products with aims to improve the quality by testing and inspection of local industrial products (Eng & Yusof, 2003).

According to British Standards, TQM is a management philosophy and company practices in optimizing human and material resources to achieve the objectives (Chin, Tummala, & Chan, 2003) which includes incremental and radical changes (Hung, Lien, Yang, Wu, & Kuo, 2011). Bayazit (2003) referred TQM as a quality emphasis for entire organization, from supplier to customer and Berry (1991) indicated TQM focuses on meeting and exceeding customers' expectations with cost reduction. Eng and Yusof (2003) revealed TQM as the integration of philosophy and a set of guiding principles that include fundamental management techniques, existing improvement efforts and technical tools in a disciplined approach.

Generally, TQM covers six areas; management leadership and commitment, continuous improvement, total customer satisfaction, employee involvement, training and education, and reward and recognition (Eng & Yusof, 2003). Prajogo and Sohal (2006) as well as Samson and Terziovski (1999) identified six TQM components; leadership, strategic planning, customer focus, information and analysis, people management and process management. Seven core elements in TQM has been examined; customer focus, leadership, strategic quality planning, design quality, speed and prevention, people participation and partnership, fact-based management and continuous improvement (Chin et al., 2002; Chin et al., 2003). Hung et al. (2011)

classified TQM dimensions into top management support, employee involvement, continuous improvement and customer focus.

Eight TQM critical factors set out by Malaysian electrical and electronics SMEs are management leadership, continuous improvement system, customer satisfaction and feedback, improvement tools and techniques, supplier quality management, employee participation, education and training, and work environment and culture (Eng & Yusof, 2003). Eight elements classified by Arumugam, Ooi, and Fong (2008) are leadership, process management, information analysis, customer focus, supplier relationship, quality system improvement, continual improvement and people involvement. Bayazit (2003) highlighted employee empowerment, upper management commitment and involvement, close co-operation among functions, the use of statistical techniques, the use of quality tools, and quality training and teamwork.

Huarng and Chen (2002) had differentiated between soft (philosophy) and hard (techniques). The philosophy consists of employee empowerment, all employee quality perception through top executive support and employee involvement, whereas the techniques consist of training, measuring product and service, benchmarking on quality and service, statistical method, benchmarking on cost and supplier co-operation. Lakhal, Pasin, and Limam (2006) put ten generic practices into three main categories: management practices which covers commitment and support; infrastructure practices which covers quality, employee training, employee participation, supplier quality management, customer focus and continuous support; and core practices which covers quality system improvement, information and analysis, and statistical quality techniques use.

TQM practices have influence on manufacturing performance (Flynn et al., 1995; Huarng & Chen, 2002; Hung et al., 2011; Prajogo & Sohal, 2003) which is positive and significant (Ng & Jee, 2012), with 49.2 percent of the variance in manufacturing performance is explained by TQM. 85.1 percent of the variance in innovation performance was related to TQM practices (Ooi, Lin, Teh, & Chong, 2012). Arumugam et al. (2008) reported that the coefficient of determination was 0.379, showing a 37.9 percent of quality performance can be explained by the eight model variables of TQM. TQM has an impact in the organizational learning (Hung et al., 2011) and innovation (Hung et al., 2011; Kim, Kumar, & Kumar, 2012; Prajogo & Sohal, 2003) with a significant relationship with inventory turnover (Demeter & Matyusz, 2011). Abdel-Maksoud, Cerbioni, Ricceri, and Velayutham (2010) found positive associations of TQM with other innovative managerial practices facet and non-financial performance measures of employee morale.

Christiansen et al. (2003) studied performance of six manufacturing industries in chemical, metal, machinery, electronics, telecom and medical devices which revealed TQM has significant relationship with cost, quality, delivery reliability and delivery speed. Huarng and Chen (2002) found the integration between TQM philosophy and TQM techniques were related to cost reduction and business performance in the manufacturing companies in Taiwan. Arumugam et al. (2008) study revealed that customer focus and continual improvement were found to have a significant and positive effect on quality performance.

Samson and Terziovski (1999) found that TQM practice and organizational performance is significant in a cross-sectional sense with variance in customer satisfaction, employee morale, productivity, quality of output and delivery performance. Leadership, management of people and customer focus were the strongest significant predictors of operational performance. Bayazit (2003) in the case study of Turkish manufacturing firms found that TQM implementation showed

Table 2.10
Summary of Some Selected Past Studies on Mixed Findings between TQM and Manufacturing Performance

Source	Input	Output	Findings
Belay, Kasie, Helo, Takala, and Powell (2014)	Leadership, policy and strategy, people management, resources management, processes, customer satisfaction, people satisfaction, impact on society, business results.	Labor productivity; revenues per employee, total assets per employee.	Adopting quality management has strong relationships with revenue per employee unlike total asset per employee that is weakly related.
Zhang, Linderman, and Schroeder (2014)	Customer focus, process management, team work, training.	Customer's perception of quality results to assess the performance implication of quality exploitation and quality exploration.	Mixed results.
Ng and Jee (2012)	Leadership, customer/supplier focus and relations, employee relations, product/process management, continuous improvement, teamwork	Time, cost, superiority, creativity, product development performance.	TQM influences manufacturing performance in a Malaysian firm. The influence of TQM on manufacturing performance is positive and significant.
Wu et al. (2012a)	The use of statistical process control, the use of quality control policies and plans, supplier certification for quality, competitive benchmarking for quality.	Cost, conformance quality, design quality, delivery dependability, flexibility.	Practices are additive in nature that significantly related to cost and quality. Contradict and against the nature relationship on delivery and flexibility. The effects of operational practices on operations performance depend on the dimension of operational performance considered.
Zehir, Ertosun, Zehir, and Müceldilli (2012)	Leadership management, factual approach to decision making, employee management, system approach to management, supplier management, process management, customer focus, continual improvement.	Product/service quality, productivity, cost of scrap and rework, delivery lead-time of purchased materials, delivery lead-time of finished products to customers.	Mixed results.
Phan et al. (2011)	Top management leadership, formal strategic planning, training, small group problem solving, employee suggestions, cross-functional product design, housekeeping, process control, information feedback, customer involvement, supplier quality involvement.	Unit cost of manufacturing, conformance to product specifications, on-time delivery, fast delivery, flexibility to change product mix, flexibility to change volume, inventory turnover, cycle time, speed of new product introduction, product capability and performance, customer support and service.	It appears that quality practices are significantly positively associated with every performance measure.

Table 2.10 (*Continued*)

Source	**Input**	**Output**	**Findings**
da Silveira and Sousa (2010)	Quality in general, equipment productivity, environmental performance of processes and products.	Cost, quality, delivery, flexibility.	The results indicate that capability learning and best practices are positively related to performance improvements in quality, flexibility, and dependability, whereas internal fit appears to be negatively related to flexibility improvements.
Lakhal et al. (2006)	Top management commitment and support, organization for quality, employee training, employee participation, supplier quality management, customer focus, continuous support, quality system improvement, information and analysis, statistical quality techniques use.	Waste level, productivity, cycle time, product quality reliability, product quality durability, product quality tenacity, product quality regularity.	The results reveal a positive relationship between quality management practices and organizational performance. Moreover, the findings show a significant relationship between management and infrastructure practices. In addition, the results illustrate a direct effect of infrastructure practices on operational performance and of core practices on product quality.
Challis et al. (2005)	TQM practices as one of the integrated manufacturing (IM) facets.	Employee morale, employee productivity, industrial disputes lost time, employee's skills and abilities, internal customer concept, customer satisfaction, cash flow pre-investment, total cost per unit, delivery in full on time, industrial accidents lost time.	The results show that the key drivers of both employee and MP were TQM, leadership and HRM.
Prajogo and Sohal (2003)	Leadership, strategic planning, customer focus, information and analysis, people management, process management.	Product quality, product innovation, process innovation.	TQM significantly and positively relates to both product quality and product innovation performance although it appears that the magnitude of the relationship is greater against product quality.
Shah and Ward (2003)	Competitive benchmarking, quality management programs, total quality management, process capability measurements, formal continuous improvement program.	Manufacturing cycle time, scrap and rework costs, labor productivity, unit manufacturing cost, first pass yield, customer lead time.	Lean practice bundles have significant impact on operational performance.

Source: An author's compilation from several literatures

decreasing customer complaints, increase customer satisfaction, quality upgrades, lower prices, zero defects, increase in market share, achieving teamwork and reduced costs. TQM as WCM practices have positive impact on plant performance in manufacturing costs, quality and time to market (Banker, Bardhan, & Chen, 2008). Prajogo and Sohal (2006) revealed three TQM performance measures; product quality, product innovation and process innovation. Dal Pont et al. (2008) studied on the impact of lean bundles of TQM, JIT and HRM showed that TQM have a direct and positive effect in manufacturing performance of cost, delivery, quality and flexibility. Although inconsistent, quality performance mostly indicated strong and positive relations (Prajogo & Sohal, 2003).

Table 2.10 depicted some of other selected studies on mixed findings between the TQM practices implementation and performance outcomes. The inconsistencies of empirical findings on its effect towards manufacturing performance leads to the introduction of the third variable that might moderates the impact relationship of TQM on performance.

2.3.3 Just-In-Time (JIT)

Toyota's effort to continuously improve their production systems along with diffusion of their improved production systems to another Japanese companies and a dedicated efforts to pursue perfection by Japanese, has resulted in the efficient, integrated, manufacturing system known as Just-in-time (JIT). Separate companies have different interpretation about JIT. Toyota was the pioneer that established JIT during the operation in manufacturing automobiles which later accepted by other manufacturers as the basic standard. It comprises every mechanism and technique employed in order to minimize inventory, reduce lead times, upgrade quality and avoid wastage. These are attainable by producing small batches, lesser lead times, increasing small-scale orders with frequent deliveries and minimizing setup times (Huson & Nanda, 1995; Inman, Sale, Green, & Whitten, 2011; Rahman et al., 2010). As a manufacturing company must become competitive for its survival, it has to supply products of consistent high quality at reliable and reduced delivery time at reasonable cost (Wakchaure, Venkatesh, & Kallurkar, 2006). JIT practices have a fundamental goal and ultimate objective of continuous improvement and waste reduction which incessantly minimizing and finally abolishing wastage in any form that inhibits the value chain (Chen, 2015; Mackelprang & Nair, 2010; Sugimori, Kusunoki, Cho, & Uchikawa, 1977; Sukarma, 2014). The use of JIT practices, has led to impressive results during the past decade where manufacturers which applied these approaches noted significant improvements in competitive position and increases in productivity and reliability of their products (Flynn et al., 1999).

JIT is a philosophy aimed at to produce and deliver finished goods just in time to be sold, subassemblies just in time to be assembled in to finished goods, fabricated parts just in time to go into assemblies, and purchased materials just in time to be transformed in to fabricated parts (Wakchaure et al., 2006). JIT is that subset of lean associated primarily with the elimination of waste through planning, scheduling and sequencing of operations. This definition of JIT subsumes both primary elements of JIT, JIT-purchasing and JIT-production, as elements of itself that are distinguishable from each other by where they occur in the system or supply chain (Inman et al., 2011). Claycomb, Dröge, and Germain (1999) defined JIT as a comprehensive strategy that combines the primary tactical elements of JIT-production and JIT-purchasing, to eliminate waste and optimally utilize resources throughout the supply chain. Cua et al. (2001) defined JIT as a manufacturing program with the primary goal of continuously reducing and ultimately eliminating all forms of waste through JIT production and involvement of the work force.

Cua et al. (2001) identified from various previous studies and highlighted nine practices that are frequently cited as JIT practices. These are setup time reduction, pull system production, JIT delivery by supplier, functional equipment layout, daily schedule adherence, committed leadership, strategic planning, cross-functional training, and employee involvement. Swink, Narasimhan, and Kim (2005) have listed the related literatures and its JIT practices dimensions in their study. They are from Snell and Dean (1992) which categories JIT into small batch sizes, reduced buffer stock, pull production and plant layout. Davy, White, Merritt, and Gritzmacher (1992) operationalize JIT as operating structure and control and categorized the practice into decentralized control, cellular manufacturing, preventive maintenance, and reduced setup times. Sakakibara, Flynn, and Schroeder (1993) categorized JIT as simplified physical flow into equipment layout, small lot sizes, product design simplicity, kanban and pull system. Flynn et al. (1995) conceptualize JIT practices as lot size reduction, JIT scheduling and setup time reduction. Sakakibara et al. (1997) classified JIT practices into six elements of setup reduction, schedule flexibility, maintenance, equipment layout, Kanban, and JIT supplier relationship. McLachlin (1997) used JIT flow in his study and conceptually classified it into seven elements which are setup reduction, equipment layout, small lot size, uniform plant load, daily schedule adherence, pull system and JIT delivery from suppliers. Finally, Shah and Ward (2003) classified JIT into components namely lot size reduction, cycle time reduction, quick changeover and production process reengineering, in which these components are of regular procedures that are connected to production progress.

Wakchaure et al. (2006) reviewed JIT practices in the context of Indian manufacturing sector. The study reported on the most practiced JIT elements in India are lot size reduction, product scheduling, quality circles, lifelong employment, set up time reduction, kaizen, work in process reduction, preventive maintenance, reliable and prompt delivery, smooth built up rate, whilst least used includes Poka Yoke, Kanban, reliable equipments, and layout improvement. Multiple regression analyses indicated the significant relationships between lean practices and manufacturing performance measures, lean manufacturing practices which is basically derived from JIT concept are positively correlated with all measures of manufacturing performance at the 0.05 significance level (Nawanir, Teong, & Othman, 2013).

Dal Pont et al. (2008) studied on the impact of lean bundles of TQM, JIT and HRM towards firm operational performance, and the results have prove that JIT have a positive, significant and direct effect on manufacturing performance of cost, delivery, quality and flexibility. JIT practices have been studied to directly contribute to improved performance. Cua et al. (2001) had investigated on the relationship between implementation of JIT and manufacturing performance. The results showed that all of JIT practice variables have significant structure loading on at least one dimension of performance of cost efficiency, conformance quality, on-time delivery and volume flexibility except for equipment layout.

In a study of lean bundles practices, Demeter and Matyusz (2011) found out a significant relationship between JIT as one of the bundles with inventory turnover. da Silveira and Sousa (2010) had investigated on the relationship between performance improvements of cost, quality, delivery and flexibility with best practices of TQM, lean practices and new product development practices. The lean practices it was mentioning were referred to a distinctive set of practices namely the JIT flow. JIT flow construct comprised two items of the use of focused processes and pull production. A study on the relationship of manufacturing practices and strategy integration on new product flexibility, process flexibility and cost efficiency showed mixed results depending on the involvement of strategy integration as moderator variables (Swink et al., 2005). JIT flow has been proven to significantly associate with only process flexibility, whereas the strategy integration positively moderates the association between JIT flow and new product flexibility.

Flynn et al. (1999) had investigated the relationship of WCM practices with the corresponding to Hayes and Wheelwright's description of the seven dimensions of competitive priorities. Among other WCM practices, a core JIT practices are one of it. Two scales were selected to represent core JIT practices which are the pull system and JIT supplier relations. Pull system describes the extent to which production is driven by customer demand while JIT supplier relations describe the extent of coordination with suppliers to ensure JIT deliveries. The test of the third hypothesis was also supported, with the addition of variables related to core JIT practices having a similar effect. All regression equations were statistically significant, with the exception of quality features. Further, the addition of the JIT practice variables led to increased predictive power for the equations related to quality and dependability. The use of JIT practices has proven to leads to improved quality performance.

Kadipasaoglu, Peixoto, and Khumawala (1999) investigated the relationship of improvement programs with performance outcomes of manufacturing cost, product quality, delivery speed, and on-time deliveries. The improvement programs they were referring that related to JIT namely cellular manufacturing and JIT systems. The study expected the link between improvement programs and performance to be strong, however, the reported result showed there is only marginally significant between the two. JIT systems and cost of manufacturing are both positively related to their respective latent variables. The negative sign of the path coefficient between these two latent variables implies that an increase in JIT system implementation results in a decrease in the percentage change in the cost of manufacturing. Additionally, an evaluation revealed that about 25 percent of JIT practices are having insignificant relationship with performance which signifies that no assumptions can be made that all JIT practices would enhance all perspectives in performance. It is further noted that about 50 percent of the relationship are attached to moderating factors which denote that performance target should be carried out and monitored cautiously and consider the fundamental or hidden circumstances (Mackelprang & Nair, 2010).

Table 2.11 represented some of summary of other selected studies on mixed findings between the JIT practices implementation and performance outcomes. From the table presented, it showed that JIT practices which have enormously been researched previously were inconsistent in its effect towards the manufacturing firm's performance operationally. This situation strongly proved by a meta-analysis investigation on JIT practices (i.e. daily schedule adherence, JIT link with customers, pull system, small lot sizes, setup time reduction, preventive maintenance, repetitive nature of master schedule, equipment layout, JIT deliveries from suppliers, and Kanban) and manufacturing performance (i.e. quality, cost, delivery, inventory, cycle time, and flexibility) which reported on the significant and insignificant results between the two constructs (Mackelprang & Nair, 2010). Thereby, these inconsistencies lead to the proposition of moderator variable existence between them.

Table 2.11

Summary of Some Selected Past Studies on Mixed Findings between JIT and Manufacturing Performance

Source	**Input**	**Output**	**Findings**
Wu et al. (2012a)	Small batch size, setup time reduction, pull system production, equipment/ facility/ plant layout to optimize processing sequence and flow.	Cost, conformance quality, design quality, delivery dependability, flexibility.	Practices are additive in nature that significantly related to cost and quality. Contradict relationship on delivery and flexibility.
Mackelprang and Nair (2010)	Setup time reduction, small lot sizes, JIT delivery from suppliers, daily schedule adherence, preventive maintenance, equipment layout, kanban, pull system, JIT link with customers, repetitive nature of master schedule.	Inventory, cycle time, delivery, quality, manufacturing cost, manufacturing flexibility.	About one-fourth of the JIT practices to performance relationship are not significant.
Rahman et al. (2010)	Reduction of inventory, preventive maintenance, cycle time reduction, use of new process technology, use of quick change-over techniques, reducing set-up time.	Quick delivery, unit cost of product, overall productivity, overall customer satisfactions.	There is a positive significant relationship between lean practices and operational performance for SMEs and large enterprises.
Challis et al. (2005)	JIT as one of the integrated manufacturing facet.	Employee morale, employee productivity, industrial disputes lost time, employee's skills and abilities, internal customer concept, customer satisfaction, cash flow pre-investment, total cost per unit, delivery in full on time, industrial accidents lost time.	Significant and positive relationship.
Kannan and Tan (2005)	Material flow, commitment to JIT, supply management.	Overall product quality, overall competitive position, overall customer service levels.	Both JIT-material flow and commitment to JIT did not significantly correlated with all three performances. JIT-supply management significantly correlated with quality and customer service but not with competitiveness.
Narasimhan et al. (2005)	JIT suppliers' delivery basis, production rate close to customer's rate of use, JIT delivery to customers, daily shipments from suppliers, JIT flow production methods, small lot sizes.	New product development, flexibility, efficiency.	JIT operations practices must be improve for internal or process focusers to gain in flexibility.

Table 2.11 (*Continued*)

Source	**Input**	**Output**	**Findings**
(Ketokivi & Schroeder, 2004a)	Frequent delivery by suppliers, setup time reduction, pull system support.	Low costs, conformance quality, volume flexibility, design flexibility, fast deliveries and production cycle time.	Some of the main effects of manufacturing practices are significant: JIT is associated with fast deliveries, low cost and low cycle times.
(Christiansen et al., 2003)	Reengineered production processes, cycle-time reductions, agile manufacturing strategies, quick changeover techniques, focused-factory production systems, JIT/continuous-flow production, pull system/kanban, bottleneck/constraint removal.	Cost, quality, delivery reliability, delivery speed.	By using strategic groups as a representation of companies' manufacturing strategy can improve the understanding of companies' implementation of bundles of manufacturing practices and of their operational performance.
(Shah & Ward, 2003)	Lot size reductions, JIT/continuous flow production, pull system, cellular manufacturing, cycle time reductions, focused factory production systems, agile manufacturing strategies, quick changeover techniques, bottleneck/ constraint removal, reengineered production processes.	Manufacturing cycle time, scrap and rework costs, labour productivity, unit manufacturing cost, first pass yield, customer lead time.	Lean practice bundles have significant impact on operational performance.
(Sakakibara et al., 1997)	Set-up time reduction, schedule flexibility, maintenance, equipment layout, kanban, JIT supplier relationship.	Inventory turnover, on-time delivery, lead time, cycle time.	Infrastructure practices drive JIT practices, which in turn drive performance.

Source: An author's compilation from several literatures

2.3.4 Human Resource Management (HRM)

The process of managing the human capital is called human resource management (HRM) (Abdullah et al., 2009). HRM practices aimed at attracting, mobilizing and keeping employees on whom rest the competence, the know-how and eventually the performance of the organization (Fabi, Raymond, & Lacoursière, 2009). Long a concern among organizational contingency theory researchers, the concept of the congruence, or fit, between diverse sets of organizational policies and practices has recently emerged as an important subject of study for HRM researchers. This new strategic, macro, HRM perspective differs markedly from the more traditional approach focusing on the effects of separate human resource practices on individual-level outcomes. In contrast, the strategic HRM perspective integrates macro-level theories and concepts to explore the impact of specific configurations, or systems, of human resource activities on organization-level performance outcomes (Arthur, 1994).

Government has also recognized that HRM can play an important role for the Malaysian government has envisioned as a developed nation by 2020. Most of the organizations, domestic companies and multinational companies or corporations (MNCs) in Malaysia nowadays tend to focus more on HRM and also treated HRM as a key of success where they believed that without efficient HRM programmes and activities, companies would not achieved and sustained effectively (Abdullah et al., 2009). Literature on HRM has proposed that better HRM practices provide a source of sustained competitive advantage for some firms through the acquisition and development of human capital (Agarwal, Green, Brown, Tan, & Randhawa, 2013). Reviews on HRM concluded that there is empirical evidence to suggest that HRM practices directly influences firm performance or competitive advantage. Studies show that HRM plays an important role in formulating and implementing organizational strategy (Abdullah et al., 2009). For instance, the Chinese manufacturers realized that the key to improve the competitiveness is by organizing proper employees' intakes and keeping them well motivated and committed (Čech, Yao, Samolejová, Li, & Wicher, 2016).

There are two types of human resource systems which are control and commitment (Arthur, 1994). Control and commitment represent two distinct approaches to shaping employee behaviors and attitudes at work. The goal of control human resource systems is to reduce direct labor costs, or improve efficiency, by enforcing employee compliance with specified rules and procedures and basing employee rewards on some measurable output criteria. In contrast, commitment human resource systems shape desired employee behaviors and attitudes by forging psychological links between organizational and employee goals. The seven HRM practices proposed by Pfeffer (1998) are employment security, selective hiring of new personnel, self-managed teams and decentralization of decision making as the basic principles of organizational design, comparatively high compensation contingent on organizational performance, extensive training, reduced status distinctions and barriers, including dress, language, office arrangements, and wage differences across levels, and extensive sharing of financial and performance information throughout the organization.

More recent empirical study on HRM practices (Lee & Lee, 2007) uncovered six underlying HRM practices on business performance, namely training and development, teamwork, compensation or incentives, HR planning, performance appraisal, and employee security. The same six factors have been used by Abdullah et al. (2009) in their study to investigate the effect of these HRM practices on business performance. Ahmad and Schroeder (2003) found the seven HRM practices such as employment security, selective hiring, use of teams and decentralization, compensation or incentive contingent on performance; extensive training, status difference and sharing information.

A number of studies have found a positive impact of HRM on organizational performance. For instance, in a study of lean bundles practices, Demeter and Matyusz (2011) found out a significant relationship between HRM as one of the bundles with inventory turnover. MacDuffie (1995) provides evidence that clusters of HRM practices are associated with higher productivity and quality in auto-manufacturing firms. Youndt et al. (1996) found that certain combinations of HRM practices are related to operational performance of manufacturing firms. Study reveals that three items of HRM practices namely training and development, compensation or incentives, and HR planning influence the business performance. However, some other researches also show that certain HRM practices have significant relationship with operational performance of employee's productivity and firm's flexibility, and quality outcomes. These research evidences showed that effective HRM practices can have positive impact on business performance (Abdullah et al., 2009).

Arthur (1994) had investigated on the effects of human resource systems on manufacturing performance and turnover. The negative coefficients for the human resource system variable in both models indicates that commitment is significantly related to both fewer labor hours per ton and lower scrap rates. Because the results of the overall regression model for scrap rate are not significant, however, the significance of the human resource system variable in this model must be interpreted with some caution. While, a study by Abdullah et al. (2009) had combined six HRM practices into one regression, to see the overall effect on firms' business performance consisting employee's productivity, product quality and firm's flexibility. The results showed that of the six hypothesized relationships of six HRM practices, four are significant while two are not significant. It is suggested that training and development, team work, HR planning and performance appraisal has a positive impact on business performance. However, compensation or incentives and employee security were reported to have an insignificant relationship with business performance.

Ahmad and Schroeder (2003) studied on the relationship of seven HRM practices underlined by Pfeffer (1998) and operational performance measures of unit cost, quality, delivery, flexibility and speed of new product introduction. The reported results found most support for the direct relationship between HRM practices and operational performance. However the proposed direct relationship between employment insecurity and organizational performance, and between status difference and organizational performance, cannot be empirically validated. Moreover, the mediating effect analysis revealed that most of HRM practices impact operational performance indirectly through organizational commitment.

Dal Pont et al. (2008) studied on the impact of lean bundles of TQM, JIT and HRM towards firm operational performance, and the results reported that HRM has a positive, significant and mediated effect on manufacturing performance of cost, delivery, quality and flexibility. The results also indicated JIT and TQM are the complete mediators of the effect of HRM on operational performance. However, the causal relationship between HRM and TQM and JIT tested by the mediation effect does not mean that all the HRM practices have to be implemented before JIT and TQM practices. Table 2.12 depicted some of other selected studies on mixed findings between the HRM practices implementation and performance outcomes.

Table 2.12

Summary of Some Selected Past Studies on Mixed Findings between HRM and Manufacturing Performance

Source	**Input**	**Output**	**Findings**
Yang (2013)	Team members' skills and expertise, team members continuing education trainings, reward and punishment system, managers continuing education trainings	Quality, cost, delivery	Significant and positive relationship.
(Urtasun-Alonso et al., 2012)	Selective staffing, extensive training, high-performance compensation practices, formal performance evaluation, regular information-sharing communication, opportunities for employee participation.	Mix flexibility, new-product flexibility, volume flexibility.	There is a positive association between the use of advanced HRM practices and manufacturing flexibility.
(Wu et al., 2012a)	Cross-trained workforce, team work and organization, rewarded for learning new skills, group problem solving.	Cost, conformance quality, design quality, delivery dependability, flexibility.	Practices are additive in nature that significantly related to cost and quality. Contradict and against the nature relationship on delivery and flexibility.
(Dan & Yuxin, 2011)	Autonomy, training, cross-functional teams, employees involvement, job rotation, skills-oriented performance evaluation, result-oriented performance evaluation.	Cost and time, efficiency, quality, scope flexibility, delivery, product and service.	Mixed results.
(Wickramasinghe & Gamage, 2011)	Team work, skill development, communication, performance evaluation, rewards and recognition, empowerment.	Quality on customer complaints, loyal customers, scrap and rework.	High –involvement work practices have significant positive impact on quality measures. Organizations with a higher level of work practices score higher on quality results.
(Robb et al., 2008)	Worker safety, motivate workers, increase supervisor training, provide more worker training, and give workers a broader range of tasks.	Delivery dependability, product reliability, after-sale service, consistent quality, product durability, low production cost, production time, new products, delivery time, new product development time, product mix flexibility, volume flexibility, modification flexibility.	Operations and supply chain practices has a positive impact on operations dimension importance, viz., that human resources, customer relationships, manufacturing technology, and manufacturing systems are each closely associated with the emphasis placed on at least one of the operations dimensions

Table 2.12 (*Continued*)

Source	Input	Output	Findings
(Challis et al., 2005)	Wide training and development process, top down and bottom up communication processes, multiskilling employee and training, pay for performance scheme, focus n skills/ competencies.	Employee morale, employee productivity, industrial disputes lost time, employee's skills and abilities, internal customer concept, customer satisfaction, cash flow pre-investment, total cost per unit, delivery in full on time, industrial accidents lost time.	HRM is correlated with manufacturing performance. HRM are one of the three attributes with the greatest association with employee and manufacturing performance
(Shah & Ward, 2003)	Self-directed work teams, flexible, cross functional workforce.	Manufacturing cycle time, scrap and rework costs, labour productivity, unit manufacturing cost, first pass yield, customer lead time.	Lean practice bundles have significant impact on operational performance.
(Cagliano et al., 2001)	Shared vision with employees, employee involvement, training and education.	Rapid equipment changeover, production cycle time, frequency of priority orders, process capability, internal defects, inventory turns, delivery reliability, product reliability, product costs.	The adoption of manufacturing practicesin SMEs does have an impact on manufacturing performance and the impact varies a lot depending on firm size.
(Jayaram et al., 1999)	Top management commitment, communication of goals, employee training, cross functional teams, cross training, employee autonomy, employee impact, broad jobs, open organizations, effective labour management relations.	Cost reduction, quality, flexibility, time-based competition	All four priority-specific HRM factors are strongly significantly related to their respective manufacturing performance dimensions.

Source: An author's compilation from several literatures

2.3.5 Supply Chain Management (SCM)

In the face of a competitive global market, organizations have downsized, focused on core competencies, and attempted to achieve competitive advantage by more effectively managing purchasing activities and relationships with suppliers (Tan et al., 1999). In managing organizational quality, it has become widely recognized that effective integration of suppliers and customers into the productor value supply chain is a key factor in achieving the improvement necessary to gain competitive advantage (Kaynak & Hartley, 2008). To implement supply chain management (SCM), some level of coordination across organizational boundaries is needed which includes integration of processes and functions within organizations and across the supply chain (Cooper, Lambert, & Pagh, 1997). In addition, as revealed by the research, the established practices in SCM are implementable to Malaysia and other developing countries as against to former SCM practices which mainly concentrated on developed or Western countries. Unlike those developed countries, Malaysia focuses on manufacturing and implements economical strategy. In spite of that, such approach is only applicable for short term and Malaysian companies are currently utilizing SCM to be more efficient and effective in their operations (Chong, Chan, Ooi, & Sim, 2011).

SCM is defined by the members of The International Center for Competitive Excellence in 1994 as the integration of business processes from end user through original suppliers that provides products, services and information that add value for customers (Cooper et al., 1997). Tan et al. (1999) referred SCM to a simultaneous integration of customer requirements, internal processes, and upstream supplier performance. Lenny Koh, Demirbag, Bayraktar, Tatoglu, and Zaim (2007) defined

SCM practices as a set of activities undertaken in an organization to promote effective management of its supply chain.

Cooper et al. (1997) had identified the SCM components based from past literatures. The components of SCM are planning and control, work structure, organization structure, product flow facility structure, information flow facility structure, product structure, management methods, power and leadership structure, risk and reward structure and culture and attitude. Ulusoy (2003) categorized SCM practices into logistics, supplier relations, customer relations and production. Chen and Paulraj (2004) divided the SCM practices into five dimensions of supply base reduction, long-term relationship, communication, cross-functional teams and supplier involvement. Min and Mentzer (2004) identified seven dimensions of SCM practices of agreed vision and goals, information sharing, risk and award sharing, cooperation, process integration, long term relationship and agreed supply chain leadership. Li et al. (2005) underlined six dimensions of SCM practices which include strategic supplier partnership, customer relationship, information sharing, information quality, internal lean practices and postponement. Strategic supplier partnership represents the long-term relationship between the organization and suppliers. Burgess, Singh, and Koroglu (2006) identified seven dimensions of SCM practices. They are leadership, intra-organizational relationship, inter-organizational relationships, logistics, process improvement orientation, information systems and business results and outcomes.

Tan et al. (1999) had studied on the relationship of two SCM practices with performance. The practices are supply base management practices and customer relation practices with performance measures of production cost, level of customer service, product quality and competitive position. The results indicated that an effective management of the supply base and a customer relations focus had positively affects performance. A study by Fynes, Voss, and de Búrca (2005) identified that there was a mixed support for the impact of supply chain relationship dynamics on manufacturing performance. The relationship of supply chain relationship in respect of cost and quality were significant however the relationship in respect of flexibility and delivery were not.

In addition, to have a focus on quality, understanding supply chain relationships is a key driver of performance. Whether it is by coordination and integration of activities throughout the supply chain or by recognizing the capabilities of immediate suppliers, understanding supply chain dynamics has a significant impact on performance. As the trend towards outsourcing and focusing on core competencies increases, organizations will be under greater pressure to effectively leverage supplier and customer relationships. The results demonstrate that doing so be a significant driver of a firm's success (Kannan & Tan, 2005). Chavez et al. (2015) indicated that there are increasing evidence that SC integration has positive consequences on operational performance. However, there are also inconclusive researches and in many instances contradicts against performance measures in manufacturing. Table 2.13 illustrated the summary of some other selected studies on mixed findings between the SCM practices implementation and performance outcomes.

Table 2.13

Summary of Some Selected Past Studies on Mixed Findings between SCM and Manufacturing Performance

Source	Input	Output	Findings
(Ng & Jee, 2012)	Customer/supplier focus and relations.	Time, cost, superiority, creativity, product development performance.	Significant and positive relationship.
(Wu et al., 2012a)	Customer orientation, supplier relationship management.	Cost, conformance quality, design quality, delivery dependability, flexibility.	Practices are additive in nature that significantly related to cost and quality. Contradict and against the nature relationship on delivery and flexibility.
(Chong et al., 2011)	Strategic supplier partnership, customer relationship, information sharing, information technology, training, internal operation.	Lead time, inventory turnover, product rejection/ return, sales level, cost reduction, meeting customers' requirement, process innovation, product and service innovation.	Both upstream and downstream supply chain showed a direct and significant impact of SCM practices on firm and innovation performance.
(Islam & Karim, 2011)	Supplier relationship	Product quality, customer return rate, on-time delivery.	Significant and positive relationship.
(Bayraktar, Demirbag, Koh, Tatoglu, & Zaim, 2009)	Close partnership with suppliers, close partnership with customers, just in time supply, e-procurement, outsourcing, subcontracting, 3PL, strategic planning, supply chain benchmarking, few suppliers, many suppliers, holding safety stock.	Lead time in production, forecasting, resource planning, operational efficiency, inventory level, cost, costing.	SCM positively and significantly influence the firm operational performance. SCM and operational performance is moderated by the SCM-Information System enablers.
(Robb et al., 2008)	Customer relationships, Supplier relationship, e-commerce, enterprise software.	Delivery dependability, product reliability, after-sale service, consistent quality, product durability, low production cost, production time, new products, delivery time, new product development time, product mix flexibility, volume flexibility, modification flexibility.	Significant and positive relationship.
(Lenny Koh et al., 2007)	Close partnership with suppliers, close partnership with customers, JIT supply, strategic planning, supply chain benchmarking, few suppliers, holding safety stock, e-procurement, outsourcing, subcontracting, 3PL, many suppliers.	Flexibility, lead time in production, cost, forecasting, resource planning, inventory level.	SCM practices have direct positive and significant impact on operational performance.

Table 2.13 (*Continued*)

Source	Input	Output	Findings
(Wook Kim, 2006)	Company's integration with suppliers, cross functional integration within a company, company's integration with customers, tentative initiative, structural initiative, logistical initiative.	Response time for product design changes, response time for product volume changes, order processing for customers, product return ratio, speed of order handling, and response time for product returns or after-service.	SCM practices may not be related to firm performance directly for small-sized firms but the effect of SCM practices on firm performance for large firms is significant and direct.
(Li, Ragu-Nathan, Ragu-Nathan, & Rao, 2006)	Strategic supplier partnership, customer relationship, level of information sharing, quality of information sharing, postponement.	Price/cost, quality, delivery dependability, product innovation, time to market.	Higher level of SCM practice can lead to enhanced competitive advantage and improved organizational performance.
(Rungtusanatham, Salvador, Forza, & Choi, 2003)	Supply chain linkages.	Operational performance.	The enhanced supply chain linkages can yield rent and offer concrete competitive advantage, even though its relational benefits are not easily quantifiable.
(Tan, 2002)	Supply chain integration, supply chain characteristics, information sharing, strategic location, customer service management, JIT capability.	Product quality, competitive position, customer service levels.	SCM practices significantly influence all three performance measures.

Source: An author's compilation from several literatures

2.4 Technological Capability (TC)

Technological capability has been studied for over 30 years since 1980 as according to the earliest literature of model development on technological capability by Kim (1980). Firms are originally technologically immature and incapable, where technological capability starts to be developed through the learning process over time when knowledge starts to accumulate and the firms are able to progressively run new activities while improving the capabilities (Dutrénit, 2004). This has proof that the development of technological capability is not a short term commitment. For technological capability to be built, it must involves with a long term process instead of a short term planning (Husseini & O'Brien, 2004). Therefore, it must takes effort of every component to obtain the result of the firm performance and acquire competitive advantages while at the same time trying to sustain the commercial success in the local and global market during the long life span. In a long-term view, technological interactions between firms and their environments have to be considered in manufacturing strategy formulations in both national and company levels, where firms' technological capabilities help build technological characteristics in both internal and external contexts in an accumulating procedure (Husseini & O'Brien, 2004).

Technological capability is a term that encompasses the system of activities, physical systems, skills and knowledge bases, managerial systems of education and reward, and values that create a special advantage for an organization or line of business. It is the capacity to utilize technological know-how efficiently, to replicate and incorporate available technologies, invent new technologies, products and processes and to tackle the dynamic economic situation. Basically, firms must be capable in operating, maintaining, adapting, and assimilating the transferred technology to survive the changing industrial technology. There are two main dimensions of technological capability which are activities and strategies (Bergek, Tell, Berggren, & Watson, 2008). Activities concerned with the R&D activity in term of patenting, product launching, and problem solving whereas strategy will consider on the technological sourcing. There were substantial numbers of research that have been done on technological capability. Technological capability plays an important role in achieving competitive advantages. It also increases performance of firms, industries, and as well as for the countries.

Previous studies in technological capability had covered sectors such as manufacturing (Hajihoseini, Akhavan, & Abbasi, 2009; Iammarino, Padilla-Perez, & von Tunzelmann, 2008; Isobe et al., 2008; Khan & Haleem, 2008; Rasiah, 2009) biotechnology (Garcia-Muina & Navas-Lopez, 2007; Haeussler et al., 2012; Kotha, Zheng, & George, 2011; Renko, Carsrud, & Brännback, 2009), automotive (Khan & Haleem, 2008; Liu & Tylecote, 2009; Rasiah, 2009), high technology (Wang et al., 2006; Zhou & Wu, 2010; Zou et al., 2010), services (Abeysinghe & Paul, 2004, 2005; Ortega, 2010; Oyebisi, Olamade, & Agboola, 2004), and construction (Takim, Omar, & Nawawi, 2008). Every outcomes and findings on technological capability studies reflected particularly to the respective sector. Quite a number of previous studies had covered manufacturing sector against other sectors. This has brought an idea that technological capability studies are almost known to the industry that heavily involved in the processes that equipped and related to the use of machinery equipments. Thus, technological capability is widely known as critically important for the manufacturing companies' competitive advantages which drives performance of an organization.

2.4.1 Definitions of Technological Capability

In the early studies, many researchers have defined the term technological capability in a broad area of knowledge. The role and explanation of technological capability differs with different perspective of the studies as presented in Table 2.14. As technological capability goes beyond the trilogy of science, engineering and technology, it includes organizational know-how, knowledge of behavioral patterns of workers, suppliers and customers. This knowledge and skills are evolutionary. They come from iterative trial and error, cumulative learning by doing and using, and by interactions within a firm; between a firm and its suppliers and between a firm and its customers (Oyebisi et al., 2004). Wang et al. (2006) operationalized TC as the accumulated technological knowledge and skills in order to assimilate, use, adapt and change existing technologies and develop new products and processes.

Table 2.14
Technological Capability Definitions

Definitions	**Source**
The competency rate of companies in inventing new products in relation to the age of the company.	(Kim, 1980)
The competency to implement every technicalities pertaining to the operation, upgrading and the updating the manufacturing facilities of the company.	(Lall, 1990)
The acquisition of sources required to create and administer the changes in the aspect of technical that have been built up and personified in expertise, education, experience and the system in the company.	(Bell & Pavitt, 1992)
The capability to choose applicable technologies to carry out the current task, the aptitude to take in, adjust and localize the technologies and the capability to invent new technologies, procedures and manufactured goods through innovations in local scene.	(Wilson, 1995)
The capability to carry out any related organizational technological task or mass production action together with the capability to invent new items and processes and to efficiently running the facilities.	(Teece et al., 1997)
The capability to adjust or absorb and integrate foreign technology by utilizing productively the newly obtained added and diversified techniques.	(Aw & Batra, 1998)

Table 2.14 (*Continued*)

Definitions	Source
The required expertise, know-how and experience to ensure the company succeed at various technological transformation stages.	(Costa & de Queiroz, 2002)
The expertise that a company acquires in developing and utilizing diversified technologies and scheme.	(Zahra & Nielsen, 2002)
The required elements to produce and to control the upgrading in processes and manufacturing company, merchandise, equipments and engineering developments.	(Figueiredo, 2002b)
The required expertise and know-how to enable a company select, set up, run, sustain, acclimatize, upgrade and building technologies.	(Madanmohan, Kumar, & Kumar, 2004)
How a country meets its growth target by utilizing its capability to select, obtain, produce and accommodate technologies (International Labour Office, 1986).	(Oyebisi et al., 2004)
The absorption and practice the technological know-how that is gained from the R&D actions to the production.	(Tsai, 2004)
The organizational alignment between the tangible (machines, equipments, systems and procedure) and intangible (skills, knowledge and experience) that define to create firm competitive advantages through a capacity to effectively and efficiently leverage the technological sources.	(Shamsuddin & Bititci, 2005)
The competency of a firm in generating output from input effectively as against its competitor.	(Coombs & Bierly III, 2006)
The competency to build up and invent new products and processes and uniquely enhance knowledge of the real situation theoretically and practically (know-how, methods, procedures, experience and physical devices and equipment), therefore able to incorporate the knowledge in the planning and instructions of the targeted objectives.	(Wang et al., 2006)
The general capability in knowledge-intensive to activate various resources in scientific and technical to allow a firm invent new products and/of productive process, by performing strategy that is competitive and value wise in certain occasion.	(Garcia-Muina & Navas-Lopez, 2007)
The possession of capability and knowledge to run, develop, and spread the available technological know-how.	(Sethi et al., 2007)
The essential elements that are required to produce and organize changes in technology.	(Figueiredo, 2008)
The expertise that promotes innovations for individuals, organizations and institutions that comes from similar location.	(Iammarino et al., 2008)
To utilize the technical expertise effectively to go further than just an effort to upgrade and create products but to upgrade the existing technological knowledge to face competitors.	(Jin & von Zedtwitz, 2008)
The skills of technical, managerial or organizational that firms need in order to utilize efficiently the hardware (equipment) and software (information) of technology, and to accomplish any process of technological change.	(Morrison, Pietrobelli, & Rabellotti, 2008)

Table 2.14 (*Continued*)

Definitions	Source
The firm's current and potential ability to absorb and apply its firm-specific technology to solve technical problems and to enhance the technical functioning of its finished or developing products.	(Tsai, Chuang, & Chen, 2008)
A specific capability that cater a different level of discipline or function which consist of acquiring, operating and shifting capability.	(Guifu & Hongjia, 2009)
An emphasized on production capacities and technology which indicates by technical experience, technological capabilities and equipment, and an efficient and effective manufacturing department.	(Ortega, 2010)
The required skills and proficiency in the specified field to introduce and administer the technologies transformations that meet the organization's aspiration and investments to increase production and move towards innovation.	(Voudouris et al., 2012)
The technical, managerial or organizational skills firms need to efficiently utilize the hardware i.e. equipment and software i.e. information of technology and to accomplish any process of technological change that consist three-stage model of acquisition, assimilation and improvement of technology.	(Wu, Yu, & Wu, 2012b)
The soft (comprises the skills, knowledge and experience), hard (machines, equipment, systems, procedure) and also the organizational alignment that define a firm's ability to effectively and efficiently leverage its technological resources to create competitive advantage.	(Shamsuddin, Wahab, Abdullah, & Kamaruddin, 2012)
The ability to make effective use of technological knowledge in order to assimilate, use, adapt and change existing technologies as well as the ability to create new technologies and to develop new products and processes in response to the changing economic environment which classified into three distinctive levels of technological acquiring capability, technological operating capability, and technological upgrading capability.	(Chantanaphant et al., 2013)
The organizational skills and abilities that enable firms to employ various technologies to develop new products and services which is critical for firms to create differentiation advantage and achieve superior performance.	(Ju, Zhou, Gao, & Lu, 2013)
The firm's ability to develop and use substantial technological resources which concerns new product development, manufacturing processes, technology development, and forecasting technological change in the industry.	(Su et al., 2013)
The firm's ability to exploit the best knowledge to produce and present its offers in product technology, process technology and technology management.	(Rahmani & Keshavarz, 2015)
The ability to acquire important technologies, identify new technology opportunities, and respond to technology changes while mastering state of the art technologies.	(Tzokas et al., 2015)

Source: An author's compilation from several literatures.

The bulk definitions on technological capability have shown it has expanded through times. Previously on a broader context, technological capability has been defined by the International Labour Office as the ability of a country to choose, acquire, generate, and apply technologies in a way to meet the development objective (Oyebisi et al., 2004). It shows that technological capability is knowledge and skills embedded in individuals, organizations, and also institutions which conducive to innovative activity (Iammarino et al., 2008).

The smaller definitions context will be more specific on technological capability at the micro level which means for an organization. The capability was referred to as the degree of capacity of organizations in developing new products which related to the organizations' age (Kim, 1980). Besides, technological capability is an ability in which involved in operating, improving, and modernizing organization's productive facilities which to perform all the human skills and technical functions (Lall, 1990). Technological capability was accumulated and embodied in skills, knowledge, experience, and organizational system. The late Professor Lall (1996) once further clarified that technological capability are the skills, technical knowledge, and organizational coherence required to make industrial technologies function in an organization. It has been said that skills, knowledge, and experience are required to achieve firm's technological change at different levels (Costa & de Queiroz, 2002). It was also described as a set of skills for firms to build and leverage its different technologies and systems (Zahra & Nielsen, 2002).

Some researchers acknowledged technological capability as the knowledge and skills required to choose, install, operate, maintain, adapt, improve, and develop various kind of technologies in an organization (Madanmohan et al., 2004). Apart from the above, technological capability is the ability to select technologies appropriate for the work being undertaken, the ability to absorb and adapt technologies into local settings, and the ability to develop new technologies, processes and products via local innovations (Wilson, 1995). It is the ability to develop and design new products and processes and upgrade knowledge about the physical world in unique ways, thus transforming this knowledge into designs and instructions for the creation of desired outcomes (Wang et al., 2006). Technological capability also functions to generate and manage improvements in processes and production organization, product equipments, and engineering projects (Figueiredo, 2002b). Sethi et al. (2007) used the same definition and added to the ability of technological capability in extending the existing pool of technological knowledge.

Technological capability is later being expressed as the know-how-intensive ability in enabling the successful innovative products or productive processes by jointly mobilizes different scientific and technical resources. Furthermore, the innovative success of firm depending very much on the competitive strategy implementation and value creation in a given ambience (Garcia-Muina & Navas-Lopez, 2007). Technological capability had further defined and explained later to make effective use of technical knowledge and skills not only to improve and develop products and processes but also to improve existing technology and to generate new knowledge and skills in response to the competitive business environment (Jin & von Zedtwitz, 2008). Technological capability is also an assimilation and application of the technological knowledge from R&D activities to production (Tsai, 2004). Lall (1990) highlighted that technological capability acquisition with all the complexity of human skills is necessarily a learning process and the capability that shows an organization's ability to be effective during the transformation process of turning inputs into outputs, relative to its competitor (Coombs & Bierly III, 2006). As a summary, technological capability being expressed in this research will particularly addressing it at the firm level context best described as a set of knowledge, skill, and experience to acquire, operate and improve values to the products and productions which in turns create strategic capability to the organization in gaining competitive advantage while surviving the global market turbulence.

2.4.2 Dimensions of Technological Capability

Technological capabilities are in general tacit, firm and sector specific. For these reasons there exists a whole range of capabilities across sectors applicable to a broad spectrum of industrial activities. Technological capabilities are not static. They are dynamic entities that change over time (Oyebisi et al., 2004). Despite the idea of how technological capability plays its roles as source of competitive advantage, there also studies that highlighted on the assessment of technological capability (Panda & Ramanathan, 1996; Shamsuddin et al., 2012), the key factors that effecting the acquisition of technological capability into the local settings (Park & Ghauri, 2011), and drivers of technological capability (Molina-Domene & Pietrobelli, 2012). The available determinants of technological capability in the literatures are classified into the internal and external factors. The internal factors that determine firm technological capability are; firms specific resources of knowledge acquirers (Park & Ghauri, 2011), knowledge sharing (Zahra, Neubaum, & Larraneta, 2007), market orientation (Madanmohan et al., 2004), privatization (Abeysinghe & Paul, 2005), strategic processes (Yu, Shi, & Fang, 2004), and technology, technical personnel and training (Madanmohan et al., 2004; Park, Choung, & Min, 2008). Whereas, the external factors are collaborative linkage (Costa & de Queiroz, 2002; Iammarino, Piva, Vivarelli, & Tunzelmann, 2009), government roles (Kumar, Kumar, & Persaud, 1999; Madanmohan et al., 2004; Sethi et al., 2007), industrial policy (Figueiredo, 2008), and technology source (Iammarino et al., 2008; Okejiri, 2000).

Professor Kim (1980) had developed a three-stage model for firms in developing countries to be responsive to the changing competitive environment. The three stage model which is identified as implementation, assimilation, and improvement in the development of industrial technology. Vast discussions on issues of development and accumulation of firm-level technological capability mentioned of its importance. The development and enhancement stages within an organization consists of learning processes which involved the basic skills, intermediate, and finally the advanced skills (Okejiri, 2000). Technological capabilities have been discussed by the types found in the firm. The types of capabilities are; acquisition, adaptive, construction, creation, design and engineering, equipment-related, generation, human resource, improvement, innovation, integration, investment, information technology, learning, linkage, marketing and selling, monitoring, process technology, product-centered, production, R&D, servicing, strategic planning, supportive, and technology capability. It is investment (Figueiredo, 2002a; Kabecha, 1999; Kumar et al., 1999; Romijn, 1997), production (Costa & de Queiroz, 2002; Gammeltoft, 2004), innovation (Gammeltoft, 2004; Romijn, 1997), and human resource capability (Park et al., 2008; Rasiah, 2009) that received much attention as compared to the others capability.

For the purpose of current study, the author will be using dimensions of technological capability operationalized by Chantanaphant et al. (2013), where they had categorized technological capability into technological acquiring capability, technological operating capability and technological upgrading capability. These three categories were first introduced by Guifu and Hongjia (2009) as the new structure of firm-level technological capability. Technological acquiring capability refers to abilities to acquire new knowledge through formal and informal networks. In general, the firms form their own technological capability by progressively absorbing, processing and improving this knowledge. Technological operating capability refers to abilities to operate, use, and sustain production equipment and facilities. Accompanying with the promotion, firms shorten the gaps with other leading companies when they continuously introduce more advanced product and process innovation. Lastly, technological upgrading capability refers to abilities to improve greatly on products and processes depending on firm's own strength and adjust the current product and process parameters according to changing market demands. The upgrading results will allow the firms to grasp greater technological capability level.

2.4.3 Past Studies on Technological Capability and Performance

It is known that the development of technological capability (TC) helps a company gain competitive advantage (Panda & Ramanathan, 1996; Prasnikar, Lisjak, Buhovac, & Stembergar, 2008; Rahmani & Keshavarz, 2015). Basically, three areas of manufacturing sector that affected by technological changes are information technology, materials technology, and manufacturing process technology (Gunn, 1987). A bunch of studies have been carried out on the effect of TC towards manufacturing, high-technology, or technology-based firms' performance specifically. The performance indicators differed within different studies' focus. Researchers have been observed and determined the TC effects on various firm performance indicators or output such as; economic performance (Rasiah & Malakolunthu, 2009; Reichert & Zawislak, 2014), export performance (Chantanaphant et al., 2013; Flor & Oltra, 2005; Wignaraja, 2007), financial performance (Song, Benedetto, & Nason, 2007), and market performance (Bergek et al., 2008; Coombs & Bierly III, 2006). It is acknowledged that TC is one most essential capabilities that has the impact on firm performances (Su et al., 2013).

A study on interactions between internal capabilities, external networks and organization performance had shown a significant relationship between internal capabilities and organization performance (Lee, Lee, & Pennings, 2001). The three indicators of internal capabilities that have been studied under this research are entrepreneurial orientation, TCs, and financial resources and these indicators play important predictors of a start-up's performance in which measured by sales growth according to the regression results. On the other hand, an instance of analysis between firm performance and firm TC scale and also firm TC measure (Schoenecker & Swanson, 2002), showed that firm TC scale that measured by number of patents count has not significantly related to firm performance no matter how it will be measured. Contradictingly, other study had measured organization performance by the realized growth and profit. The result showed that technological capabilities do have a significant and positive relationship with innovation-based growth and a positive significant relationship with growth through internationalization (Kylaheiko et al., 2011).

Tsai (2004) highly recommended that TC has a positive effect on the performance of organization. The productivity growth in high-tech organizations is proven to be substantially determined by capability. TC is improved by applying technological knowledge that will stretch the outstanding performance in productivity growth or value added. Nevertheless, TC presents a higher effect on productivity growth or value added as contrast to physical capital or labor because of the benefit of knowledge-based input factors in manufacturing. Additionally, Tsai (2004) had calculated TC in the viewpoint of stock rather than the flow of technology itself.

Flor and Oltra (2005) and Wignaraja (2007) studied the impact of TC on export performance. Flor and Oltra (2005) emphasis on the impact of TC in the manifestation of technological innovation strategies that are; production, investment, and linkages-related capabilities which have impact on the profitability performance in export, market infiltration, sales progress and the image of the organization overseas. Wignaraja (2007) had examined on export-to-sales ratio in relation to firm-level technology index. The total regression equation is statistically important between technological innovation strategies and export performance whereas according to econometric analysis, TCs index are positively correlated with export shares in which accentuated on the investment of skills and information to effectively implement the imported technologies. Moreover, the outcomes revealed that greater rate of TCs are related with greater firm size, manpower's education's level and firm research and development.

Coombs and Bierly III (2006) indicated that it is challenging and very complicated to explain the connection between organization performance concepts and TC. The researchers had calculated the performance on six items; return on sales, return on assets, return on equity, market value, market value added, and economic value added. The feedback from 201 companies in manufacturing disclosed that R&D spending is not a good TC assessment when it generates a strongly negative correlation with returns on sales and assets. Nevertheless, it enhances the capacity for an organization to understand better, translate, and employ external knowledge. Patents exhibited no noteworthy connection on most of the performance measures in the research. Although the analysis of the constructs measures in the research is not all-inclusive, it offers an exemplification that in some way the traditional TC measures in number of patents count or the amount of R&D spending might be very deceptive to measure the organization's performance.

Song et al. (2007) studied on the organization's capabilities and their impact in regard to financial performance, with the concern of business strategic types of prospector, analyzer, and defender. The findings had recommended that there are noteworthy connection between financial performance and TC if it does not consider the strategic type moderating roles. Still, as the strategic types were analyzed collectively, only prospector firms and analyzer firms have the noteworthy connection between financial performance and TC. Another example, a research on TC is mentioned by technological exploitation and technological exploration and the connection with firm success in the value creation revealed that knowledge exploration processes in technological activities to have better prospective than those TC which concentrated on sheer upholding of a specific competitive advantage (Garcia-Muina & Navas-Lopez, 2007). Besides, technological exploration capabilities are discovered to possess a straight connection to success of the firm.

Bergek et al. (2008) recognized TC in the construct of technology strategies and technology activities and studied the impact of these capabilities on the performance of the firm. The outcomes recommended that the difference in TCs lead to the major variations in the performance when market share is involved. Rasiah and Malakolunthu (2009) discovered that TC expressed as technological intensities of; process technology, human resource, and research and development possess negative connection on export intensity, indicating that electronics manufacturers in Malaysia are dedicated to inward-oriented production. Su et al. (2013) studied the connection between firm performance and TC of return on assets, return on investment, and return on sales in the unstable circumstances. The results revealed that technological turbulence boosted the performance impact of TC, but the impact is hampered by the market turbulence. The study recommends the suitable substitute is by incorporating TC and marketing capability to react to the turbulence conditions.

In China, local firms face a higher performance return from their TC as against to foreign firms. But, foreign firms produce a better growth rate in the long run (Ju et al., 2013). Furthermore, firms are able to work up TC much quicker in areas where intellectual property protection is superior, and TC exercises a stronger effect on performance when industrial uncertainty is greater. Chantanaphant et al. (2013) examined three levels of TC; technological acquiring, technological operating, and technological upgrading capability on export performance. The results showed that multiple levels of TC are substantially connected to export intensity and export growth. It recommends that technological upgrading capability could lead to the success of SMEs in worldwide trades. It also suggests the call for SMEs in developing countries to acquire technological knowledge from internal and external sources and to build up distinctive level of technologies in order to increase their performance in the international economy.

The economic conditions of an emerging economy are mostly founded on low and medium-low technology industries, therefore it is impossible to confirm there is a positive connection between firm performance and TC (Reichert & Zawislak, 2014). There are other features that enable firms to attain such success, for example, they are in more stable industries, concentrated on operational efficiency, producing exceptional quality products, and operating at lowest cost conceivable. Tzokas et al. (2015) found that firm TC measured by acquisition of important technologies, identification of new technology opportunities, response to technology changes, and mastering state of the art technologies enhanced the overall performance of the firm in terms of new product development performance, market performance, and financial performance. The discovery of a multivariate regression analysis by a study in Zimbabwean manufacturing sector have revealed that five apparent technological elements (patent registration, ISO certification, information technology, transfer of technology, and human resource development) are established to have positive impact in stimulating the firm performance of return on assets (Siwadi & Pelser, 2015). These five variables that obviously linger around in TC increase and the backing of human resources and information system provide the strategists the groundworks they required to recover in the Zimbabwean economy.

Recently, chepkemboi Limo (2016) examined and concluded that TC assessed in technology acquiring capability, technology operating capability, and technology upgrading capability have a noteworthy impact on the performance of SMEs by measuring customer satisfaction, profit growth, sales growth, market share and return on investment. The study indicated that technology upgrading capability grants the SMEs to further enhanced their products and processes to counterbalance the varying demands in the market. The study also showed outstanding proof that technological operating capability has positive impacts firm performance. Nevertheless, to comprehensively understand the technology acquiring capability potential in SMEs, it is significant for the SMEs to tie with the technology suppliers in the market.

Besides the various firm performance measures, TC has also been tested on its impact towards operational performance aspects namely; innovative output and technological impact (Kotha et al., 2011), competitive priorities (Rahmani & Keshavarz, 2015), customer satisfaction (chepkemboi Limo, 2016), innovativeness (Renko et al., 2009), strategic launch decisions (Hsieh & Tsai, 2007), system efficiency (Oyebisi et al., 2004), main technology performance (Hajihoseini et al., 2009), innovation performance (Guifu & Hongjia, 2009; Shan & Jolly, 2010; Tsai et al., 2008; Zhou & Wu, 2010), manufacturing or operational performance (Husseini & O'Brien, 2004; Isobe et al., 2008; Khan & Haleem, 2008; Peng et al., 2008), and new product development performance (Tzokas et al., 2015; Wang et al., 2006; Yu, Hao, Ahlstrom, Si, & Liang, 2014).

TC is recognized to have a direct effect on the new product development (NPD) and performance overall business performance (Wang et al., 2006). Both performances are also indirectly affected when the customer value participates as mediator. Customer value in its own has an important impact on new product development performance and overall business performance. As such, it mediates the impact on TC. Nonetheless, the finding on the impact of TC on learning orientation and environmental turbulence is provisional, while the market turbulence has a negative moderating in the correlation between customer value and TC as well as the correlation between new product development performance and TC. In technological turbulence the moderating effect only slightly moderates the correlation between TC and market share growth, overall business performance’s perception on profitability, and cost competitiveness as against to other main rivals.

Tsai et al. (2008) have investigated TC in the framework of technological applied capability and technological absorptive capability with the predictor of social interaction on innovation performance. The absorptive capability was defined as the degree of ability that a firm would involve to secure and integrate new external technology sources and the applied capability with existing and potential ability to implement its firm-specific technology to resolve technical glitches and improving the technical operation of its developing or finished products. It is found that social interaction notably played part of the cause to a firm's technological applied capability and technological absorptive capability. The positive effect of technological absorptive capability on technological applied capability consequently induces social interaction and technological absorptive capability on innovation performance is then mediated through technological applied capability.

The performance of organization can similarly be evaluated by strategic performance and operational efficiency. TC is classified as reconfiguration capability and refinement capability to evaluate the performance of organization (Isobe et al., 2008). The findings displayed a positive correlation between operational efficiency and refinement capability. Refinement capability was perceived to be positively associated more to the operational efficiency rather than reconfiguration capability and therefore influenced predominantly to short-term upgrading and exceptional operational performance. Conversely, reconfiguration capability was supposed to have more positively correlated to strategic performance than refinement capability and manipulating long-term upgrading and exceptional strategic performance. The research also indicated a positive association when a firm with exceptional refinement capability inclines to get hold of exceptional reconfiguration capability.

Peng et al. (2008) had studied the correlation between two TC categories; innovation capability and improvement capability on their impact on operational performance of manufacturers in Germany, Korea, Finland, Sweden, USA and Japan. The findings showed that innovation capability was discovered to have significantly related with volume flexibility, unit manufacturing cost, product mix flexibility, speed of new product introduction, and slightly correlated to delivery performance as $p<0.10$. But, innovation capability is found to have no direct correlation to conformance quality. On the other hand, improvement capability is significantly related to conformance quality, unit manufacturing cost, and on-time delivery, but not considerably correlated to speed of new product introduction. The regression analysis findings mutually showed that both capabilities are considerably correlated to operational performance and the impact of their performance varies according to the operational performance concerned.

In contrast, there is another research that examined TC and its correlation with operational performance in manufacturing cost and quality of final product. The results indicated that TC, considered as technology absorption capability, was found not directly correlated to the said performances (Khan & Haleem, 2008). Renko et al. (2009) had examined that TC evaluated by number of patents and share of R&D expenses in high-technology firms substantially correlated to product innovativeness. An econometric analysis finding displayed a solid and positive association between labor productivity and technological intensity in the entire Malaysian electronic firms samples (Rasiah & Malakolunthu, 2009). It showed that technological intensifying by way of growths in skills and R&D staff will notably increase labor productivity in the industry (Rasiah, 2010).

Guifu and Hongjia (2009) established three TC levels; technological shifting capability, technological acquiring capability, and technological operating capability on the impact on innovation performance. The findings revealed that technological shifting capability is significantly positively associated with product upgrading. Neither technological acquiring capability nor technological operating capability is notably related with product upgrading. Technological shifting capability and technological operating capability significantly pose a positive relation with process upgrading but not for technological acquiring capability. The magnitudes and effects of capabilities to firm transformation might be more complicated than anticipated, explaining the existence of non-related interactions between some particular TCs towards product and process upgrading.

Zhou and Wu (2010) studied the function of TC in product innovation. Moving on the organizational inertia theory and perspective of absorptive capacity, they recommended that TC has differential and curvilinear effects on explorative and exploitative innovations. The results defended the suggestion that although TC promotes exploitation at soaring speed, it exhibits an inverted U-shaped relationship with exploration. As such, a high level of TC hampers explorative innovation. Other example, Shan and Jolly (2010) had examined the TC effect on organization's competitive performance in innovation, product and sales performances. The results showed a positively significant correlation between the implementation of TC and its competitive performances. Nevertheless, it varies with various performance indicators. Particularly, it is found that investment in in-house R&D deliver a positive correlation towards the three indicators in performance. The entire TCs are associated with investment, production, and linkage on entirely three indicators.

In a more recent study, Yu et al. (2014) had investigated TC on NPD performance. The findings revealed that TC and NPD performance exhibits a significantly positive impact. Moreover, the findings also established that the impact of technological turbulence towards TC and NPD performance is positive. To simplify, the higher the technological turbulence, the positive effect of TC on NPD performance is also higher. Rahmani and Keshavarz (2015) had given prioritization to TC elements in corresponds with competitive priorities and competitive advantages, namely; cost, price, quality, flexibility, and time. The TC elements in question are product technology, process technology, and technology management. It is expected that organizations would lay capitals in technological competency and anticipate better operating efficiency and therefore generate better financial performance. In this study, the findings from coil manufacturing industry manager's point of view indicated that to maximize the financial performance, the ultimate structure of TC importance/priority level are as follows; first priority level-process technology with an apparent weight variation, second level- product technology, third priority level-technology management.

Overall, previous studies in the field of technological capability have proved the significant roles played by technological capabilities on various organizations performance measures even though the results are happened to be mix. Developing and improving technological capability of an organization is a long-term commitment and therefore its implementation plays important roles to ensure companies survival in the market for future undertakings. As a conclusion, technological capability is labeled as a crucial determinant together with other firm capabilities that promote competitive advantage and firm performance advances.

2.4.4 Moderating Role of Technological Capability

A moderator variable is a third variable that will give an impact towards the direction or strength between the independent or predictor variable and the dependent or criterion variable (Baron & Kenny, 1986; Dawson, 2014; Frazier, Tix, & Barron, 2004). A moderating variable can exists when there are inconsistencies have been reported on the direct relationship of independent variable (IV) and dependent variable (DV) as had been broadly discussed in the previous sections i.e. 2.3.2, 2.3.3, 2.3.4, and 2.3.5 between manufacturing practices and manufacturing performance. Figure 2.3 depicted a conceptual path diagram of a moderated model where the undefined, or inconsistencies relationship between IV and DV will leads to the introduction of the third variable which might either strengthen or weaken the relationship (Dawson, 2014).

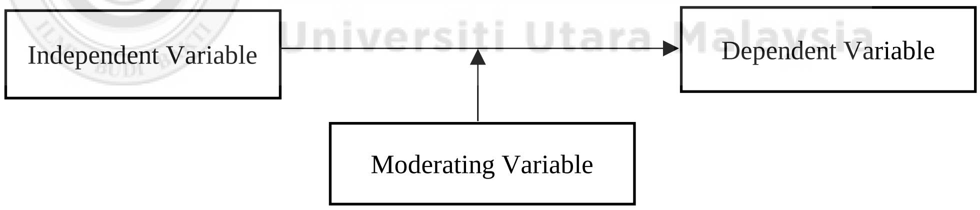


Figure 2.3
Conceptual path diagram of a moderated model

Most of manufacturing strategy process models hold that business objectives drive the selection of competitive priorities, and, in turn, competitive priorities set the choice of technologies and practices (Sonntag, 2003). Literatures in the field of operation strategy concentrate on the relationship between the key practices and company performance. Previous studies have overlooked the importance of a significant relationship between manufacturing strategy and capabilities technologically (Brown

& Bessant, 2003; da Silveira & Sousa, 2010; Hallgren, 2007; Machuca et al., 2011). Competitiveness is derived not only from the strategies and technology employed, but also, and perhaps more importantly, from the way in which the strategies and technologies are implemented and managed. This can also suggest that a minor difference in managing strategy or practice can result in a major difference in competitiveness (Sohal, Gordon, Fuller, & Simon, 1999).

Several academic papers investigated the moderating effect of technological capabilities. These are the few. A study on strategic implications of manufacturing performance in comparisons for newly industrializing countries, Husseini and O'Brien (2004) had mentioned on the effect of process technology towards quality, cost, speed, reliability, and flexibility of manufacturing operation. They highlighted the importance of taking into consideration other environmental aspects such as TC into the effect relationship. Perdomo-Ortiz et al. (2009) provided limited evidence regarding the existence of a moderating effect of TC on the relationship between TQM and innovation performance. A moderating effect was found. The moderating effects of business innovation capability are significant only for the relationship between technological innovation and the process management dimension of TQM. Specifically, the relationship between technological innovation and the process management dimension is shown to be negatively moderated by four dimensions of business innovation capability (i.e. planning and management commitment, projects, knowledge and skills, and external environment).

Unlike other studies, Ortega (2010) did research on the relationship of competitive strategies with the firm performance and had identified the moderating roles of TCs. Ortega measured the organization performance by return on investment, profit margin, market share, growth of sales, and general performance which is the general valuation of the organization's development. The relationship between TCs and organization performance has proven to be significantly positive. TCs have a significant interaction on differentiation strategy via marketing and quality orientation, while on cost leadership strategy via cost orientation and process improvement orientation. Zou et al. (2010) studied the influence of TC as well as the effect of integration among TC and networking capability and financial capital implemented on growth strategies by new-ventures in China. TC is expressed by the technology establishment and utilization in product development. The findings showed that TC that integrated with other capability such as networking capability in the new ventures influence positively towards internationalization strategies. García et al. (2012) observed the moderating effect of firms with TC and the connection between productivity and exporters and found out that exporters more inclined to require knowledge than companies with lower TC.

Haeussler et al. (2012) examined the function of strategic alliances in creating collaborations of better worth. It showed that high TC firms acquired knowledge and resources by making strategic alliances while firms with less international experience and restrained resources seemed more susceptible to opportunistic conduct of their associates. Wu (2014) studied the relationship between cooperation with competitors and product innovation by assessing the moderating role of TC and strategic alliance with research institutes and universities. It showed that cooperation with competitors generate an inverted U-shaped relationship with successful product innovation. High TCs and alliances with research institutes and universities generate a moderate, negative relationship with successful product innovation. Excess collaboration with competitors has negative impact on the performance of product innovation due to the opportunistic conduct of rival companies. Srivastava et al. (2015) had researched the role of technological effort and TC in leveraging alliance network technological sources of patent through which is grounded on the behavioral implications of these different dimensions of absorptive capacity. The findings recommended that when a firm's TC intensifies, the benefits from the alliance network resources in the form firm technological innovations come at a lower rate. Companies with solid TC possess better capacity to apply external knowledge, if acquired, but higher internal strength restrains the company's motivation to explore, value, and carry in external knowledge. In other words, the higher the TC, the company will be more bothered to safeguard its expertise resources and more terrified of losing its treasured technological competencies.

More recently, de Almeida Guerra and Camargo (2016) prepared a systematic literature analyses on TC's moderating impact in the relationship between firm's internationalization and success of new product. They established a conclusion that TC is an applicable moderating variable for few reasons; firstly, because TC is regarded as a significant component of economic development; secondly, it assists firm's internationalization; thirdly, it contributes to success of new product and finally, the transfer of technology helps the creation of TC through the tacit knowledge, skills, and competencies of employees; and as a rule, exporters have higher TCs. With the justifications made by de Almeida Guerra and Camargo (2016) and all the previous studies mentioned earlier, the proposition to examine TC as moderator variable between manufacturing practices and manufacturing performance is strengthen and worthy.

2.5 Underpinning Theory

A theory is a proper, rational, testable description of some events that includes predictions of how things are related to one another (Zikmund, Babin, Carr, & Griffin, 2010). A theory in quantitative research is an interconnected set of variables which formed into hypotheses that identify clearly the connection in terms of magnitude or direction among variables (Creswell, 2014). A theory might appear in a research study as an argument, a discussion, a figure, or a rationale, and it helps to explain or predict phenomena that occur in any specified context. There are numbered of theories that discuss the firm resources which maximize advantages in manufacturing strategy studies. The theories are for example; structural contingency theory, dynamic capability theory, social capital theory, and resource-based view (RBV) theory.

Structural contingency theory explains that there is no one best organizational structure, rather, the appropriate organizational structure depends on the contingencies facing the organization (Donaldson, 2001; Rumelt, 1974). Contingency theory posits that organizational success does not mean adopting the maximum level, but adopting the appropriate level of structural variables that depend on some level of the contingency variable (Donaldson, 2001). Meanwhile, dynamic capabilities theory examines how organization integrate, build, and reconfigure the internal and external firm-specific capabilities into new competencies that match the turbulent environment (Teece et al., 1997). The theory assumes that firms with superior dynamic capabilities will leave behind firms with slighter dynamic capabilities. The aim of the theory is to understand how firms use dynamic capabilities to create and sustain a competitive advantage over other firms by responding to and making environmental changes (Teece, 2007).

Next, on the social capital theory, the main idea is that people gain both tangible and intangible resources at the individual, group, and organizational level through social interactions and connections with others (Coleman, 1988; Lin, 2002). A key focus in this theory is that social capital resources are embedded within, available through, and derived from social networks of interconnected people, groups, or nations. In the meantime, last but not least, RBV examines performance differences of organizations based on their resources and capabilities (Arend & Lévesque, 2010; Barney, 1991; Barney & Mackey, 2016; Bertram, 2016; Leiblein, 2011; Peteraf, 1993; Wernerfelt, 1984). It explains that firm resources and capabilities will bring competitive advantages to the firms in so many ways. These organizational theories had focused on a few perspectives and had different aims in the organizational environment. Consequently, the current study considers a meso-level theory of RBV, as a major underpinning theory in describing the relationship between manufacturing practices and manufacturing performance, and between technological capabilities on manufacturing performance of an organization. A meso-level theory is a social theory focusing on the relations, processes, and structures at a midlevel of social life such as organizations and occasions operating over moderate period such as many months, several years, or a decade (Neuman, 2014). The details discussion on RBV proceeds in the next sub-sections.

2.5.1 Resource-Based View (RBV) Theory

This section explains how organizations sustain their business competitive advantages in a broader environment. It is an attempt to clarify a theoretical groundwork for linking manufacturing practices and technological capability towards manufacturing performance. An underpinning theory lies behind the proposed research is a well-recognized and developed RBV theory. RBV has continues to be the essential principle in strategic management research (Barney, Della Corte, Sciarelli, & Arikan, 2012; Barney, Wright, & Ketchen, 2001; Barney, Ketchen, & Wright, 2011; Ketokivi, 2016; Wernerfelt, 1995). A viewpoint on strategic direction has mentioned that firms are now competing on the resources and not the product solely (Andersén, 2010). Even after twenty years, RBV has been broadly acknowledged as one of the most outstanding and influential theories in strategic management studies for describing, explaining and predicting organizational relationship (Barney et al., 2011). The focus in strategic research has shifted from mainly the firm's products and product development toward the focus on firm's internal factors development of resources and capabilities (Barney, 1991).

Originally, going back to Penrose's (1959) seminal works on RBV, it has been referred to view the firms as a wider set of resources that can be managed, deployed and reorganized which can contribute to firm's distinctive values. Followed by the study of Wernerfelt (1984), where he reviewed the RBV theory as on how firm's competitive advantage will be realized through the organizational processes of tangible and intangible resources and capabilities. Later, Barney (1991) had refined a more succinct model to understand how sustainable competitive advantage can be realized through resources based on two assumptions which is first, the heterogeneity of resources and second, the degree of resources mobility. The resources and capabilities must meet four main features of potentially valuable, rare, imperfectly imitable, and non-substitutable to ensure sustainable competitive advantage which is very hardly to find (Barney, 1991).

Valuable resources are those that enable an organization to create a differentiated strategy, that is, that help the organization to create value for its stakeholders. Second, resources must be rare, assuring that a specific resource is difficult to be developed by other competitors. Third, resources must be imperfectly imitable. In other words, resources must be difficult to imitate, enabling firms to create strategies based on resources that are difficult to imitate. Perhaps competitors can try to replicate firm's strategy based on imperfectly imitable resources, but it is not possible to fully imitate and acquire the same advantage. Finally, resources must not be substitutable. Saying it differently, organization's resource cannot have similar or equivalent resources in the market.

In theory, the fundamental argument of RBV addresses the basic issue of why firms are diverse and how firms attain and sustain competitive advantage by deploying their resources and capabilities (Wernerfelt, 1984). The bundles of tangible and intangible assets of resources and capabilities will considers the firm's management skills, its organizational processes and routines, and information and know-how it controls (Barney et al., 2001). Amit and Schoemaker (1993) defined resources as the productive assets that are possessed by the firm, whilst capability is defined as the ability through productive activity of the firm to efficiently exploit these resources, to produce products or develop services in attaining business objectives. Resources are anything that represents certain amount of value whether it will become as strengths or threats to any given organization (Wernerfelt, 1984). Meanwhile, resource is the tangible and intangible assets that can be valued and traded, whereas capability is unobservable tangible and intangible which cannot be valued and changes hands only as part of its entire unit (Makadok, 2001). These difference characteristic of resources will be combined together in the firm to generate some specific capabilities that are difficult to potentially imitate by competitors (Amit & Schoemaker, 1993). Capabilities may be valuable due to its ability to increase the value of other resources (Makadok, 2001).

RBV assumes that firm's growth is relied on the efficient use of both resources and capabilities deployment since every firm must have its distinctive resources and capabilities (Wernerfelt, 1984). Due to the firm resources are heterogeneous in nature, there is a potential that all resources are not in an equal importance or possess a characteristic to be the source of sustainable competitive advantage. Moreover, Lawson and Samson (2001) mentioned on the challenges in performing and realizing RBV which might becoming as the core reason of firm's rigidity. The challenges include the difficulty in recognizing precious resources and capabilities, the difficulty in incorporating complementary resources and capabilities, and the confrontation of resource value fluctuation due to the changing over time. However, more or less, it is firmly suggested that it is simply easier to explained firm's competitiveness by its complex resources as opposed to its products (Löfsten & Löfsten, 2016; Wernerfelt, 1984).

2.5.2 The Connection of RBV and this Study

A long-term sustainable competitive advantage will be generated if only a company develops its strategy based on the firm's resources and capabilities. At this point in time, the proposed study is attempted to provide a support for the argument that resources and capabilities are greatly important in relation to manufacturing practices, technological capability and manufacturing performance of manufacturing businesses. Hayes and Wheelwright (1984) manifested the relation between manufacturing strategy and RBV, where manufacturing strategy leads to the formation of a set of specific capabilities. Furthermore, RBV propose that it is an essential determinant of strategy to use the company's internal resources and capabilities. Meanwhile, the variation that exists in the firm's performances will be easily traced back to heterogeneous resources and capabilities owned by the company. Wernerfelt (1995) stressed out that strategies which are not resource-based are doubtful to succeed in business environment.

RBV is a theory first coined by earlier works on investigating the issue of manufacturing strategy and technological capability in which later had inspired many researchers to adopt RBV as their studies' theoretical base. In investigating the issue of manufacturing area, many studies have adopted RBV theory as their theoretical foundation, see a few for example; manufacturing performance (Ketokivi & Schroeder, 2004a; Schroeder, Bates, & Junttila, 2002); manufacturing practices (Ketokivi & Schroeder, 2004a; Ketokivi & Schroeder, 2004c; Rungtusanatham et al., 2003); and technological capability (DeSarbo, Di Benedetto, & Song, 2007). Two discussions will followed after in the next paragraphs; first on the connection of RBV in the relationship between independent variable, the manufacturing practices and manufacturing performance; and second on the connection of RBV towards the roles that played by technological capability as an independent and moderator variable on manufacturing performance.

Firstly, in the context of direct relationship between manufacturing practices and manufacturing performance, the theoretical argument implicitly advanced in much of extant manufacturing strategy research is that it is the manufacturing practices, not resources per se, that is subject to inimitability and causal ambiguity and is context-specific, and hence, they offer value for the company that makes use of them

(Ketokivi & Schroeder, 2004a). It is proposed that what manufacturing strategy researchers have implicitly developed is a "routine-based view of manufacturing strategy". They submit that this view combined with the evolutionary view of the firm provides a solid organization-economic foundation to practice-performance research. The study also submitted an argument that practices are heterogeneous and contributes to competitive advantage across organizations. The understanding of routine-based applies to the exercising of manufacturing practices such as total quality management, just-in-time, human resource management and supply chain management.

It is indicated that manufacturing performance is critical to overall competitiveness, and that manufacturing practice is critical to manufacturing performance (Voss & Blackmon, 1994). Thus, the causal relationship between manufacturing practices and manufacturing performance are the key to improving overall competitive advantages (Davies & Kochhar, 2002) and this particular relationship between manufacturing practices and manufacturing performance fit the RBV theory ideally (Schroeder et al., 2002).

Additionally, the emphasis on the aspect of human resources within the company has contributed to the emergence of the relationship between human resource management issues with interaction and convergence of firm strategy. A debate and arguments took place on whether human resource management practices can offer sustainable competitive advantage of the firm. Barney et al. (2001) clarified on the issues by pointing out that a developed human resource management as systems and routines over times may be unique to a particular firm as opposed to the individual human resource management practices that may be potentially imitable. The developed systems and routines are believed to contribute to the creation of specific human capital skills. Furthermore, Andersén (2010) in his point of view raised the importance of linking the human resource management practices to the firm strategic direction that will make the competitive advantage sustainable. These assertions make RBV fits in relation to human resource management practices as a system and routines which will give an impact to the firm performance and offer competitiveness (Kaufman, 2015).

Secondly, as in the case of moderator variable, technological capability acts as the resources needed by an organization to generate and manage technical changes (Bell & Pavitt, 1992), and technological changes (Figueiredo, 2008) which promote firm performance. Technological capability works as a set of functional abilities that reflected an organization's performance through various technological activities and whose ultimate purpose is firm-level value management by developing inimitable organizational abilities (Panda & Ramanathan, 1995; Voudouris et al., 2012). Praest (1998) suggested that capabilities are related to a specific application domain inside the firm, and thereby technological capabilities are referred to the specific capacity of R&D-related resources and innovation capability which promotes firm competitive performance in the technological development (Shan & Jolly, 2010). Furthermore, in the dynamic point of views, capabilities approach is a theoretical stream inside the RBV. This theory considers that, on one hand, the firms are constantly creating new combinations of capabilities and, on the other hand, the market competitors are continually improving their competences or imitating the most qualified competences from other firms (chepkemboi Limo, 2016).

On top of that, Wernerfelt (1984) had highlighted that a technological leader will allow the firm with higher returns, and thus enable it to keep better people in a more motivating setting so that the company can develop and calibrate more advanced ideas than the followers which are usually the competitors. While the competitors on the other hand, will often find the reinvention of the leader's ideas are easier than to find the original invention, so the technological leader will be needed to keep growing its technological capability in order to protect the exceptional position. Equally important, Wang et al. (2006) suggested that TC aids to escalate a firm's capacity to recognize and apply new exterior knowledge to continue the competence enlargement, which may result in superior performance.

It is argued that firm growth is drives by the development of new technology of products or processes which make the focus will be mainly to the firm technological capabilities (Kylaheiko et al., 2011; Praest, 1998; Wang et al., 2006). According to Ketokivi (2016) and Barney's (1991) claim that resources are heterogeneous which means that firms have different resources, routines, capabilities and other assets that distinguish one firm from another helps to create diverse strategies and sustained competitive advantage. DeSarbo et al. (2007) also investigated on the heterogeneity of resources and capabilities when adopting RBV in relating the firm capabilities to performance. They had identified three possibility of resource heterogeneity that might be the reason for difference level in performance which are; level heterogeneity, structural heterogeneity and unexplained heterogeneity. Moreover, firms may achieve different levels of performance by pursuing different resources and creating different strategies (Barney, 1991).

The aim to clarify the location of where technological capability fit in the resource base in both theoretical and empirical is by acknowledging the relationship between firm-specific capabilities and competitive advantage. For instance, a case study by Rangone (1999) on forteen SMEs had revealed an interesting point of view of RBV where companies will developed a sustainable competitive advantage through three basic capabilities of innovative capability, production capability and market management capability. Specifically, the TC being under consideration of the current study is the accumulated know-how and skills that ranging from acquiring capability, operating capability and upgrading capability.

Being equivalent, this study is attempted to examine on the firm's ability to develop and upgrade knowledge on new products and processes while exploiting these knowledge in order to assimilate, use, adapt and change existing technologies. These abilities will be evaluated in response to the changing economic environment of manufacturing industries. Capabilities are defined not by resource type, but in term of resource functionality to deploy its available resources as its main assets and the argument is that resource functionality is a true source of competitive advantage in a sense of its rareness (Löfsten & Löfsten, 2016; Peteraf & Bergen, 2003). In other words, capabilities are a complex bundle of skills and accumulated knowledge that enable firms to coordinate activities and make use of their assets (Nath, Nachiappan, & Ramanathan, 2010). According to the dynamic capabilities point of view, the resource base must be reconfigured and developed to adapt to movement in the environment (Löfsten & Löfsten, 2016). As supported by Barney et al. (2001), where they have suggested what are likely to be the most important capabilities that a firm can possess are the learning ability and the changing ability. The idea is, it is not only to proficiency in the technological capabilities, but to also comprehend in deploying and expanding the full implications of core competencies, combine various stream of technologies and mobilize technological resources efficiently across organization (Wang et al., 2006).

To summarize, manufacturing practices and technological capability are proven to function as the unique resources and source of distinctive capabilities for an organization that can response to firm environmental changes and contribute to sustainable competitive advantage. Discussions on manufacturing practices and technological capabilities are hereby reveal these assets are considerable as valuable, rare, difficult to imitate and difficult to substitute. Besides, a number of articles had also suggested that resources (i.e. organizational processes and routines), capabilities (skills, information and know-how) and knowledge are very much interlinked. Firms are required to discover those resources which can offer a sustainable resource position barrier, but in which no one currently has one, and where they have a good opportunity of being among the few who succeed in building one. Firms must look at resources which combine well with what they already have and in which they are likely to confront only a few competitive acquirers (Wernerfelt, 1984).

2.6 Gap Analysis

The basis and motivation that guide to the completion of present study is to fill in the gaps aroused in the body of knowledge of relevant areas. Each identified gaps in this study creates a problem statement. Therefore, the present research has been undertaken in order to respond to each research question derived from the problem statements. This is to ensure the focus of the study is unchanging and to achieve the study objectives. The gaps that have been recognized and analyzed are divided into theoretical and practical aspect as depicted in Table 2.15.

Table 2.15
Recapitulated of Gaps Analysis between Present Study and Past Studies

No.	Past Studies	Present Study
Theoretical gaps		
1	A future research suggested on the occurrence of moderating variables of the complexity of production process and the complexity of the technology into the relationship between manufacturing practices and manufacturing performance (Lazim & Ramayah, 2010).	The proposed study will determine the relationship between manufacturing practices with a set of manufacturing performance measures while considering the moderating effect of technological capability.
2	A study had highlighted on the need for complementary between competitive strategies and technological capability towards firm performance and hypotheses testing of the technological capability moderating effect is limited to only competitive strategies and firm financial performance measures (Ortega, 2010).	
3	Limited studies on multidimensional constructs of manufacturing performance measures. Previous studies on the relevant area have evaluated manufacturing practices towards single or some of manufacturing performances dimensions. See examples (Ooi et al., 2012).	The proposed study will be using multidimensional constructs of quality, cost, delivery, and flexibility. The manufacturing practices involved will basically fulfill the effect towards more than one manufacturing performance measures.
Practical Gaps		
4	There is a concern on the insufficient technological capabilities and little adoption of technology enabler in the manufacturing sectors of SMEs, despite the notably enhanced performance (Murad & Thomson, 2011).	The proposed study will research and elaborate further on the status of technological capability development in the small, medium and large-sized manufacturing companies.
5	A study in Malaysia had identified the low level implementation on technological incorporation within the local manufacturers in which had become the most impediments to the firms' development and expansion (Anuar & Yusuff, 2011).	The proposed study is going to discuss in-depth on the impact of level technological capability implementation onto the significant relationship between manufacturing practices and manufacturing performance.
6	In the Malaysia's Productivity Report of 2012-2013, the corporation had highlighted on the strategies that must be action taken by the local firms to confront the top priorities of business challenges; which is operational performance (MPC, 2013).	The proposed study will be highlighting on the most business challenges in local context, while proposing a strategy and an action taken towards excellence manufacturing practices and technological capability implementation.

Source: Author's own analysis

2.7 Chapter Summary

The second chapter particularly discusses on the extensive literature reviews of the study, which includes the particulars explanation on research variables of manufacturing practices, technological capability and manufacturing performance.

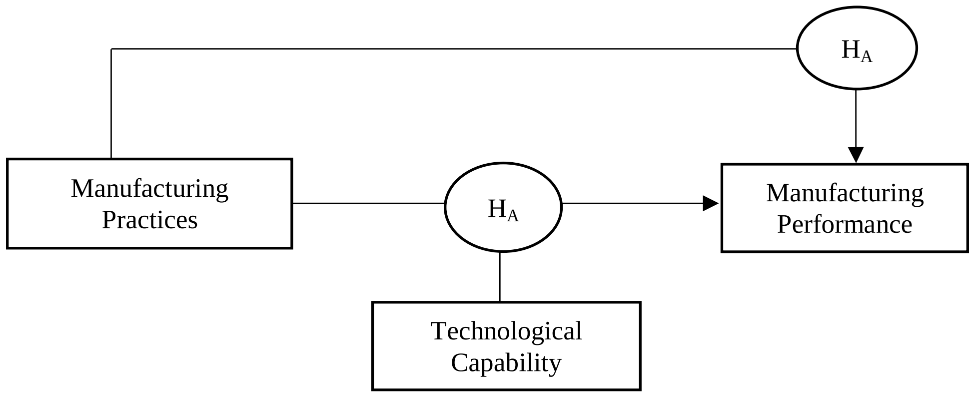


Figure 2.4
Conceptual framework

To summarize, the researcher is investigating on two models as depicted in Figure 2.4. This research is intended to focus on the manufacturing performance of a company i.e. quality, flexibility, cost, and delivery. Since testing the direct effect of manufacturing practices on manufacturing performance has been done by many researcher, thus, this research aims at introducing and examining the contingency variable of "technological capability" as a moderating variable, to test whether the output (manufacturing performance) results of implementing input (manufacturing practices) factors depended on the differences in certain characteristics of technological capability. The utilization of RBV as the underpinning theory of the research framework gives a strong foundation to the model, where the connection of research framework and RBV were explained in details. The theoretical framework development on how the concept of moderator model is operationalized will be discussed in the next chapter together with research design.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

In the third chapter, a further discussion and details of the research framework, hypotheses development, and scientific methodologies that were adopted throughout the research are presented. A methodology is a description of the techniques used in order to achieve the objectives of the study. It is the process of mining and exploring data. The researcher gives an account of how the study was carried out by weighting on; the research design, operational definitions, survey instruments development, sampling design, procedures of data collection and data analyses techniques. Through the research methodology, every data that were successfully gathered were used to generate findings and conclusions in subsequent chapters.

3.2 Research Framework

The research framework is presented by highlighting on the key research areas. The framework is derived from the gaps of past literatures reviews on preferred research field which is accordance to current issues. Motivated by the issues of; current global manufacturing competitiveness, evolution of industrialization in Malaysia, productivity and performance of manufacturers, manufacturing strategies formulation in meeting the predicted business challenges, resources and capabilities of firm, and scarcity empirical findings in linking technological capability and manufacturing strategy lead to the proposition of the current research. As combined and synthesized from the previous conceptual writings and empirical findings along with these motivations have directed towards the development of the theoretical model illustrated in Figure 3.1.

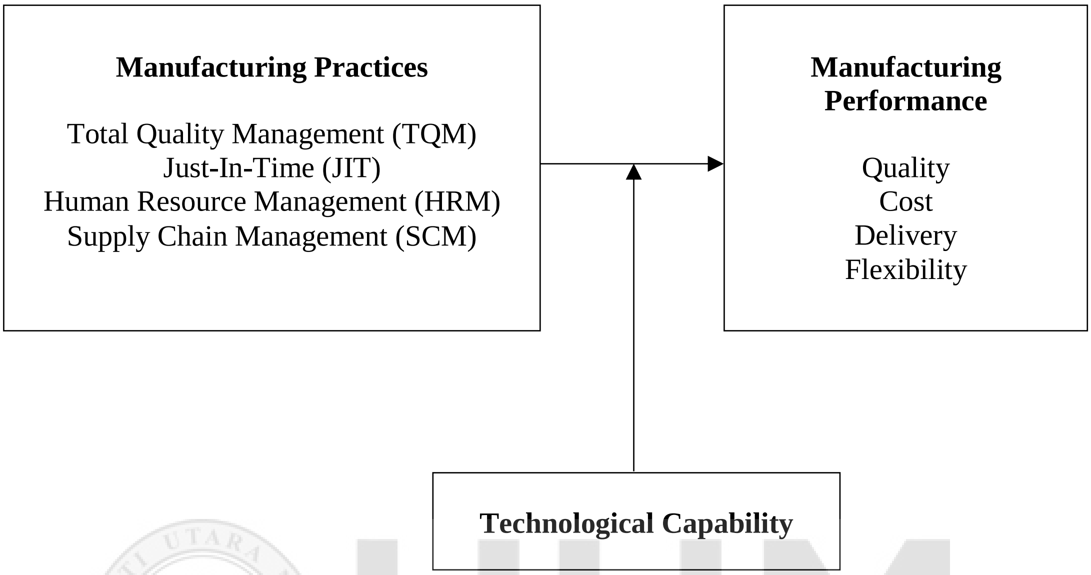


Figure 3.1
Theoretical framework

A few studies that have almost similar model were found during the literatures survey. Ortega (2010) had done her research on the moderating effect of technological capability towards the relationship between competitive strategies and firm performance of return on investment, profit margin, market share, sales growth and general performance. A study by Perdomo-Ortiz et al. (2009) had covered the effect of business innovation capability on the relationship between total quality management and technological innovation. They have explored on both the mediation and moderation effect of business innovation capability which is dimension of the technological capability. Haeussler et al. (2012) did a study on the moderating effect of technological capability specialization on the relationship between strategic alliances and product development. The research has been done in biotechnology industry. Renko et al. (2009) had investigated on the moderating effect of technological capability on the relationship between market and entrepreneurial orientation on innovativeness. The study was also conducted in biotechnology industry. Finally, García et al. (2012) have done their research study on the moderating effect of technological capability in a form of research and development intensity towards the relationship between export status and firm productivity.

In contrary, the current theoretical framework or research model is unique and diverse from all the mentioned studies in its own sense of contributions. The current study introduces technological capability as the moderator that defined by the technological knowledge and skills accumulated of acquiring, operating and upgrading capability. This hypothesized moderating effect will be tested on the relationship between manufacturing practices and non-financial performance measures of quality, cost, delivery and flexibility performance. As compared to the past empirical researches on the technological capability's moderating framework, most of them have covered on diverse research focus such as new product success and new product development (de Almeida Guerra & Camargo, 2016; Haeussler et al., 2012), financial and market performance (Ortega, 2010), technological innovation and product innovation performance (Srivastava et al., 2015; Wu, 2014), and productivity performance (García et al., 2012), but they overlooked on the viewpoint of non-financial operational performances.

There are three main constructs to be examined which the first is manufacturing performance as the dependent variable. Manufacturing performance consists of four dimensions of which are; quality, cost, delivery and flexibility. The second construct is the manufacturing practices as the independent variable. Manufacturing practices consists of four practices of total quality management, just-in-time, human resource management and supply chain management practices. The final construct is the technological capability as the moderator variable. The blend of various studies conducted in the related area lends credence to a better understanding of every relationship in regards to the study presented in the research framework. Discussions on the construction of all research hypotheses will be elaborated in the next sub-section.

3.3 Hypotheses Development

Hypothesis statement is a tentative statement of prediction that can be tested which basically derived from the theory (Sekaran & Bougie, 2013). The development of hypothesis is to illustrate and analyze the relationship of two or more variables which predict the researcher's expectation of certain results in the empirical data and findings. In this study, the hypotheses statements developed are purely based on the moderator model of Baron and Kenny (1986) as diagrammed in Figure 3.2.

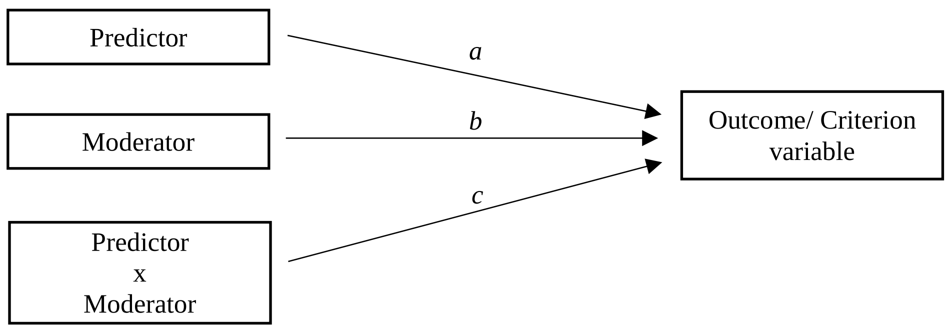


Figure 3.2
The moderator model
Source: Adopted from Baron and Kenny (1986), p. 1174

The moderator model will has three causal paths that feed into the outcome variable of manufacturing performance. The *Path a* will shows on the impact of manufacturing practices as a predictor, while the *Path b* will shows on the impact of technological capability as a moderator, and lastly the *Path c* will shows on the interaction or product term of manufacturing practices and technological capability on the criterion variable.

As for testing all the hypotheses, there are direct and indirect interactions that will be considered. There are two direct interactions; first will be between the predictor variable and the criterion variable (*Path a*), while the second will be between the moderator and the criterion variable (*Path b*). Even so, there may be significant main effects for these direct interactions of manufacturing practices and technological capability on manufacturing performance, but these are not directly relevant conceptually to testing the moderating effects hypothesis. This discussion leads to the indirect interaction that exists in the moderator model. The moderator hypothesis which is the indirect interaction will be supported if the interaction of *Path c* is found to be significant. Additionally, as a nature of moderator variable, technological capability will always function as the same level as manufacturing practices as independent variables with regard to their causal interaction to manufacturing performance.

The details of hypotheses statements for each variable will be discussed in the next sub-section. While considering the causal path of moderating effects model of Baron and Kenny (1986), thus the main research hypotheses statements are stated as follows:

H_A 1: Manufacturing practices dimensions significantly affect the quality performance.

H_A 2: Manufacturing practices dimensions significantly affect the cost performance.

H_A 3: Manufacturing practices dimensions significantly affect the delivery performance.

H_A 4: Manufacturing practices dimensions significantly affect the flexibility performance.

H_A 5: Technological capability significantly moderates the relationship between manufacturing practices dimensions and quality performance.

H_A 6: Technological capability significantly moderates the relationship between manufacturing practices dimensions and cost performance.

H_A 7: Technological capability significantly moderates the relationship between manufacturing practices dimensions and delivery performance.

H_A 8: Technological capability significantly moderates the relationship between manufacturing practices dimensions and flexibility performance.

3.3.1 Relationship between the Independent Variables on Dependent Variables

Previous studies have researched on the effect of quality management practices on manufacturing performance. It was found that quality practices were statistically significant with quality performance on three items which are final inspection testing procedure, procedure for investigating the cause of a non-conforming product and the corrective action needed to prevent recurrence, and an established and documented quality management system exists to ensure that the product conforms to specified requirements (Anuar & Yusuff, 2011). It appears that quality practices are significantly associated with every performance measure of quality, cost, delivery, and flexibility at the significant level of 5 percent, where speed of new product introduction, manufacturing unit cost, flexibility to change volume, conformance to product specifications, and customer support and service are strongly connected to quality practices (Phan et al., 2011). Quality management practices are believed to create improvement towards quality, cost, delivery, and flexibility performance on a short-term basis (Wu et al., 2012a). A study results showed that TQM bundles are significantly related to cost and quality performance of a plant (Shah & Ward, 2003).

The influence of TQM on manufacturing performance has also proven to be positive and significant (Ng & Jee, 2012).

However, a result showed that the direct impact of quality practices on project manufacturing performance was found to be not significant (Yang, 2013). A study by Samson and Terziovski (1999) reported that three of the factors of TQM; leadership, human resources management and customer focus proved to be strongly significant and positively related to performance. While, the other three factors were shown to be either not significantly related (planning and process management) or negatively related (information and analysis). It is interesting that the strong predictors of performance were the so-called 'soft' factors of leadership, human resources management and customer focus, and the more systems and analytic oriented criteria (information and analysis, strategic planning, process analysis) were not strongly and positively related to operational performance in the regression. Therefore, the following hypotheses are proposed:

Hypothesis 1a: Total quality management significantly affect the quality performance.
Hypothesis 2a: Total quality management significantly affect the cost performance.
Hypothesis 3a: Total quality management significantly affect the delivery performance.
Hypothesis 4a: Total quality management significantly affect the flexibility performance.

Past studies on just-in-time practices effect on manufacturing performance have found to be in mixed results. Most of the studies found that the implementation and adoption of JIT practices lead to improvement in performances. Chen (2015) found that productions operation performance were affected by JIT implementation positively significantly. JIT were found to be significantly effecting firm's on-time delivery, quality level, inventory level, cost efficiency and labor productivity.

Moreover, Abdallah and Matsui (2007) had emphasized that JIT production practices had a significant and positive impact towards JIT performance measures of inventory turnover and cycle time. The investment in JIT practices were also found to reduce setup times in which allowing for inventory control and lessen the product defects (Kaplan, 1983; Sakakibara et al., 1997). The connection between JIT and manufacturing performance was confirmed as much of the results reveal its positive and significant effects (Banker et al., 2008; Challis et al., 2005; Rahman et al., 2010; Shah & Ward, 2003).

Even though there were numbered of studies that confirmed the significant relationship between JIT practices and manufacturing performance, a few had revealed the otherwise. Sakakibara et al. (1993) had identified that two dimensions of JIT which are setup time reduction and daily schedule adherence were identified as less influential towards JIT-related performance improvement as compared to the others four of supplier quality level, kanban, equipment layout, and pull system support. Sakakibara et al. (1997) had further studied on JIT practices and manufacturing performance, where the results indicated that JIT alone was not significantly related with the performance. Moreover, Cagliano and Spina (2002) had identified process flow layout, setup time reduction and cost reduction activities as JIT production management practices which did not lead to the escalation of production performance of cost, quality and delivery. Yet, Mackelprang and Nair (2010) had highlighted that not all individual JIT practices are linked with all types of performance outcomes. Thus, the following hypotheses are proposed:

Hypothesis 1b: Just-in-time significantly affect the quality performance.
Hypothesis 2b: Just-in-time significantly affect the cost performance.
Hypothesis 3b: Just-in-time significantly affect the delivery performance.

Hypothesis 4b: Just-in-time significantly affect the flexibility performance.

Some scholars have previously studied on the effect of human resource practices on manufacturing performance. The human resource area have been covered on different functions such as management practices (Jayaram et al., 1999), systems (Arthur, 1994), and bundles of human resource (MacDuffie, 1995). Human resource management practices were significantly and positively associated with manufacturing performance measures on cost, quality, flexibility, and time. The system was categorized into control system and commitment. These two categories significantly influence manufacturing performance on labor productivity and scrap rate. However, for firms to improve their performance, human resource system must be integrated with the companies' production strategy (MacDuffie, 1995). It was proven that human resource bundle contribute to better performance when it was integrated with bundle of manufacturing practices of a flexible production system. Human resource development practices are believed to create improvement towards quality, cost, delivery, and flexibility performance on a short-term basis (Wu et al., 2012a). A study results shows that HRM bundles are significantly related to cost and quality performance of a plant (Shah & Ward, 2003). However, a result shows that the direct impact of human resource practices on project manufacturing performance found to be not significant (Yang, 2013). Therefore, the following hypotheses are proposed:

Hypothesis 1c: Human resource management significantly affect the quality performance.
Hypothesis 2c: Human resource management significantly affect the cost performance.
Hypothesis 3c: Human resource management significantly affect the delivery performance.
Hypothesis 4c: Human resource management significantly affect the flexibility performance.

Earlier studies have found the significant relationship between supply chain management practices and performance in a manufacturing companies. Lenny Koh et al. (2007) found a direct and positive significant impact of SCM on operational performance measures of flexibility, production lead time, cost saving and inventory level. On the same argument, Li et al. (2006) proved a direct impact of SCM on firm's competitive advantages namely; quality, cost, dependability, flexibility and time-to market. A study from Bayraktar et al. (2009) found that operational performances measures which are production lead time, operational efficiency, inventory level and cost saving were positively and significantly influenced by SCM practices. It was later supported by Chong et al. (2011) who also found a significant and positive impact of SCM practices towards firm performance, specifically, production lead time, inventory turnover, product rejection, sales level, cost reduction and customers' requirements. On the other hand, a study by Fynes et al. (2005) on manufacturing performance impact of SC relationship dynamics showed a mixed outcomes. The results suggested that the adaptation of SC relationship among suppliers and customers lead to an enhancement in product quality and saving in product cost, unfortunately had no influence on flexibility and delivery performance. Thus, the following hypotheses are proposed:

Hypothesis 1d: Supply chain management significantly affect the quality performance.
Hypothesis 2d: Supply chain management significantly affect the cost performance.
Hypothesis 3d: Supply chain management significantly affect the delivery performance.
Hypothesis 4d: Supply chain management significantly affect the flexibility performance.

Overall, there is overwhelming empirical support, spanning different sets of practices, countries and industries for the linkages between manufacturing practices implementation and improved manufacturing performance. In summary, the researcher put forward overall direct relationship hypotheses statements between manufacturing practices and manufacturing performances as depicted in Table 3.1.

Table 3.1
Summary of Hypotheses Statements of the Relationship between Manufacturing Practices and Manufacturing Performance

Hypo-theses	Statement
H_A 1:	**Manufacturing practices dimensions significantly affect the quality performance.**
a	Total quality management significantly affect the quality performance.
b	Just-in-time significantly affect the quality performance.
c	Human resource management significantly affect the quality performance.
d	Supply chain management significantly affect the quality performance.
H_A 2:	**Manufacturing practices dimensions significantly affect the cost performance.**
a	Total quality management significantly affect the cost performance.
b	Just-in-time significantly affect the cost performance.
c	Human resource management significantly affect the cost performance.
d	Supply chain management significantly affect the cost performance.
H_A 3:	**Manufacturing practices dimensions significantly affect the delivery performance.**
a	Total quality management significantly affect the delivery performance.
b	Just-in-time significantly affect the delivery performance.
c	Human resource management significantly affect the delivery performance.
d	Supply chain management significantly affect the delivery performance.
H_A 4:	**Manufacturing practices dimensions significantly affect the flexibility performance.**
a	Total quality management significantly affect the flexibility performance.
b	Just-in-time significantly affect the flexibility performance.
c	Human resource management significantly affect the flexibility performance.
d	Supply chain management significantly affect the flexibility performance.

3.3.2 Moderating Effects of Technological Capability on the Relationship between Independent Variables and Dependent Variables

Technological capability has been studied to have an interaction with the manufacturing performance. Tsai et al. (2008) have investigated technological capability in forms of absorptive capability and applied capability on the innovation performance. The results showed that technological applied capability has a significant positive relationship with innovation performance. A study by Zhou and Wu (2010) had found that technological capability has an increasingly positive effect on the exploitation innovation, whereas the impact on exploration innovation declined after a certain point. The measure of technological capability used is related strongly to research and development intensity. Wang et al. (2006) have found out a positive and direct main effect of technological capability on both overall business performance and new product development performance. Cost effectiveness has been included in the overall business performance measures.

On the other dimension of manufacturing performance, the findings from a study by Garcia-Muina and Navas-Lopez (2007) showed that technological exploration capability is directly related to firm success, where the results also shows technological activities oriented to knowledge exploration processes will have more potential than technological capabilities that focused on the mere maintenance of a certain competitive advantage. Tsai (2004) had found out that technological capability has a significant effect on labor productivity growth. It was proven that technological capability is a significant determinant of productivity growth for high-tech firms. The results from Isobe et al. (2008) had highlighted that firm refinement capability relates more positively to operational efficiency than does the reconfiguration capability. However, reconfiguration capability relates more positively to strategic performance than does the refinement capability. The items considered under operational efficiency are profitability and the firm production processes. While, new technologies or products development and sources of technological competence were considered as strategic performance measurement.

Despite the positive significant and direct effect of most technological capability on varies performance measures, Khan and Haleem (2008) had found quite a contrary result on the interaction between technological capability and manufacturing performance of manufacturing cost and quality of final product. The results showed that there is no direct relationship for technological capability towards these two performance measures. Even though manufacturing performance is proven not to be dependent on technological capability, it still depends on the manufacturing processes which considered as innovation, flexibility and improvement. The manufacturing processes however, depend on the technological capability.

Firms' technological capability must have interaction with environmental aspects for it could help the company to build external and internal technological characteristics (Husseini & O'Brien, 2004). Therefore, it is importance and worthwhile of an emphasized of technological capability in the manufacturing strategies implementation and formulations beside manufacturing objectives by goals, human resource, planning and control. Husseini and O'Brien (2004) did a study on the newly industrializing companies (NICs) by which have been compared to two benchmarks in process technology and as a result showed that NICs being behind an advanced countries within large gap. The inferiority in technological issues will likely to affect the quality, cost, speed, reliability and flexibility of manufacturing operations.

Only a few studies did mention briefly on the importance of alignment between manufacturing strategy and technological basis which specifically referred to the technological capability, see examples; (Husseini & O'Brien, 2004; Perdomo-Ortiz et al., 2009; Sun & Hong, 2002). To summarize, it is anticipated that a good manufacturing strategy must aligned between firm's capabilities and resources with its manufacturing performance (Butt, 2009).

Findings by Ortega (2010) appeared to be greater technological capability increase firm performance at a greater rate and therefore improve the positive relationship between quality orientation and firm performance. Technological capability has marginally significant interaction on low-cost strategy via cost orientation. Greater technological

Table 3.2
Summary of Hypotheses Statements for the Moderating Effect of Technological Capability on the relationship between Manufacturing Practices and Manufacturing Performance

Hypo-theses	Statement
H_A 5:	**Technological capability significantly moderates the relationship between manufacturing practices dimensions and quality performance.**
a	Technological capability significantly moderates the relationship between total quality management and quality performance.
b	Technological capability significantly moderates the relationship between just-in-time and quality performance.
c	Technological capability significantly moderates the relationship between human resource management and quality performance.
d	Technological capability significantly moderates the relationship between supply chain management and quality performance.
H_A 6:	**Technological capability significantly moderates the relationship between manufacturing practices dimensions and cost performance.**
a	Technological capability significantly moderates the relationship between total quality management and cost performance.
b	Technological capability significantly moderates the relationship between just-in-time and cost performance.
c	Technological capability significantly moderates the relationship between human resource management and cost performance.
d	Technological capability significantly moderates the relationship between supply chain management and cost performance.
H_A 7:	**Technological capability significantly moderates the relationship between manufacturing practices dimensions and delivery performance.**
a	Technological capability significantly moderates the relationship between total quality management and delivery performance.
b	Technological capability significantly moderates the relationship between just-in-time and delivery performance.
c	Technological capability significantly moderates the relationship between human resource management and delivery performance.
d	Technological capability significantly moderates the relationship between supply chain management and delivery performance.
H_A 8:	**Technological capability significantly moderates the relationship between manufacturing practices dimensions and flexibility performance.**
a	Technological capability significantly moderates the relationship between total quality management and flexibility performance.
b	Technological capability significantly moderates the relationship between just-in-time and flexibility performance.
c	Technological capability significantly moderates the relationship between human resource management and flexibility performance.
d	Technological capability significantly moderates the relationship between supply chain management and flexibility performance.

capability increases firm performance at a greater rate and therefore improve the positive relationship between cost orientation and organization performance. Technological capability does not significant on low-cost strategy via improvement orientation, and hence do not improve relationship between process improvement orientation and firm performance. An interaction between practices and capability alters the direction or intensity of effects on performance. This argument can be posed for considering the capability as a moderating factor. Based upon the above discussion, the proposed hypotheses statements for the moderating effect relationships are presented in Table 3.2.

3.3.3 Relationship among Hypotheses, Research Questions and Objectives

Overall, there is an overwhelming empirical support, spanning different sets of practices for links between manufacturing practices implementation and improved manufacturing performance while the existence of technological capability might modified the links between two.

Table 3.3
Recapitulated of the Relationship between Hypotheses Statements, Research Questions and Research Objectives

Hypotheses (H)		Research questions (RQ)	Research objectives (RO)
H_A 1:	Manufacturing practices dimensions significantly affect the quality performance.	**RQ1:** Do manufacturing practices have significant effect on manufacturing performance in Malaysian manufacturing companies?	**RO1:** To determine the effect of manufacturing practices on manufacturing performance of Malaysian manufacturing companies
H_A 2:	Manufacturing practices dimensions significantly affect the cost performance.		
H_A 3:	Manufacturing practices dimensions significantly affect the delivery performance.		
H_A 4:	Manufacturing practices dimensions significantly affect the flexibility performance.		
H_A 5:	TC significantly moderates the relationship between manufacturing practices dimensions and quality performance.	**RQ2:** Does TC moderates the relationship between manufacturing practices and manufacturing	**RO2:** To examine the moderating effect of TC on the relationship between manufacturing practices and
H_A 6:	TC significantly moderates the relationship between manufacturing practices dimensions and cost performance.		
H_A 7:	TC significantly moderates the relationship		

	between manufacturing practices dimensions and delivery performance.	performance in Malaysian manufacturing companies?	manufacturing performance of Malaysian manufacturing companies.
H_A 8:	TC significantly moderates the relationship between manufacturing practices dimensions and flexibility performance.		

Note: TC = Technological Capability

Again, it is to shows how beneficial is to implement such practices into the company and to gain performance advantages (Shah & Ward, 2003). Thus, throughout the research process, the proposed hypotheses which appeared in the research framework will be answering set of research questions and satisfying the research objectives as shown in Table 3.3.

3.4 Research Design

Research design is a structure that guides the researcher for data collection and how the data will be analyzed in order to answer the research questions and meet the study's objectives. In general, it is a master plan that specifies the techniques and processes for gathering and analyzing the needed information for the study (Zikmund et al., 2010). Qualitative, quantitative and mix method are the three types of research design (Creswell, 2009). Seeing that the research community will be greatly benefited from the proposed study which it will fills in the loopholes and rectify problems that have been identified by the extensive literature reviews, therefore an appropriate research design that suit for the proposed study will be a quantitative research design. It is an attempt to enlighten, foresee, and control a certain phenomenon through appropriate procedures (Gay & Diehl, 1996). This method will be applied to cater the researcher's intention in examining research objectives on relationship among measurable variables and provides the results and evidence of research findings in the form of statistical numbers and figures.

3.4.1 Research Process

Research process shows the overall processes that related to the research. It shows the processes and steps that the researcher follows in attempt to complete the study. The research starts with the observation and extensive review of related literatures on the preferred area of study. The detail phases of research process are presented in Figure 3.3.

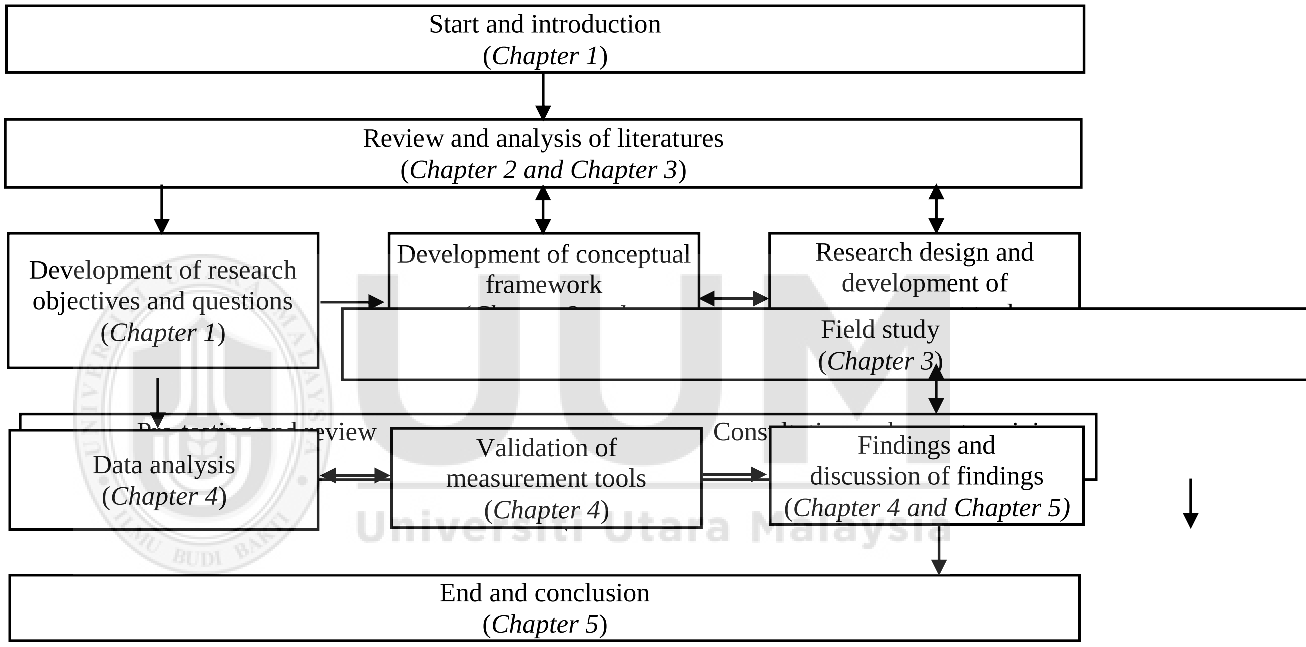


Figure 3.3
Outline of research process

3.4.1 Purpose of Research

In general, research can be carried out through exploratory, descriptive, causal-comparative, or experimental design (Gay & Diehl, 1996; Hair, Babin, Money, & Samouel, 2003). Specifically, the main purpose of this study is to determine the impact of manufacturing practices and technological capability on firm manufacturing performance. Since the study is intended to test particular research hypotheses, thus it is a kind of descriptive research in which to confirm or testing hypotheses (Hair et al., 2003). The descriptive type of research is purposely to provide an accurate representation of observation and mapping a piece of ground of particular observable facts.

3.4.2 Types of Investigation

Types of investigation that will take place are suggested to be the hypotheses testing and correlation between variables in nature. Instead of causal study, this research is more likely to adopt the correlational investigation where the researcher is intended in investigating, describing and distinguishing the important factors (independent and moderator variables) that associated with the main problem (dependent variable) (Sekaran & Bougie, 2013). The research will specifically analyzing significant impact between the problem and the important variables; dependent variable (manufacturing performance), independent variables (manufacturing practices) and moderator variable (technological capability). Hence, the main idea will be to generate precise conclusion about the correlation that reflects the relationships of these variables holistically.

3.4.3 Time Dimension

There are two preferences of time dimension in conducting a research; which are longitudinal and cross-sectional study. Longitudinal study involves a multiple points in time of data collection whilst cross-sectional study involves only one time data gathering (Sekaran & Bougie, 2009). The nature of the current research is a cross-sectional, where respondent were selected only once and data were gathered within a certain time frame. Four months' time frame was used. Within the short time frame, it gives the researcher a degree of control over whom and what to measure and maintaining the stability and validity of the survey questionnaires. The cross-sectional study is conducted in non-contrived settings, called the field studies and data collection activities and had been conducted through a set of survey questionnaires without an interruption to respondents' work routines, whereas data analysis is carried out without to involve the respondents. Other factor that motivates the researcher to use cross-sectional method is due to the nature position of selected respondents which have a busy work task that involves the daily basis operations. Thus, the current study has applied a cross-sectional method as it involves the natural setting where measures normally take place with minimal interference from the researcher (Sekaran & Bougie, 2009).

3.4.4 Unit of Analysis

According to Sekaran and Bougie (2009), unit of analysis refers to the level of aggregation of the data collected which determined by the research questions. It is important to decide and have a clear preference on unit of analysis since it will aid and guide the determination of data collection method, size of sample, and the operationalization of investigated variables. The unit is tied to the aim or objective of the carried out analysis (Bhattacherjee, 2012). With a simple sentence, it is a unit type of selected subject by researcher to measure variables in a research (Neuman, 2006). As this study is attempting to determine the significant impact of important factors on manufacturing performance in the manufacturing firms and, even though decisions are made by individuals in these firms, these people are representing their firm's decision rather than their personal decisions, thus the unit of analysis used will be the firm (Bhattacherjee, 2012). This being said that the respondents or key informants are in the best position to access and has the best knowledge and familiarity regarding the real level of practices and technological capability development and performance in their company (Fai Pun & Jaggernath-Furlonge, 2012; Kafetzopoulos & Psomas, 2015; Meybodi, 2013).

3.5 Operational Definition

According to Hair, Money, Samouel, and Page (2007), operational definition is a definition of a construct in measurable terms by reducing it from its level of abstraction through the delineation of its dimension and elements. In other words, it is a statement that defines how a concept will be measured where it interprets the nominal meaning into a form in which the concept can be measured empirically with the data (Meier, Brudney, & Bohte, 2015). It is occasionally termed as a working definition which is developed only for the purpose of a particular study (Kumar, 2011). To put forward, operationalizing a concept is a process that will results in the indication and designed of the variables and its elements to measure the concept. The definitions of all key variables in this study are further discussed in the next sub-sections.

3.5.1 Manufacturing Performance

In the previous chapter of literature reviews, there are mixed explanations for MP where sometimes researchers referred to within the scope of financial or non-financial views. Nevertheless, for the objective of this study, constructs for measuring MP was based on elements of MP as tested by Chi (2010) and Boyer and Pagell (2000) as discussed and justified in chapter two. The authors' defined manufacturing performance as the achievement level on four non-financial measures of quality, cost, delivery and flexibility. The respondents were asked to indicate their opinion on how the company's performances for the last three years. The respondents' opinion on MP variable contained an overall 14 items were rated on a six-point Likert scale index measure ranging from; 1 = "Strongly Disagree" to 6 = "Strongly Agree". The details of the dimensions are deliberated one after the other.

a) Quality performance

Quality performance in any manufacturing companies reflect the quality of a product manufactured. It was always measured from two perspectives of either the product itself or from the perspective of customer feedback and responses. The construct of current study focuses only the quality improvement perspective of the product itself which includes performance of its features, reliability, and product conformance (Chi, 2010). The construct was measured using three (3) items.

b) Cost performance

Cost performance is aways related to the cost involves in the manufacturing production and labor productivity which firms targeting to produce at low cost and sell at high price. For the aim of current study, cost performance is emphasized on the continuous improvement in regards the inventory level, utilization of capacity, cost of production, and labour productivity (Boyer & Pagell, 2000). The construct consists of four (4) measurement items.

c) Delivery performance

Delivery performance of a company is often associated with speed and time. Speed is measured by how the products can be delivered faster than the actual delivery schedule, while the measured time involves reducing the production lead time. A concern for delivery performance in this study involves speed of delivery, timely delivery and lead time reduction (Chi, 2010). Three (3) items measurement were employed to measure the delivery performance construct.

d) Flexibility performance

The ability for respond to sudden changes are associated with flexibility performance. Past researches have concluded a variety of flexibility dimensions ranging from machine flexibility until the market flexibility of a factory. Flexibility in manufacturing companies has conventionally been attained at a high cost by operating common purpose machinery and equipment instead of more efficient special purpose-built machinery and by positioning more highly skilled production workers than would otherwise be needed. The focus of flexibility performance for current study is aimed at time-related outcomes namely, volume changes, product mix, capacity adjustment, and equipment changeover (Chi, 2010). This construct is measured by four (4) items.

3.5.2 Manufacturing Practices

In this study, manufacturing practices is a term to describe a specific set of activities which act in accordance of specified guidelines that bring values to the company where it will contribute to the improvement continuity (Lee et al., 2015; Wiengarten et al., 2011; Wu et al., 2012a). The practices under concern for this study are TQM, JIT, HRM, and SCM. The opinion of respondents were obtained on how the company have implemented these practices in the factory. The respondents' opinion on manufacturing practices variables contained an overall 44 items were rated on a six-point Likert scale ranged from; 1 = "Strongly Disagree" to 6 = "Strongly Agree". The manufacturing practices items were adapted and modified from previous studies conducted by Challis et al. (2005), Bayo-Moriones, Bello-Pintado, and Merino-Diaz-de-Cerio (2008), Dal Pont et al. (2008), Ahmad and Schroeder (2003), and Chong et al. (2011). The details of each practices are deliberated one after the other.

a) TQM

The literature review showed that TQM had been defined varied by previous researchers depending on their study objectives. This study however considered the total quality management instruments used by Challis et al. (2005) which was tested as an integrated manufacturing facets on the manufacturing performance measures. The study defines TQM as a set of innitiatives which concerned on the methods and approaches to improve products and processes continuously. Seven (7) items measurement were employed to measure the TQM construct.

b) JIT

JIT practices have been defined previously in terms of JIT-purchasing or JIT-production with primary objectives to eliminate waste and optimally utilize resources (Claycomb et al., 1999; Inman et al., 2011). Meanwhile, this study considered just-in-time practices that related to the JIT-production which was adopted by (Bayo-Moriones et al., 2008) from several references on JIT. This variable concerned on the lot size reduction, set-up time reduction, layout, and Kanban. There are ten (10) items that measuring the JIT contruct.

c) HRM

HRM practices is defined in this study as a set of innitiatives that shape the production workers' profile and coordination of the firm's commitment throughout the production employees. The HRM practices were also associated to the improvement in employees' skills and knowledge, which associated with training, motivation and reward and punishment system. This definition followed the studies of Ahmad and Schroeder (2003) and Dal Pont et al. (2008) in which they were both examining it with all four manufacturing performances of quality, delivery, flexibility and cost. There are six (6) items measuring the HRM variable.

d) SCM

SCM practices have various definition back in previous studies. These definitions as mentioned in the literature reviews, reflect particularly on the context of each studies. For the goal of current study, the definition provided by Chong et al., (2011) is used. The authors defined SCM as practices portrayed from the upstream, downstream, internal supply chain process and customer relationships. These practices are relating to strategic supplier partnership, customer relationship, information sharing, information technology, training and internal operation. This construct is measured by twenty one (21) items.

3.5.3 Technological Capability

For the purpose of current study, the definition of TC is employing the definition provided by Chantanaphant et al. (2013). They defined TC as how well the firm can make effective use of the accumulated knowledge over time to acquire, operate and upgrade the existing technologies and develop new products and processes. Acquiring capability accounts on the ability of the firm in attaining new knowledge through formal, informal, internal and external channels. In general, the companies form their own TC by progressively absorbing, digesting and improving this knowledge. Operating capability refers to the ability to operate, utilize and sustain production equipment and facilities. Upgrading capability is closely linked to firm's ability in advancing greatly on products and processes depending on firm's own strength. The items were adapted and a few modification have been made to adjust with the current context. The respondents were requested to rate their opinion on the company implementation of TCs in the factory. The respondents' opinion on TC variable contained an overall 10 items were rated on six-point Likert scale ranged from; 1 = "Strongly Disagree" to 6 = "Strongly Agree".

3.6 Measurement of Variables or Instrumentation

The survey instrumentation explains on the type of survey design used, the detail of each variable measurement item, type of scale used, and pre-testing of the instrument. The basis of instruments development are arise from the developed research framework and hypotheses, whereas the design and scaling considerations are basically chosen as to comply a survey-based study.

3.6.1 Survey Design

A survey is a pre-expressed written group of questions, which is used for data collection (Sekaran, 2003). In order to gain the required data, a set of survey questionnaires will be developed. Questionnaire is a written set of questions to which respondents record their answers, usually within rather closely defined alternatives.

Questionnaire is an efficient data collection mechanism when the researcher knows exactly what is required and how to measure the variables of interests. It will be divided into sections as to develop interest and focus among respondents. This type of research is firmly in the rationalist paradigm, which corresponds to test or confirm existing theories (Meredith, 1998).

Additionally, the substance of the questionnaire itself is a suitable technique for capturing data from a bulky number of respondents and facilitate the use of statistical analysis techniques had make it being the most frequently used modus operandi in recent empirical operations management researches (Barnes & Rowbotham, 2004). The questionnaires are more preferable as the respondents will only have to give their perceptual answers towards the perceptual measures provided with references to their companies' performance three years back, followed studies by i.e. (Banker et al., 2008; Bello Pintado, Kaufmann, & Merino Diaz-de-Cerio, 2015; Dal Pont et al., 2008) whom also employed the perceptual realized past performance of respondents.

In the current study survey instrument, the questionnaires were structured and funneled into four sections (Appendix 1.1). It is comprising a total of 76 questions. The first three sections consist of specific questions that are intended to measure and analyze the studied variables, beginning with the Section One which straightaway asking on the independent variable of manufacturing practices, Section Two questioning a measurement related to moderating variable of technological capability, and Section three measured for the dependent variable of manufacturing performance. All questionnaires are adapted from previous empirical researches through literature survey process. In the final section of the survey instrument, some general questions about demographic profile were asked. The demographic section consists of basic company background information and respondents' profiles. The company background includes the ownership, area of manufacturing business, years of company's establishment in Malaysia and number of full-time employees. Whereas, the current job functions, designation in the company and working experience period in the industry were considered as profiles of respondent.

The entire selected questions meet the appropriate level of Cronbach's coefficient alpha value that proved the reliability of each item measurement are belong to a certain dimension. To the extent possible, the researcher will be using the existing item measurements and reworded some of the item to relate specifically to the current research context.

The questionnaire's original version was dictated in English to be in line with the particular aim of this study. It was later translated into the national language (Bahasa Malaysia) in view of the multi-racial respondents in Malaysia (Appendix 1.2). In accordance with the recommendation by Brislin (1986) which reckoned that to ensure the calculation of the derived data from the questionnaire is consistent and legal, a back to back translation should be conducted. Furthermore, since the Bahasa Malaysia is the national language, the respondents would easily comprehend the questionnaire's requirements and would comfortably respond accordingly.

Initially, a local Malaysia who is a TESL degree student of OUM translated the original English version into Bahasa Malaysia. He is fluent and conversant in both material languages. The research objective was not revealed to this particular translator. Afterwards, without the view of the original version, the translated Bahasa Malaysia version was re-translated into English by a qualified TESL school teacher.

Finally, the translated English version is compared with the original version where the researcher will scrutinize the resemblances and dissimilarities to make necessary amendments and fine tuning. A translated questionnaire is essential to accumulate greater range and more depth in responses (Sekaran, 2000).

3.6.2 Variable Measurement

Multi-item measurements were developed for each of the variables included in the theoretical model. The items used to measure manufacturing practices were basically from Challis et al. (2005), Chong et al. (2011), Bayo-Moriones et al. (2008), Dal Pont et al. (2008) and Ahmad and Schroeder (2003). On the other hand, the scales developed by Chantanaphant et al. (2013) were adapted to evaluate technological capability. Additionally, items used to rate attainment of manufacturing performance were based on the surveys developed by Boyer and Pagell (2000) and (Chi, 2010). The summary of variables and items are depicted in Table 3.4.

Table 3.4
Measurement of Variables and Items

No.	Variables	No. of Items	Cronbach's Alpha
1	Total quality management	7	0.742
2	Just-in-time	10	0.621
3	Human resource management	6	0.770
4	Supply chain management	21	0.739
5	Technological capability	10	0.948
6	Quality	3	0.702
7	Cost	4	0.780
8	Delivery	3	0.832
9	Flexibility	4	0.876

The construct and the measurement of manufacturing practices were conceptualized as implemented routines that offer an improvement in products and processes which bring values to the firm's competitive advantage. In operationalizing manufacturing practices for the proposed study, the researcher will be assessing mainly four practices of TQM, JIT, HRM and SCM.

Altogether, there were 44 items to measure the construct of manufacturing practices. TQM consists of seven items with alpha value of 0.742. The construct of JIT consists of ten items with the Cronbach's Alpha value of 0.621. According to Sekaran (2003), the items with a coefficient value of 0.60 and above is still considered as acceptable. Furthermore, the constructs of HRM consists of six items with 0.770 alpha value. For these particular constructs, it was recorded above the 0.7 level suggested by Hair et al. (2006), indicating an adequate reliability for each construct. Thus, the results provide evidence that the scales are reliable. Finally, for the SCM, this practice will consists of 21 items with almost all the coefficient alpha values reported above 0.73 which are portraying a good reliability of constructs items.

The constructs and items of manufacturing practices for the proposed study are shown in the Appendix 1 of survey instruments. Table 3.5 below depicts the items used to measure four types of manufacturing practices and its sources from which they were adapted. All of the items were coded accordingly as for later on, it is much easier for the author to input the data into the analytical tools for analysis. Moreover, some minor wording changes of the sentences by the author without changing its source meaning. The modification is purposely for adapting all the items properly into the context of current research.

Table 3.5
Variable Measurement of Manufacturing Practices

Code	Items	Source
Total Quality Management		
TQM1	All production workers believe that quality is their responsibility.	Challis et al. (2005)
TQM2	We have well established methods to measure the quality of our products.	
TQM3	At our company, we proactively pursue continuous improvement rather than reacting to crisis.	
TQM4	Customer requirements are disseminated/understood throughout the workforce.	
TQM5	We have effective processes for resolving customer complaints.	
TQM6	Customer complaints are used to initiate process improvement.	
TQM7	We use the statistical process control in factory operations for quality control.	
Just-In-Time		
JIT1	Production facilities are arranged in relation to each other, so that material handling is minimized.	Bayo-Moriones et al. (2008)
JIT2	Production processes are located close together, so that material movement is minimized.	
JIT3	Our equipment are grouped according to the product family to which they are dedicated.	
JIT4	We emphasize putting all tools and fixtures in their places.	
JIT5	We are aggressively working to lower production lot sizes.	
JIT6	Our company producing many different products.	
JIT7	We frequently change the product models produced in our factory.	
JIT8	We have low set-up times of equipment in our factory.	
JIT9	We aggressively working on reducing equipment's set-up times.	
JIT10	We use the Kanban pull system (producing in response to demand from the next stage of production process) to control our production.	
Human Resource Management		
HRM1	We encourage the production workers to work together to achieve common goals, rather than encourage competition among individuals.	Dal Pont et al. (2008); Ahmad and Schroeder (2003)
HRM2	In the past three years, many problems have been solved through small group sessions.	
HRM3	Our company has developed a reasonable reward and punishment system for production workers who achieve factory goals and who do not achieve factory goals.	
HRM4	The production workers have received training and development in work-place skills on a regular basis.	
HRM5	The production workers are cross-trained to perform several difference tasks (so they can fill in for other task if necessary).	
HRM6	In our company, goals, objectives and strategies are communicated throughout the workforce.	

Table 3.5 (*Continued*)

Code	Items	Source
Supply Chain Management		
SSP1	We include our key suppliers in our planning and goal-setting activities.	
SSP2	We actively involve our key suppliers in new product management.	
SSP3	We have continuous improvement programs that include our key suppliers.	
SSP4	We have helped our key suppliers to improve their product quality.	
CR1	We frequently interact with customers to set our customer satisfaction standards (such as reliability, responsiveness, etc.).	
CR2	We frequently evaluate customer satisfaction.	
CR3	We frequently evaluate future customer expectations.	
CR4	We provide easy access to customer to seek assistance.	
CR5	We periodically evaluate our relationship with customers.	
IS1	Our trading partners share business knowledge of core business processes with us.	
IS2	Our trading partners keep us fully informed about issues that affect our business.	Chong et al. (2011)
IS3	Our trading partners share proprietary information with us.	
IS4	We and our trading partners exchange information that helps establishment of business planning.	
IT1	Our IT technology throughout the supply chain is up to date.	
IT2	Our ordering system from major customers is IT enabled and automated.	
IT3	We use IT-based automated ordering to send purchase order to major suppliers.	
IT4	The IT systems throughout the supply chain are adequate.	
IT5	We use IT based automated production process.	
IO1	Our main products are innovative.	
IO2	The management has sufficient knowledge in supply chain effectiveness process.	
IO3	There are continuous improvements in production delivery system.	

Previous study had conceptualized technological capability as the technological knowledge and skills. This characteristic gives a technological ability for the firm to assimilate, use, adapts and change existing technologies while develop new products and processes to the firm.

For the purpose of current study, all items of technological capability have been reported previously on Cronbach's Alpha exceeding the value of 0.90. It means the items are good and internally consistence to measure the construct of technological capability. Altogether, there will be 10 items of measurements and the author has reworded some of the items to make them in standardized sentences to the current context without changing the original meaning of the statements.

The constructs and items of technological capability are shown in the Appendix 1 of survey questionnaire. Table 3.6 exhibits the coded items that were used to measure technological capability together with the source from which they were adapted.

Table 3.6
Variable Measurement of Technological Capability

Code	Items	Source
Technological Capability		
TC1	We intensely cooperate with scientific research institutions to develop technologies.	
TC2	We cooperate with others (suppliers/customer) to develop technologies.	
TC3	We tie with the technology suppliers in the market.	
TC4	We manufacture with advanced technologies.	
TC5	We have more skillful technical workers and operational workers.	Chantanaphant et al. (2013)
TC6	We have less operation discontinuity.	
TC7	We frequently upgrade our production process.	
TC8	We strongly upgrade our products according to market demand.	
TC9	We improve greatly on production process based on our own ideas.	
TC10	We develop and test our own new product design.	

The researcher adapts manufacturing performance measurements from four works of past researches and was conceptualized as the point of reference of achievement level on a set of strategic manufacturing objectives. In operationalizing the manufacturing performance of the current study, the researcher focuses on assessing the performance on four facets of quality, cost, delivery and flexibility by which altogether consist of 14 items.

Quality performance consists of three items and coefficient alpha value reported in prior study is 0.702. Next, cost measurements consists of four items with the alpha values of above 0.780. On the other hand, delivery construct consists of three items that have an alpha value of 0.832. Finally, flexibility performance construct consists of four items with the reported alpha value of 0.876. All of the selected instruments measuring manufacturing performance construct have been reported to portray an acceptable coefficient values, hence the items are all reliable.

The constructs and items of manufacturing performance in the proposed study are illustrated in Appendix 1. Table 3.7 exhibits the items that have been coded accordingly and the sources from which they were adapted. There are a few number of items developed under each manufacturing dimensions as compared to other variables. However, the quantity are adequate as according to previous literatures i.e. (Boyer & Pagell, 2000; Chavez et al., 2015; Chi, 2010; Khanchanapong et al., 2014) which also empirically tested on a few items only. Hence, these few items are appropriate and feasible to be further tested in this study.

Table 3.7
Variable Measurement of Manufacturing Performance

Quality		
PQ1	Improve high performance product features.	
PQ2	Offer consistence and reliable product quality.	Chi (2010)
PQ3	Improve conformance to product specification.	
Cost		
PC1	Reduce inventory.	
PC2	Increase capacity utilization.	Boyer and Pagell (2000)
PC3	Reduce production costs.	
PC4	Increase labour productivity.	
Delivery		
PD1	Improve fast delivery.	
PD2	Improve delivery on time.	Chi (2010)
PD3	Reduce production lead time.	
Flexibility		
PF1	Make rapid volume changes.	
PF2	Adjust capacity quickly.	Chi (2010)
PF3	Adjust product mix quickly.	
PF4	Improve rapid equipment changeover.	

3.6.3 Scale of the Questionnaire

In the survey type of research, questionnaire is deemed to be one of the most suitable data collection instruments (Asika, 1991). This method is also more applicable in obtaining information of quantitatively primary data (Malhotra, 2006). Generally, the statement used in a questionnaire must be effortlessly understood by the respondents (Oppenheim, 1992), and the statement in the survey instrument must not be leading the respondents (Parten, 1950). As suggested by Goldberg and Velicer (2006), using multi-step scales (i.e. Likert rating scale) giving plentiful benefits over other item formats (i.e. dichotomous choices or checklists) from the psychometric point of view, where it produce better factor loadings than the other two formats. Even though the designing of questionnaire consists series of format, it is however, depending on the researcher's purpose of research to measure, thus suggest why, scholars believe the format had better be common and universal.

The measurement scale used in this study are itemized rating scale as it is one of the scales of intervals measurement. Likert scale is a psychometric type of scales used in instruments to be able to tap respondents' degree of agreement or disagreement with a given item statement. On the basis of this therefore, this study uses Likert scale type of questionnaire, where, according to Cavana, Delahaye, and Sekaran (2001), the rating scale permits researchers to practice the range of four, five, six, seven, nine, ten, and so on. For instance, Goldberg and Velicer (2006) recommended a rating scales with five to seven response categories which gives advantages from the psychometric views.

There are many and varied types of Likert measurement scale as listed by Vagias (2006). It was originally a 5-point scale that range from strongly disagree to strongly agree with neither disagree nor agree at the middle (Likert, 1932). A lot of researchers will prefer to use longer scales by adding options (i.e. a 7-point or 9-point scales) i.e.; (Amrina & Yusof, 2010; Inman et al., 2011; Koufteros et al., 2014). Other researchers rather use an even scale (mainly 4-point, 6-point, or 10-point scales), i.e.; (Ahuja & Khamba, 2008; Tan & Wong, 2015; Thrulogachantar & Zailani, 2011; Wang et al., 2006). Borrowing the argument of Malhotra (2006), lengthier scales tolerate the respondents to freely select the preferences without being forced.

In this study, the six-point scale was used for all the questionnaires as taking into consideration that the changing or increasing of scale is not about to increase the reliability but the measurement quality itself (Elmore & Beggs, 1975) as well as to tackle and lessen social desirability bias (Krosnick, 1999). The use of a six-point scale indicated the range of this study that does not offer a midpoint, no opinion or a neutral point. It is most preferably for respondents to have the middle point as they are free and not being burdened with the researcher's restricted choices (Martin & Polivka, 1995). However, to cater the concern and to counterbalance the argument of middle tendency bias that possibly encountered with Asian respondents specifically (Thrulogachantar & Zailani, 2011), six-point scale are more than appropriate.

3.6.4 Pre-testing the Survey Instrument

Validity generally determines whether the measuring instrument is indeed measuring what it purports to measure where it is associated with measurement procedures (Hair et al., 2007; Kumar, 2011). It is critical to ensure the content validity of the questionnaires. The fact that measures were drawn from well-established empirical and conceptual works helps to assure their validity (Bohrnstedt, 1983) cited in (Kathuria, Partovi, & Greenhaus, 2010).

To authorize complete and correct questions statement, a pre-test was conducted to decide which items among those adopted and adapted from former studies were most appropriate for the survey questionnaire. Pre-testing is a process of judgment, by experts, of the extent to which a question truly measures the concept it was intended to measure and to ensure for the quality of data. Researcher must then modified the survey instrument to enhance the possibility that the meaning of each item was clear (Krosnick, 1999). It cannot be determined statistically; it can only be determined by experts and by reference to the literature (Flynn, Sakakibara, Schroeder, Bates, & Flynn, 1990; Gable, 1994). In addition to the face validity through extensive literature reviews, DeVellis (2003) suggested a response of input from both the experts in academia and industry to warrant the content validity. More so, it is highlighted that a questionnaire pre-testing must be conducted in advance by consulting experts for their recommendation before deploying it for the actual survey (Ghauri & Grønhaug, 2005).

For that purpose, a total of six experts were invited to enhance and validate measures for each concept (Appendix 2). The questionnaire was first passed to five senior academicians in the field of production, operation and manufacturing industries and one expert from the electronic industry for facial validity where a lot of observations were made and the contents were enriched. After those, 15 copies of the draft survey instrument were sent randomly to some operations and productions managerial personnel of specified manufacturing industries in order to determine whether the phrasings and content are straightforwardly understood by the respondents. Some suggestions were offered and their insights were incorporated into the final revised version of the survey questionnaires. Finally, a refined assessment items were included in the final survey as enclosed in the Appendix 1.

3.7 Sampling Design

As the aim of quantitative study is to establish definite "truth" about the social world with the goal of making generalizations, thus, quantitative approaches to sampling, therefore, need to ensure that the findings are representative of the general population under study (Hesse-Biber, 2010). Quantitative sampling designs rely on "laws of probability" where the indication is that all members of a given population have an equal and known probability of being selected in a sample in order to permit the use of statistical testing. It is also as to ascertain whether the research findings are in fact "true" with respect to the overall target population. Hence, the sampling design will entail the targeted population, sampling frame, the size of preferred sample, and sampling technique.

3.7.1 Population

A population signifies the whole group of people, events, or things of concern in which researcher desired to examine (Sekaran & Bougie, 2009). Based on the data obtained from the Federation of Malaysian Manufacturers (FMM) Directory 2014, there are about 2,500 manufacturing companies were registered under the Federation. According to Cooper and Schindler (2003), a target population is the total collection of elements about which the researcher wishes to make some inferences. As the sampling for current research is targeting on the manufacturing companies, therefore, 2,500 enlisted companies are regard as the potential preferred population size. As being the sole directory that encompassed over 2,000 list of specifically manufacturing and manufacturing-related services companies in Malaysia, therefore this directory is highly relevant to be fully utilized (Jusoh, Ibrahim, & Zainuddin, 2008). Moreover, FMM is a well-known and prominent representative of the manufacturing and service industries for over 40 years, the selected sample in this study is considered to be a valid representation of the population (Ooi et al., 2012).

The targeted respondents will be the person at the executive and managerial level and above due to their close relation and involvement with the operations of manufacturing strategy and firm's capability. The targeted respondents were also identified as the individuals who were familiar with information on the desired study area. These officials will be chosen for the reason that they possess sufficient and an immense knowledge of manufacturing practices, level of technological capability and very familiar about manufacturing performance of the companies.

3.7.2 Sampling Frame

The sampling frame for the proposed study is supposed to be a list of all manufacturers enlisted in the FMM directory, however, only industries which fall under the top four most contributing to the sector GDP's share will be considered to be included into the frame. The sampling frame consist only four industries because these industries play a very significant roles to the national manufacturing sector as they have contributed a significant number of share to sector GDP in three years consecutively as summarize in Table 3.8. The total contribution of four industries in 2011, 2012 and 2013 are very remarkable which amounting to 56.39, 46.81 and 46.80 percent respectively.

This study aims at assessing the manufacturing performance, manufacturing practices and technological capability in four industries of the manufacturing sector in the country, namely; computer, electronic and optical products (SIC 26: 219 number of companies), chemicals and chemical products (SIC 20: 378), food products (SIC 10: 378), and rubber and plastic products (SIC 22: 403). These four industries are considered valid and reliable as the selected sample for current research focus. There are also previous studies which have covered on the same industries for the similar research area such as the studies by Kafetzopoulos and Psomas (2015), Chen (2015), Fai Pun and Jaggernath-Furlonge (2012), and Christiansen et al. (2003) where they had includes the combination of the electronics, chemical, food, plastic, medicine and cosmetics product industries into their research.

Table 3.8
Contribution to Manufacturing Sector GDP's Share

Industry sector	**Manufacturing value added (%)**		
	2011	**2012**	**2013**
SIC 26 – Computer, electronic and optical products	24.11	20.40	22.60
SIC 20 – Chemicals and chemical products	13.82	10.43	10.60
SIC 10 – Food products	9.42	9.78	7.70
SIC 22 – Rubber and plastic products	9.02	6.20	5.90
Total	**56.39**	**46.81**	**46.80**

Source: Adopted from Malaysia Productivity Report 2011/2012, *p. 245*; Malaysia Productivity Report 2012/2013, *p.189*; Malaysia Productivity Report 2013/2014, *p. 133*

According to Malaysia Standard Industrial Classification (MSIC), both computer, electronic and optical products industry and food products industry comprises eight groups, three groups for chemicals and chemical products industry, whereas two groups for rubber and plastics products industry. The details of each division's group are presented in Table 3.9. Only the data related to manufacturing performance, manufacturing practices and technological capability will be reported and analyzed in this research.

Table 3.9
List of Manufacturing Division's Group

SIC	Industry sector	Manufacturing group
10	Food products	1. Processing and preserving of meat 2. Processing and preserving of fish, crustaceans and molluscs 3. Processing and preserving of fruit and vegetables 4. Manufacture of vegetable and animal oils and fats 5. Manufacture of dairy products 6. Manufacture of grain mill products, starches and starch products 7. Manufacture of other food products 8. Manufacture of prepared animal feeds
20	Chemicals and chemical products	1. Manufacture of basic chemicals, fertilizers and nitrogen compounds, plastics and synthetic rubber in primary forms 2. Manufacture of other chemical products 3. Manufacture of man-made fibres
22	Rubber and plastic products	1. Manufacture of rubber products 2. Manufacture of plastics products
26	Computer, electronic and optical products	1. Manufacture of electronic components and boards 2. Manufacture of computers and peripheral equipment 3. Manufacture of communication equipment 4. Manufacture of consumer electronics 5. Manufacture of measuring, testing, navigating and control equipment; watches and clocks 6. Manufacture of irradiation, electromedical and electrotherapeutic equipment 7. Manufacture of optical instruments and photographic equipment 8. Manufacture of magnetic and optical media

Source: Adopted from Malaysia Standard Industrial Classification (2008), *p. 82-232*

3.7.3 Sample Size

A sample is a selection of subgroup from the targeted population in which the results from studied sample can be generalized for the population of interest (Sekaran & Bougie, 2013). Most of the selected manufacturers were certified with ISO 9000 where these companies were deemed as the least and best choice as respondents, since they implement various manufacturing practices and portray yield improvements of performance in the company (Anuar & Yusuff, 2011; Sohail & Hoong, 2003).

The rule of thumb of sample size to perform a multiple regression analysis is preferably 10 times or more as the number of variables in the study (Roscoe, 1975). Since the proposed study has four independent variables, four dependent variables, and one moderator variable, thus the suitable sample size is 90 (9 x 10). In determining the sample size, a larger sample is recommended in order to obtain higher accuracy (Kumar, 2011). By using a formula for determining sample size (Krejcie & Morgan, 1970) as shown below, the sample size is identified;

$$s = \frac{X^2 NP(1-P)}{d^2(N-1) + X^2 P(1-P)}$$

s = required sample size.
X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841).
N = the population size.
P = the population proportion (assumed to be .50 since this would provide the maximum sample size).
d = the degree of accuracy expressed as a proportion (.05).

To simplify, the sample size of this research is based on the generalized scientific guidelines tabulation derived from this formula (Krejcie & Morgan, 1970). The tabulation can be seen in the Appendix 3. Thus, provided the total populations of 1,378, as depicted in Table 3.10, the suitable sample size that will be useful are 302 samples and this sample size has also fulfilled the minimum number required of rule of thumb.

Table 3.10
Total Population of Current Study

Industry sector	SIC	N
Food products	10	378
Chemicals and chemical products	20	378
Rubber and plastic products	22	403
Computer, electronic and optical products	26	219
Total		**1,378**

Source: Figures are adopted from Federation of Malaysian Manufacturers Directory 2014

3.7.4 Sampling Technique

The proposed study will employs stratified random sampling technique, where every element in the population has an equal and independent chances of being selected as a subject (Kumar, 2011; Sekaran & Bougie, 2013). The selected sampling frame comprised of four different industries. The potentially heterogeneity and extent of variability of sampling population in regards to industries are subject to the application of stratified sampling (Kumar, 2011). Therefore, by using stratified sampling, the sampling frame is divided into strata which are subgroups of homogeneous and non-overlapping, and then a simple random sampling is drawn within each subgroup (Bhattacherjee, 2012).

Since the proposed study will be employing probability types of sampling, therefore the total sample size of 302 as according to Krejcie and Morgan (1970) will be used to determine the appropriate proportion of desired samples drawn of each stratum. In the proportionate stratified random sampling, all of the stratum will have the similar sampling fraction (Explorable, 2009). Stratified sampling approach was used to select a broadly representative sample. A proportionate stratified random sampling will be chosen because the number of elements from each stratum is in relation to its proportion of the total population. Whereby, a disproportionate sampling decisions are not being considered due to the strata are not too small or too large and there is not so much variability suspected within a particular stratum (Sekaran & Bougie, 2013). The procedure of selecting a stratified sample is according to the steps wise provided by Kumar (2011) as discussed in the Table 3.11.

Accordingly, a total of 81 companies from food products industry, 81 companies from chemicals and chemical products industry, 91 companies from the rubber and plastics products industry and 49 companies from the computer, electronic and optical products industry were included in the sample.

Table 3.11

The Procedure for Selecting a Stratified Sample

Step	Item	Consideration for the current study
1	Identification of all elements or sampling units in the sampling population.	1,378 elements (total population of four industries).
2	Deciding upon the different strata into which the desired stratify population.	The desired strata of four industries; (1) Food products (2) Chemicals and chemical products (3) Rubber and plastic products (4) Computer, electronic and optical products.
3	Placement of each element into the appropriate stratum.	(1) Food products (378 elements) (2) Chemicals and chemical products (378) (3) Rubber and plastic products (403) (4) Computer, electronic and optical products (219).
4	Numbering of every element in each stratum separately.	Numbered using Microsoft Excel worksheets according to stratum.
5	Deciding the total sample size.	Selected sample size as according to Krejcie and Morgan (1970) = 302 sample.
6	Deciding between proportionate and disproportionate stratified sampling.	Proportionate stratified sampling technique.
7	Determining the proportion of each stratum in the study population (p) $= \frac{\text{element of each stratum}}{\text{total population size}}$	Stratum (1), the proportion p is $= \frac{378}{1,378}$ = 0.27 Stratum (2), the proportion p is $= \frac{378}{1,378}$ = 0.27 Stratum (3), the proportion p is $= \frac{403}{1,378}$ = 0.30 Stratum (4), the proportion p is $= \frac{219}{1,378}$ = 0.16
8	Determining the number of elements to be selected from each stratum = (sample size) x (p)	Stratum (1), the elements are; = 302 x 0.27 = 81 elements Stratum (2), the elements are; = 302 x 0.27 = 81 elements Stratum (3), the elements are; = 302 x 0.30 = 91 elements Stratum (4), the elements are; = 302 x 0.16 = 49 elements.
9	Selecting the required number of elements from each stratum with stratified random sampling technique.	Number of elements required are selected using random number in Microsoft Excel; 81, 81, 91 and 49 elements respectively for stratum (1) until (4).

Source: Adopted from Kumar (2011), *p. 211*, and author's own analysis

Table 3.12 provides summary information of sampling frame and stratification process. Once the desired stratum size has been determined, the random selection of element of each stratum will be conducted using an independent table of randomly generated number in Microsoft Excel.

Table 3.12
Summary of the Sampling Frame and Stratification Process

Industry sector	SIC	N	Sampling fraction (%)	Stratum size (n)
Computer, electronic and optical products	26	219	16	49
Chemicals and chemical products	20	378	27	81
Food products	10	378	27	81
Rubber and plastic products	22	403	30	91
Total		**1,378**	**100**	**302**

Source: Data from Malaysian Industries FMM Directory (2014), and author's own analysis

3.8 Data Collection Procedures

Data collection methods are an integral part of research design. The data collection method of this research is solely using; survey questionnaires. In this research, the researcher prefers to use self-evaluation questionnaires to gather primary data. The format for the data collection has been designed by separating the questionnaires into sections that may develop the interest and focus among respondent. Even though the idea of the primary data is to gather opinion but the format adopted is highly structured where the respondent needs to circle or highlight on the most relevant answer. The questionnaires will be short, simple sentences, and facilitate the respondents. There was argument that self-evaluation approach tend to be biased (Rose, Kumar, & Ibrahim, 2008). However, the perceptual subjective measures are considered as reliable alternative since there is absence of any objective measures (Youndt et al., 1996).

The researcher originates the primary data for the specific purpose when addressing issues that occur. It means that when adopting the primary data as method of data collection, the researcher will gathers information by creating primary data forms. In this research, the result from the respondent who answered the questionnaires is therefore known as the researcher's primary data which is to be processed further for research analysis. Moreover, the primary data collected shows the originality of this research.

The questionnaires were constructed as closed-ended questions and data collection were completed self-administered by the researcher. Prior to self-administration of data collection, each respondent were contacted by telephone and e-mail to notify them about the questionnaires, to verify their address and to identify the key personnel responsible in the subject research area. Finally, the researcher will possibly personally administer the survey by herself. This method was applied as it is quicker to administer and convenience for the respondents (Bryman, 2008).

A cover letter was enclosed together that particularly explained the purpose of the questionnaire to motivate and encourage respondents to participate (Appendix 4). The cover letter also mentioning on requesting that the questionnaire to be answered by those in the managerial position and have sufficient knowledge in the preferred area. The researcher had also highlighted on the confidentiality of every response as this is the main obstacle to gain the respondents' trust in getting their perception about the company's current situation. A researcher's certification of student status (Appendix 5) and an approval letter for data collection (Appendix 6) from the Graduate School were enclosed together as to strengthen the respondents' trust about the survey. Finally, several ways for follow-ups such as e-mail, telephone calls and company visits were made to remind the respondents of the questionnaires.

3.9 Techniques of Data Analysis

The current study used manufacturing performance as the dependent variable, which was separated into four dimensions of quality, cost, delivery and flexibility. Manufacturing practices as the independent variable was separated into TQM, JIT, HRM and SCM. Technological capability was the moderator variable. To test the multivariate relationships hypothesized by the research model, the data had undergone series of analyses. As suggested that Statistical Package for Social Science (SPSS) software is one of the most reputable and prevalent package used to analyze data (Cramer, 1998), thus by utilizing the IBM SPSS statistics version 22 to test hypotheses and provide descriptive explanation, the method analyses that were used in this study includes:

a) *Cleaning and screening of data*

b) *Descriptive statistics*

c) *Factor and reliability analysis*

d) *Correlation analysis*

e) *Regression analysis*

3.9.1 Data Cleaning and Screening

Data cleaning and screening is the process of the data where it begins after all the data have been collected and before starting any further statistical testing. After the data were obtained, each question in the questionnaires were coded and keyed-in in the

SPSS. The data was examined through basic descriptive and frequency distribution to identify any improperly coded or out of range data. Any missing responses were detected during the frequency test. Basically, there are three main steps in screening and cleaning the data of which are; 1) inspection for errors, 2) discovery of errors in the data file, and finally 3) rectifying the errors in the data file (Pallant, 2013).

3.9.2 Descriptive Analysis

Prior to carrying out statistical analyses, it is important to ensure no violations were found during the assumptions made for a test. Data were analyzed mainly through descriptive statistics. Descriptive statistics is a term used to summarize a group of data (Meier et al., 2015). The data will be analyzed using descriptive data analysis, which covered the frequency distribution in order to observe the characteristics of respondents, measures of central tendency of mean, and measures of dispersions of standard deviation, skewness and kurtosis (Pallant, 2013). The software was also utilized to summarize and determine data whether there are significant differences between early and late responses.

3.9.3 Factor and Reliability Analysis

Factor and reliability analysis were conducted to measure the validity and reliability of the independent variables (manufacturing practices), dependent variables (manufacturing performances), as well as the moderating variable (technological capability). The basic function of factor analysis is to reduce data by analyzing a bulky numbers of items variables whether there is a tendency for groups of them to be interrelated (Bryman, 2008; Hair, Black, Babin, & Anderson, 2010). It is also a statistical technique used to identify a smaller number of factors underlying a large number of observed variables (Gaur & Gaur, 2009). It is often used with multiple-item measures to see if the items tend to gather to form one or more groups of items. Items that have a high correlation between them and are largely independent of other subsets of variables, are combined into factors. These groups of items are called factors and must then be given a name according to literatures. Principal Components Analysis (PCA) is the common data reduction technique used.

The reliability test is purposively used to test the internal consistencies of the instruments used. It was critical to ensure the reliability of the questionnaires (Hair et al., 2007). In this study, Cronbach's Alpha correlation coefficient will be used to analyze the reliability of instruments and the goodness of data that were collected. Cronbach's coefficient alpha is commonly used to measure the reliability for a set of two or more construct indicators (Cronbach, 1951). The reliability of data is reflecting through the range between 0 and 1. The alpha coefficient value more than 0.70 is classified as acceptable (Nunnally & Bernstein, 1994), and more than 0.80 is good (Sekaran & Bougie, 2009). Nevertheless, it is still considered acceptable with the coefficient value of 0.60 (Sekaran, 2003). Even though a value of 0.70 and higher is often considered as the criterion for internally consistent established factors (Hair et al., 2003), it is stated that values between 0.50 and 0.60 are acceptable in the early stages of research (Nunnally, 1978), and indicate adequate reliability (Fornell & Larcker, 1981). This indicates an acceptable level of internal consistency for the measured constructs. The reliability test were carried out for dependent, independent, and moderator variables.

3.9.4 Correlation Analysis

Correlation analysis was carried out to determine the association between the variables under study. It identified the power and direction of the linear relationship between two variables (Gaur & Gaur, 2009). The analysis results reveal the variables that correlate with the dependent variable as well as the presence of multicollinearity before proceed to multiple regression analysis (Pallant, 2013). The correlation coefficient (*r*) value range from -1.0 to +1.0 with +1.0 represents an absolute positive linear relationship, 0 represents no linear relationship, and -1.0 represents an absolute inverse relationship (Hair et al., 2010). There are three types of correlation coefficients available in the SPSS program namely Pearson's, Kendall's tau-b, and Spearman's (Gaur & Gaur, 2009). Though, Pearson's coefficient was used as it is commonly employed for continuous data as compared to the others two which are mainly used for ranked data.

3.9.5 Regression Analysis

According to Hair et al. (2010), multiple regression analysis is a statistical technique that can be used to analyze the relationship between a single dependent (criterion) variable and incorporate with several independent (predictor) variables (Meier et al., 2015). The aim of multiple regression analysis is to use the independent variables whose values are known to foresee the single dependent value. Furthermore, as being a dependence technique for hypotheses testing, thus, to use a multiple regression analysis the researcher must be able to split the variables into dependent and independent variables. Through conducting multiple regression analysis, it have answered the first research objective by testing the direct relationship hypotheses between manufacturing practices and manufacturing performance.

Furthermore, in the case of current study, the existence of moderating variable demanded further analysis of the data. The hierarchical regression analysis was utilized to test the interaction effect of the moderating variables on the relationship between predictor and criterion variables. As suggested by Gaur, Vasudevan, and Gaur (2011), moderated multiple regression analysis were preferred over moderated structural equation modeling (SEM) due to sample size constraint. Testing for interaction effects in SEM requires creating multiple indicators for the interaction term by multiplying each indicator of an interaction variable with each indicator of the other interaction variable. This, results in a large number of indicators, for the interaction term, which increases the sample size requirement, for conducting SEM. Given the sample size limitations, the researcher found hierarchical regression analysis to be more appropriate in the current empirical setting besides it is able to answer both of the research objectives (Abdallah & Matsui, 2007; Gaur et al., 2011; Shah & Ward, 2003).

3.10 Chapter Summary

This chapter discussed in details the theoretical framework. The discussions on the development of research hypotheses were followed after. The developed theoretical framework has been exposed to follow the highly recognized moderator model developed by Baron and Kenny (1986). Next, the recapitulated of relationship between research questions, objectives and hypotheses statements were exhibited. This chapter has further described the methods that were occupied which included in the research design, starting with an overview of overall research process, population and sampling, variables operationalization, questionnaires development, data collection procedure until the explanation on data analysis techniques. Overall, chapter three has provides the discussions on theoretical framework and the research design employed.

CHAPTER FOUR

DATA ANALYSIS AND FINDINGS

4.1 Introduction

This Chapter Four elaborates on the pertinent analyses and the achieved results of the material research with the purpose to narrate on the findings of laborious analyses of the collected data using the IBM SPSS Statistics Version 22. The analyses which comprise of the response rate will be analyzed together with the relevant respondents' demographic profiles, the testing of non-response bias, the goodness of measures via validity and reliability analysis, the fundamental statistical assumption, the descriptive statistics, the analysis of correlation and the testing of hypotheses that arisen. The chapter is concluded with summarization of the hypotheses testing and the result findings.

4.2 Data Screening

Once the data have been collected, preliminary action is taken to investigate if there are any vital values that are missing. Upon investigation, it revealed that for an individual case about less than 3 percent of the data was missing at random and compared to the complete data, this figure is minimal. It is of the opinion that without considering for missing data or other variable, the collected data still could be processed (Hair et al., 2010). Referring to incidents where some answers were unobtainable, the figure is replaced with a mean substitute. This method is used by generating the most likely representable replacement value on the ground of assumption that the value derived is the mean of all other observations in the sample

(Ho, 2014; Pallant, 2013). In other aspect, observations revealed that straight lining responses were also at minimal.

4.3 Response Rate

The respondents of this study come from the rank of senior executives and managers above who have experience and engage in the manufacturing firms in Malaysia. The data were collected within the duration of approximately four months period. Throughout the research, a self-visit and courtesy calls were made and the respondents were frequently reminded in order to generate a better rate of response (Sekaran, 2003). A total of 1,378 firms made up the population size of this study. They comprised of food, chemicals, plastic and rubber, computer, electronic and optical product manufacturing industry (FMM, 2014). In accordance with the recommended sample size by Krejcie and Morgan (1970), about 302 questionnaires were distributed with 186 sets were returned, of which 175 responses were realized to be useful for analysis. 11 questionnaires were discarded due to straight lining responses and missing values for some cases that amount to more than 50 percent.

Table 4.1
Response Rate

Response	Frequency	Percentage
Total response	186	62%
• Usable response	175	58%
• Non-usable response	11	4%
Total non-response	116	38%
Total distributed questionnaire	**302**	**100%**

As detailed in Table 4.1, the final usable response rate is 58 percent. When comparing to past studies of practices and manufacturing performance which were conducted in the same context, Malaysia, showed that 10.86 percent (Chong et al.,

2011) of response rate with 163 sample of firms has been collected, 21 percent (Thrulogachantar & Zailani, 2011) response rate accounted for 158 firms had successfully contacted for feedback, and 27.20 percent (Ramayah, Sulaiman, Jantan, & Ching, 2004) response rate represented 68 small-, medium- and large-sized manufacturing companies successfully responded to the particular study.

From the usable response rate of 58 percent, 56 responses are from food products industry, 44 responses are from the chemicals and chemical products industry, 38 responses are from computer, electronic and optical products industry, and the remaining 37 responses are from the rubber and plastic products industry. Additionally, while comparing the present response rate with past researches with regards the same industries and same research areas, it exposed that 46.80 percent (Ismail Salaheldin, 2009) response rate represents 139 firms, 44.10 percent (Rahman et al., 2010) response rate represents 187 firms, 38.63 percent (Ye & Wang, 2013) response rates represents 141 firms, and 23.93 percent (Chen, 2015) response rate represents 173 firms had been successfully collected and analyzed. All of these surveyed past studies had been quantitatively analyzed by the researchers.

A 30 percent response rate is acceptable for surveys (Hair et al., 2010; Sekaran, 2003). Pallant (2013) recommended that a sample size should be in between five to ten times of the independent variables for regression type of analysis to be conducted. As the number of variables in this study is eight (8), it recommends a sample size of 80 respondents. Thus, by comparing the current response rate with past studies and complying the recommended suggestions, the available 175 responses (58 percent) qualify the required sample size to further conduct regression analysis.

4.4 Demographic Profile of Respondents

The statistical frequency distribution of key variables in the questionnaires was objectively classified and presented in logical categories to reflect the originality of the study.

Table 4.2
Demographic Profiles of the Respondents

Demographic	Frequency	Percentage
Company ownership		
Malaysia owned	126	72.00%
Foreign owned	49	28.00%
Industry		
Food products	56	32.00%
Chemical and chemicals products	44	25.15%
Rubber and plastic products	38	21.70%
Computer, electronic and optical products	37	21.15%
Number of years of company establishment in Malaysia		
Less than 5 years	17	9.70%
Between 5 to 10 years	30	17.15%
More than 10 years	128	73.15%
Number of full-time employees		
Less than 75 workers	82	46.90%
Between 75 to 200 workers	37	21.10%
More than 200 workers	56	32.00%
Current position in the company		
Managing director or above	16	9.15%
Director	9	5.15%
General manager	11	6.30%
Plant manager	13	7.40%
Senior manager	15	8.60%
Department manager	37	21.10%
Senior Executive	74	42.30%
Job function		
Corporate executive or managing director	19	10.90%
Operation or production	119	68.00%
Planning and inventory	15	8.60%
Purchasing	2	1.10%
Quality control	9	5.10%
Supply chain management	11	6.30%
Number of years of experiences working in the industry		
Less than 5 years	48	27.40%
Between 5 to 10 years	64	36.60%
More than 10 years	63	36.00%

Source: Computed data analysis

The summary of demographic profile of respondents are presented in Table 4.2. The questionnaires were distributed proportionately among four industries, where valid responses received are 56 respondents (32.00 percent) from food products manufacturing industry, 44 respondents (25.15 percent) from chemicals and chemical products, 38 respondents (21.70 percent) from rubber and plastic products, and 37 respondents (21.15 percent) from computer, electronic and optical products manufacturing industry.

From all of the 175 respondents, the majority of the companies are Malaysian-owned (72.00 percent) with 126 firms and 28.00 percent are foreign-owned with 49 firms. In reference to the years of establishment, 128 respondents of more than 10 years of establishment form the largest group which represents 73.15 percent. This is followed by the 5 to 10 years group with 17.15 percent comprised of 30 respondents. 17 companies with less than 5 years establishment represent the remaining balance of 9.70 percent.

In respect of the number of full time employees, 82 respondents (46.90 percent) are from small-sized companies with less than 75 workers. 37 medium-sized companies with between 75 to 100 workers represent 21.10 percent while the remaining 56 respondents (32.00 percent) are large-sized companies with more than 200 workers.

Another important aspect in the research is the position of the person that responded to the inquiry. This survey managed to get 16 respondents from the position of Managing Director and above which represents 9.15 percent. A total of 9 Directors responded and contributed the 5.15 percent. This is followed by 11 respondents from the rank of General Managers which represent 6.30 percent. Subsequently, 13 respondents from the position of Plant Manager make up another 7.40 percent. The rank of Senior Manager with 15 respondents contributes 8.60 percent, followed by 37 Department Manager with 21.10 percent. Lastly, 74 Senior Executives make up the remaining 42.30 percent of the respondents. It concluded that 57.70 percent responses are coming from the managerial personnel and above who are relevant to provide the most adequate answer to the distributed questionnaire. However, the remaining 42.30 percent who came from a senior executive position are also relevant as they are well verse in the industry and their designated area for a quite some time. Thus, the feedback from all the respondents are considered reliable.

In regards of the job function, 19 of the respondents (10.90 percent) are in the line of Corporate Executive or Managing Director. 15 respondents from Plant & Inventory area represent 8.60 percent while 2 respondents (1.10 percent) whose job functioning is in Purchasing. Quality Control job function personnel provides 9 respondents which comprise the 5.10 percent and followed by Supply Chain Management with 11 responses which make up 6.30 percent. Personnel who has job function in the Operation or Production forms the largest percentage which is 68.00 percent with a total of 119 respondents.

The respondents comprised of people with working experience of from less than 5 years to more than 10 years in the related industries. 48 respondents have working experience of less than 5 years which represents 27.40 percent. Another 64 respondents (36.60 percent) are people with 5 to 10 years of working experience. This is followed by 63 respondents or 36.00 percent are from the category of people who have more than 10 years working experience. This shows that most of the respondents are experienced people who have been working many years and well-versed in the industries. Eventually, the details of demographic profiles are provided in Appendix 7.

4.5 Non Response Bias

Non-response bias was analyzed by comparing early and late respondents on the main variables (Armstrong & Overton, 1977), by dividing them into two groups. Those early respondents who responded within two (2) months' time frame will be positioned in the first group. The second group will comprise the late respondents who responded the circulated questionnaire after the first two months expired. In analyzing a non-response bias, the independent sample *t*-tests were implemented to assess whether the responses received from late respondents (e.g., after two-month) differed significantly from early respondents (i.e. within two-month). The early responses were 89 responses as compare to the late responses which were 86. Table 4.3 depicts the results of the independent sample *t*-tests.

Table 4.3
Non Response Bias Analysis on Main Variables for Early and Late Responses

Variables	**Early responses (n=89)**		**Late responses (n=86)**		**Sig. (2-tailed)**
	Mean	**SD**	**Mean**	**SD**	
Information Technology	4.57	0.78	4.63	0.83	0.64
Customer Relationship	5.15	0.73	5.16	0.62	0.96
Information Sharing	4.73	0.84	4.72	0.66	0.92
Strategic Supplier Partnership	4.64	0.80	4.69	0.80	0.71
Human Resource Management	4.87	0.66	5.01	0.65	0.16
Quality Culture	5.22	0.67	5.19	0.67	0.82
Production Layout	5.03	0.76	4.96	0.70	0.53
Setup-Time Reduction	4.70	0.84	4.76	0.72	0.62
Technological Acquiring Capability	4.22	1.17	4.23	1.07	0.96
Technological Upgrading Capability	4.90	0.84	5.01	0.71	0.33
Quality	5.11	0.74	5.31	0.56	0.05
Flexibility	4.68	0.85	4.68	0.73	1.00
Cost	4.40	1.13	4.41	0.96	0.93
Delivery	4.76	0.90	4.82	0.84	0.64

Source: Computed data analysis
Note: SD = standard deviation

Independent sample *t*-tests of all continuous variables were carried out to assess if the means for early and late responses were significantly different between the groups. From Table 4.3, it revealed that all variables were not significantly different between the late and early respondents. Thus, it appears that non-response bias is not significantly problematic. Consequently, it is unnecessary to provide a separate data analysis.

4.6 Goodness of Measures

Based on Sekaran (2003), the goodness of measures is established by measuring the validity and reliability. Generally, a study has to ensure whether or not the tested measures do actually measure what it is to be measured (validity) and uphold consistency of the measurement outcomes (reliability) (Cooper & Schindler, 2003). In this research, before subsequent multivariate analyses were undertaken, the goodness of measures was first analyzed through the factor analysis as well as the test of reliability.

4.6.1 Factor Analysis

For this study, factor analysis was conducted to test the construct validity of the measurement instruments. A factor analysis was conducted to define the underlying structure among the variables in the analysis (Hair et al., 2010). The sample size guideline by Coakes and Steed (2003) and Hair et al., (2010) indicates that a minimum of five subjects per variable is needed for factor analysis, and it is more acceptable for 10:1 ratio of the sample size for performing the analysis (Hair et al., 2010). With fourteen variables, this study managed to obtain 175 samples which are above the acceptable requirement and therefore, definitely the minimum requirement for factor analysis was fulfilled.

Principal Component Factor Analyses (PCA) with varimax rotation were utilized to identify the underlying structure or dimensions in the independent, moderating, and dependent variables in this study. Factor analysis can recognize whether a common factor or more than a single factor is present in the responses to the items. In essence, factor analysis was used to understand the underlying structure in the data matrix, to identify the most parsimonious set of variables, and to establish the goodness of measures for testing the hypotheses (Hair et al., 2010). The objective of PCA is to derive a relatively small number of components that can account for the variability found in a relatively large number of measures. This statistical procedure, which is also called data reduction is normally performed when a study does not want to include all of the original measures in the analyses but it still wants to work with the information contained in the measures. According to DeCoster (1998), the goal of data reduction is to simplify by summarizing the variance associated using a smaller number of factor. PCA is commonly considered the best technique for the pragmatic purposes of data reduction.

The suitability of factor analysis is subjected to the criteria for factor analysis suggested by Hair et al. (2010) as follows; sample size should be more than 100 and should be a ratio of minimum five cases for each of the variables, the Bartlett's test of Sphericity (test of presence of correlation among variables) need to be significant at $p < 0.05$ or less, the Overall Measure of Sampling Adequacy (MSA) must be equivalent to 0.50 or more, and Kaiser-Meyer-Olkin (KMO) of above 0.60. Communalities give information on how much of the variance in each item is explained. Low values of <

0.50 could be deleted as it indicates that the item does not fit well with other items in the component. Removing items with low communalities values tend to increase the total variance explained. In addition, a correlation matrix that is appropriate for factor analysis should have several sizeable correlations greater than 0.3 (Hair, Black, Babin, & Anderson, 2006). The value of significant factor loading most appropriate for interpretation is determined by the sample size where items that are being tested on smaller sample size requires higher factor loading to ascertain practical significance. Hair et al. (2006) recommended that factor loading of 0.40 or greater are considered very significant, considering the sample size of 175 cases. Overall, three factor analyses were performed independently for each scale concerning manufacturing practices, technological capability and manufacturing performance. The clean factors were then interpreted or named by examining the largest values linking the factors to the items in the rotated factor matrix. Reliability tests were subsequently carried out after factor analyses.

4.6.2 Factor Analysis of Independent Variables: Manufacturing Practices

Assessing the validity of the manufacturing scale, Principle Component Analysis was conducted. There were initially 44 items for manufacturing practices scale under four dimensions; 7 items for TQM, 10 items for JIT, 6 items for HRM and 21 items for SCM. PCA with orthogonal varimax rotation was used to determine factors' dimensionality. The result of the analysis revealed that the 30 items formed 8 components equivalent to the original structures. 14 items were excluded due to low value of communalities and cross loading.

As can be seen from Table 4.4, the KMO measure of sampling adequacy value is 0.859, which exceeds the required value of 0.6. This indicates that the items were interrelated. Also, it means that the ratio of the sample size to the number of items is sufficient for factorability. Besides, the Bartlett's test of sphericity is statistically significant, as the $p < 0.001$. This supports the factorability of the correlation matrix with the approximate Chi-square value of 3812.628, which indicates the appropriateness for factor analysis. Moreover, the individual MSA values range from 0.667 to 0.938, indicating that the data matrix was suitable to be factor analysed.

Results of factor analysis with varimax rotation indicated the existence of eight factors with initial eigenvalues greater than one that explained 76.41 percent of total variance. All items under SCM have been divided into 4 factors. The first factor comprised 5 items were related to Information Technology. The factor have loadings ranging from 0.689 to 0.876 accounted for 14.10 percent of variance in the data. Thus the factor name had been renamed following the original author. The purpose of running PCA with varimax rotation is to reduce data by analyzing a bulky numbers of items variables whether there is a tendency for groups of them to be interrelated and minimizing complexity of factors by maximizing variance of loadings on each factor (Hair et al., 2010; Tabachnick & Fidell, 2013). Upfront, all items under manufacturing practices have been analyzed together to see which items are interrelated since there is possibility items under manufacturing practices to be cross-loaded and also having a low loading. All of the factors that have been factor analyzed will be checking which items have fall under the group, which make the factor to be renamed according to literature as original author or as the new factor name that is most closely to reflect the items (Gaur & Gaur, 2009).

Table 4.4

Summary of Factor Analysis for Independent Variable: Manufacturing Practices

Item	Description	Component							
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
IT2	Our ordering system from major customers is IT enabled and automated.	**0.876**							
IT5	We use IT based automated production process.	**0.872**							
IT3	We use IT-based automated ordering to send purchase order to major suppliers.	**0.852**							
IT4	The IT systems throughout the supply chain are adequate.	**0.802**							
IT1	Our IT technology throughout the supply chain is up to date.	**0.689**							
CR2	We frequently evaluate customer satisfaction.		**0.826**						
CR5	We periodically evaluate our relationship with customers.		**0.815**						
CR4	We provide easy access to customer to seek assistance.		**0.796**						
CR3	We frequently evaluate future customer expectations.		**0.735**						
CR1	We frequently interact with customers to set our customer satisfaction standards (such as reliability, responsiveness, etc.).		**0.709**						
IS1	Our trading partners share business knowledge of core business processes with us.			**0.869**					
IS2	Our trading partners keep us fully informed about issues that affect our business.			**0.811**					
IS4	We and our trading partners exchange information that helps establishment of business planning.			**0.805**					
IS3	Our trading partners share proprietary information with us.			**0.797**					
SSP3	We have continuous improvement programs that include our key suppliers.				**0.815**				
SSP2	We actively involve our key suppliers in new product management.				**0.758**				
SSP4	We have helped our key suppliers to improve their product quality.				**0.731**				
SSP1	We include our key suppliers in our planning and goal-setting activities.				**0.728**				

Table 4.4 (*Continued*)

Item	Description	Component 1	2	3	4	5	6	7	8
HRM4	The production workers have received training and development in work-place skills on a regular basis.					**0.734**			
HRM5	The production workers are cross-trained to perform several difference tasks (so they can fill in for other task if necessary).					**0.665**			
HRM6	In our company, goals, objectives and strategies are communicated throughout the workforce.					**0.645**			
HRM3	Our company has developed a reasonable reward and punishment system for production workers who achieve factory goals and who do not achieve factory goals.					**0.638**			
IO2	The management has sufficient knowledge in supply chain effectiveness process.					**0.547**			
TQM2	We have well established methods to measure the quality of our products.						**0.768**		
TQM3	At our company, we proactively pursue continuous improvement rather than reacting to crisis.						**0.726**		
TQM1	All production workers believe that quality is their responsibility.						**0.638**		
JIT2	Production processes are located close together, so that material movement is minimized.							**0.906**	
JIT1	Production facilities are arranged in relation to each other, so that material handling is minimized.							**0.832**	
JIT8	We have low set-up times of equipment in our factory.								**0.791**
JIT9	We are aggressively working on reducing equipment's set-up times.								**0.789**
Initial Eigenvalues		10.945	2.921	2.103	1.797	1.679	1.246	1.193	1.037
% of Variance Explained (after rotation)		14.095	13.455	11.370	10.451	8.255	7.032	6.239	5.512
Total Variance Explained (%)		76.409							
KMO		0.859							
Bartlett's Test of Sphericity:									
Approx. Chi-Square		3812.628							
df		435							
Sig.		0.000							

Source: Computed data analysis

The second factor accounted for 13.45 percent of the total variance with loadings ranged from 0.709 to 0.826. This factor consisted five items which reflected the respondents' perception on the implementation of Customer Relationship. The factor name was also renamed following the original source. The third factor consisted of four items accounted for 11.37 percent of the total variance with loadings ranging from 0.797 to 0.869. These items are related to the information sharing with the trading partners practiced in the respondents' organization, thus the factor name was renamed into the original author's as Information Sharing. The fourth factor consisted of four items related to supplier relationship with loadings ranged from 0.728 to 0.815 and accounted for 10.45 percent from the total of variance explained. The factor was renamed as to original theory as Strategic Supplier Partnership. All of the first four components are following the original work of Chong et al. (2011).

The fifth factor contained of five items related to human resource management practices with loadings ranging from 0.547 to 0.734 which accounted for 8.26 percent of variance explained. This factor was originally consisted of six items, but two items were deleted due to low communalities values and factor loading less than 0.40, and one item from supply chain management practices which is regarding to the sufficient knowledge of management on supply chain effectiveness process was included under the HRM factor. The factor name is thus remained. The sixth factor comprised of three items related to quality practices. The loadings are ranging from 0.638 to 0.768 and accounted for 7.03 percent of the variance explained. Four items were discarded under this factor due to the same reasons of low communalities and cross loadings. The three remaining items formed a renamed factor as Quality Culture practice as suggested by (Narasimhan et al., 2005). The seventh and eighth factors were formed from Just-In-Time production practice (Bayo-Moriones et al., 2008). The seventh factor was specifically related to the production layout while the eighth factor was related to setup-time reduction and their loadings are ranged from 0.832 to 0.906 and from 0.789 to 0.791 respectively. The factors' name were renamed into the Production Layout and Setup-Time Reduction as according to the original source (Bayo-Moriones et al., 2008). The percentage of total variance explained are 6.24 percent and 5.51 percent respectively. Meanwhile, the details are provided in Appendix 8.1.

4.6.3 Factor Analysis of Moderating Variables: Technological Capability

To determine the validity of technological capability scale, again, principle component analysis was performed. Initially, there were ten items of technological capability. The results of factor analysis are shown in Table 4.5. As can be seen in the tabulation, the KMO measure of sampling adequacy for TC scale is 0.811 indicating that the items are interrelated. Bartlett's Test of Sphericity shows a significant value (Approx. Chi-Square = 786.683 $p < 0.001$) indicating the significance of the correlation matrix and appropriateness for factor analysis. Moreover, the individual MSA values range from 0.789 to 0.881, indicating that the data matrix was suitable to be factor analysed.

Results of factor analysis with varimax rotation indicated the existence of two components with initial eigenvalues greater than one that explained 71.17 percent of total variance. There are four items merged together relating to firm's acquiring capability and was named as Technological Acquiring Capability component. This first factor accounted for 38.30 percent of the total variance with loadings ranged from 0.715 to 0.912. The second factor which is related to firm's upgrading capability consisted of four items with loadings ranging from 0.671 to 0.843 which accounted for 32.87 percent of total variance explained.

Table 4.5
Summary of Factor Analysis for Moderating Variable: Technological Capability

Item	Description	Component	
		1	**2**
TC2	We cooperate with others (suppliers/customer) to develop technologies.	**0.912**	
TC3	We tie with the technology suppliers in the market.	**0.909**	
TC1	We intensely cooperate with scientific research institutions to develop technologies.	**0.795**	
TC4	We manufacture with advanced technologies	**0.715**	
TC10	We develop and test our own new product design.		**0.843**
TC8	We strongly upgrade our products according to market demand.		**0.828**
TC9	We improve greatly on production process based on our own ideas.		**0.799**
TC7	We frequently upgrade our production process.		**0.671**
Initial Eigenvalues		4.028	1.665
% of Variance Explained (after rotation)		38.298	32.867
Total Variance Explained (%)		71.166	
KMO		0.811	
Bartlett's Test of Sphericity:			
Approx. Chi-Square		786.683	
df		28	
Sig.		0.000	

Source: Computed data analysis

The second factor was named Technological Upgrading Capability. Both names of these two factors were renamed according to the original source (Chantanaphant et al., 2013). Meanwhile, two items which are having more skilful technical workers and operational workers, and having less operation discontinuity were discarded due to low on communalities values. The details of factor analysis for moderating variable are provided in the Appendix 8.2.

4.6.4 Factor Analysis of Dependent Variables: Manufacturing Performance

Determining the validity of manufacturing performance scale, again, PCA was carried out. Initially, there were 14 items and four dimensions; three items for quality performance, four items for flexibility performance, four items for cost performance and three items for delivery performance. The results of factor analysis are presented in Table 4.6, which revealed that each dimension are remained with the same factor name with only a slightly changes in the measuring items. Results of factor analysis with varimax rotation indicated the existence of four factors with initial eigenvalues greater than one that explained 77.50 percent of total variance.

Table 4.6

Summary of Factor Analysis for Dependent Variable: Manufacturing Performance

Item	Description	Component			
		1	2	3	4
PQ3	Improve conformance to product specification.	**0.894**			
PQ1	Improve high performance product features.	**0.880**			
PQ2	Offer consistence and reliable product quality.	**0.872**			
PF2	Adjust capacity quickly.		**0.838**		
PF3	Adjust product mix quickly.		**0.750**		
PF4	Improve rapid equipment changeover.		**0.745**		
PF1	Make rapid volume changes.		**0.666**		
PC1	Reduce inventory.			**0.841**	
PC3	Reduce production costs.			**0.834**	
PD3	Reduce production lead time			**0.767**	
PD1	Improve fast delivery.				**0.878**
PD2	Improve delivery on time.				**0.796**
Initial Eigenvalues		5.328	1.626	1.302	1.044
% of Variance Explained (after rotation)		21.657	21.497	19.253	15.091
Total Variance Explained (%)		77.499			
KMO		0.809			
Bartlett's Test of Sphericity:					
Approx. Chi-Square		1267.106			
df		66			
Sig.		0.000			

Source: Computed data analysis

The results also shows the KMO measure of sampling adequacy for manufacturing performance scale is 0.809 indicating that the items were interrelated. Bartlett's Test of Sphericity shows a significant value (Approx. Chi-Square = 1267.106, $p < 0.001$) indicating the significance of the correlation matrix and appropriateness for factor analysis. Moreover, the individual MSA values range from 0.771 to 0.903, indicating that the data matrix was suitable to be factor analysed.

The first factor consisted of three items which were related to the Quality performance. This factor with loadings ranging from 0.872 to 0.894 accounted for 21.66 percent of the variance in the data. This factor was mainly concerned with respondents' perceptions on their companies' performance regarding of quality; therefore, the original name of Quality (Chi, 2010) was retained. The second factor which consisted of items related to the flexibility accounted for 21.50 percent of the total variance with factor loadings ranged from 0.666 to 0.838. The factor contained four items which reflected the respondents' perceptions on their flexibility performance; therefore, the original name of Flexibility (Chi, 2010) was upheld.

The third factor was represented by three items which comprised the items relating to cost. It was accounted for 19.25 percent of the total variance in the data with factor loadings ranged from 0.767 to 0.841. This factor was regarding the respondents' perceptions on the cost performance; thus, the original name of Cost (Boyer & Pagell, 2000) was maintained. Two items from the Cost factor were deleted due to low communalities values. The fourth factor accounted for 15.09 percent of the total variance in the data with loadings ranged from 0.796 to 0.878. The factor which consisted of two items was related to respondents' perceptions on the delivery performance; thus the original name of Delivery (Chi, 2010) was kept. One item from Delivery factor which considering the reduction of production lead time has been merged under the Cost variable. Eventually, the details of factor analysis for dependent variable are provided in the Appendix 8.3.

4.6.5 Reliability Analysis

According to Hair et al. (2010), a reliability analysis determines the extent the variables are reliable to measure the constructs. It indicates the stability and consistency of the instrument in measuring a concept and helps to assess the goodness of a measure (Sekaran, 2000). In determining the internal consistency of the measurement items, Cronbach's Alpha is suggested and has been commonly used for reliability coefficient (Cronbach, 1951). Accordingly, in this study, a reliability analysis has been conducted on the scale to ascertain the applicability of the instrument by computing the Cronbach's alpha coefficient values for each construct.

Nunnally (1978) recommends 0.70 as the minimum acceptable Cronbach's alpha value, while Sekaran (2000) suggested that the minimum acceptable reliability be set at 0.60. By studying the recommendations, it is shown that this research has developed reliable constructs since the reliability analysis produced Cronbach's alpha values in the range of 0.678 to 0.924 as depicted in Table 4.7. Hence, based on the reliability analyses, the measurements used in the study were reliable and three items were deleted during this analysis which are; the use of IT technology throughout the supply chain is up to date, the manufacture with advanced technologies, and the reduction of production lead time. The deletion of these items hence improve the reliability values of the information technology, technological acquiring capability and cost performance scale, thus, suggested its readiness for further analyses. Further, Appendix 9 exhibits the detailed results of reliability analyses.

Table 4.7
Reliability Analysis

Variable	No. of Items	No. of Item Deleted	Cronbach's Alpha
Manufacturing Practices			
Information Technology	4	1	0.924
Customer Relationship	5	0	0.923
Information Sharing	4	0	0.905
Strategic Supplier Partnership	4	0	0.896
Human Resource Management	5	0	0.780
Quality Culture	3	0	0.766
Production Layout	2	0	0.839
Setup-Time Reduction	2	0	0.678

Technological Capability			
Technological Acquiring Capability	3	1	0.889
Technological Upgrading Capability	4	0	0.827
Manufacturing Performance			
Quality	3	0	0.910
Flexibility	4	0	0.821
Cost	2	1	0.903
Delivery	2	0	0.820

Source: Computed data analysis

4.6.6 Common Method Variance (CMV) Test

As a precaution, the study has adopted measures, such as hiding the information of the participants and organizing the wording of the items, to prevent the occurrence of common method variance. Furthermore, the study adopts Harman's single factor techniques using principal components factor analysis on the variables used in this study to conduct posterior examination of common method variance (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). In this study, the observation of percentage of variance explained by measurement items the first component in factor analysis is less than 50 percent (Appendix 10). Therefore, there is no issues of common method variance.

4.7 Revised Framework and Restatement of Hypotheses

The results of the factor analysis has led to slight changes of current theoretical framework with regard to manufacturing practices and technological capability. The analysis discovered the presence of eight factors instead of four factors to measure the concept of manufacturing practices, whereas for technological capability, there are two factors to measure the concept. The revised framework is as displayed in Figure 4.1. After running the factor analyses, a summated scale was used to categorize the emerged factors for the revised framework (Hair et al., 2010). Manufacturing practices were categorized into eight dimensions of information technology, customer relationship, information sharing, strategic supplier partnership, human resource management, quality culture, production layout, and setup-time reduction. The construct of information technology, customer relationship, information sharing and strategic supplier partnership were originally measured under the construct of supply chain management.

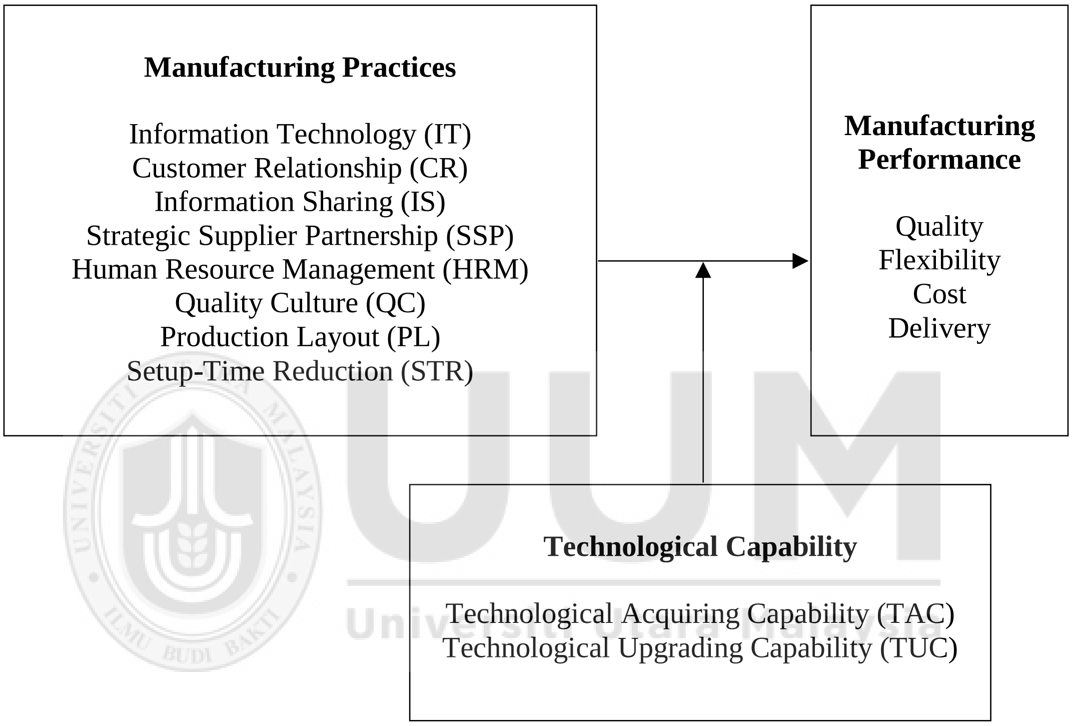


Figure 4.1
The revised research framework of the study

The factor analysis revealed the emergence of four factors which in line with the study by Chong et al. (2011) who classified supply chain management practices into subgroups representing dimensions relating to be latent construct. Human resource management construct was maintained in line with Dal Pont et al. (2008) and Ahmad and Schroeder (2003). As the items of total quality management were reduced quite significantly during the factor analysis, the remaining construct was then renamed into quality culture (Narasimhan et al., 2005). On the same analysis, items under the just-in-time production practices were reduced significantly and left with the emergence of two factors namely production layout and setup-time reduction (Bayo-Moriones et al., 2008). Thus, the independent variables of the current study consist of eight variables.

While, the moderating variables (TC) were split into two dimensions (TAC and TUC). Previously, the surveyed instruments under TC were also consist of operating capability elements. However, these elements were all discarded during the factor analysis and reliability analysis. Even so, the remaining elements were still in line with Chantanaphant et al. (2013) and still highly representing the technological capability. Thus in the final model, the moderating variables that will be looking into for the study are two variables of technological acquiring capability and technological upgrading capability.

For the dependent variables, no changes have been made as the results from factor analysis showed the same emergence of components which are in line with the original theory. They are quality performance (Chi, 2010), flexibility performance (Chi, 2010), cost performance (Boyer & Pagell, 2000), and delivery performance (Chi, 2010).

The results from the analysis also indicate that the hypotheses need to be revised to throughout the study. Therefore, the existing hypotheses on manufacturing practices and technological capability are revised to reflect the results of factor analysis. The restatement of hypotheses are shown in Table 4.8.

Table 4.8
Summary of Restatement of Hypotheses

Hypo-theses	Statements
H_A 1:	**Manufacturing practices dimensions significantly affect quality performance.**
a	Information technology significantly affect quality performance.
b	Customer relationship significantly affect quality performance.
c	Information sharing significantly affect quality performance.
d	Strategic supplier partnership significantly affect quality performance.
e	Human resource management significantly affect quality performance.
f	Quality culture significantly affect quality performance.
g	Production layout significantly affect quality performance.
h	Setup-time reduction significantly affect quality performance.
H_A 2:	**Manufacturing practices dimensions significantly affect flexibility performance.**
a	Information technology significantly affect flexibility performance.
b	Customer relationship significantly affect flexibility performance.
c	Information sharing significantly affect flexibility performance.
d	Strategic supplier partnership significantly affect flexibility performance.
e	Human resource management significantly affect flexibility performance.
f	Quality culture significantly affect flexibility performance.
g	Production layout significantly affect flexibility performance.
h	Setup-time reduction significantly affect flexibility performance.
H_A 3:	**Manufacturing practices dimensions significantly affect cost performance.**
a	Information technology significantly affect cost performance.
b	Customer relationship significantly affect cost performance.
c	Information sharing significantly affect cost performance.
d	Strategic supplier partnership significantly affect cost performance.
e	Human resource management significantly affect cost performance.
f	Quality culture significantly affect cost performance.
g	Production layout significantly affect cost performance.
h	Setup-time reduction significantly affect cost performance.
H_A 4:	**Manufacturing practices dimensions significantly affect delivery performance.**
a	Information technology significantly affect delivery performance.
b	Customer relationship significantly affect delivery performance.
c	Information sharing significantly affect delivery performance.
d	Strategic supplier partnership significantly affect delivery performance.
e	Human resource management significantly affect delivery performance.
f	Quality culture significantly affect delivery performance.
g	Production layout significantly affect delivery performance.
h	Setup-time reduction significantly affect delivery performance.

Table 4.8 (*Continued*)

Hypo-theses	Statements
H_A 5:	**Technological acquiring capability moderates the relationship between manufacturing practices dimensions and quality performance.**
a	Technological acquiring capability moderates the relationship between information technology and quality performance.
b	Technological acquiring capability moderates the relationship between customer relationship and quality performance.
c	Technological acquiring capability moderates the relationship between information sharing and quality performance.
d	Technological acquiring capability moderates the relationship between strategic supplier partnership and quality performance.
e	Technological acquiring capability moderates the relationship between human resource management and quality performance.
f	Technological acquiring capability moderates the relationship between quality culture and quality performance.
g	Technological acquiring capability moderates the relationship between production layout and quality performance.
h	Technological acquiring capability moderates the relationship between setup-time reduction and quality performance.
H_A 6:	**Technological upgrading capability moderates the relationship between manufacturing practices dimensions and quality performance.**
a	Technological upgrading capability moderates the relationship between information technology and quality performance.
b	Technological upgrading capability moderates the relationship between customer relationship and quality performance.
c	Technological upgrading capability moderates the relationship between information sharing and quality performance.
d	Technological upgrading capability moderates the relationship between strategic supplier partnership and quality performance.
e	Technological upgrading capability moderates the relationship between human resource management and quality performance.
f	Technological upgrading capability moderates the relationship between quality culture and quality performance.
g	Technological upgrading capability moderates the relationship between production layout and quality performance.
h	Technological upgrading capability moderates the relationship between setup-time reduction and quality performance.
H_A 7:	**Technological acquiring capability moderates the relationship between manufacturing practices dimensions and flexibility performance.**
a	Technological acquiring capability moderates the relationship between information technology and flexibility performance.
b	Technological acquiring capability moderates the relationship between customer relationship and flexibility performance.
c	Technological acquiring capability moderates the relationship between information sharing and flexibility performance.
d	Technological acquiring capability moderates the relationship between strategic supplier partnership and flexibility performance.
e	Technological acquiring capability moderates the relationship between human resource management and flexibility performance.
f	Technological acquiring capability moderates the relationship between quality culture and flexibility performance.
g	Technological acquiring capability moderates the relationship between production layout and flexibility performance.
h	Technological acquiring capability moderates the relationship between setup-time reduction and flexibility performance.

Table 4.8 (*Continued*)

Hypo-theses	Statements
H_A 8:	**Technological upgrading capability moderates the relationship between manufacturing practices dimensions and flexibility performance.**
a	Technological upgrading capability moderates the relationship between information technology and flexibility performance.
b	Technological upgrading capability moderates the relationship between customer relationship and flexibility performance.
c	Technological upgrading capability moderates the relationship between information sharing and flexibility performance.
d	Technological upgrading capability moderates the relationship between strategic supplier partnership and flexibility performance.
e	Technological upgrading capability moderates the relationship between human resource management and flexibility performance.
f	Technological upgrading capability moderates the relationship between quality culture and flexibility performance.
g	Technological upgrading capability moderates the relationship between production layout and flexibility performance.
h	Technological upgrading capability moderates the relationship between setup-time reduction and flexibility performance.
H_A 9:	**Technological acquiring capability moderates the relationship between manufacturing practices dimensions and cost performance.**
a	Technological acquiring capability moderates the relationship between information technology and cost performance.
b	Technological acquiring capability moderates the relationship between customer relationship and cost performance.
c	Technological acquiring capability moderates the relationship between information sharing and cost performance.
d	Technological acquiring capability moderates the relationship between strategic supplier partnership and cost performance.
e	Technological acquiring capability moderates the relationship between human resource management and cost performance.
f	Technological acquiring capability moderates the relationship between quality culture and cost performance.
g	Technological acquiring capability moderates the relationship between production layout and cost performance.
h	Technological acquiring capability moderates the relationship between setup-time reduction and cost performance.
H_A 10:	**Technological upgrading capability moderates the relationship between manufacturing practices dimensions and cost performance.**
a	Technological upgrading capability moderates the relationship between information technology and cost performance.
b	Technological upgrading capability moderates the relationship between customer relationship and cost performance.
c	Technological upgrading capability moderates the relationship between information sharing and cost performance.
d	Technological upgrading capability moderates the relationship between strategic supplier partnership and cost performance.
e	Technological upgrading capability moderates the relationship between human resource management and cost performance.
f	Technological upgrading capability moderates the relationship between quality culture and cost performance.
g	Technological upgrading capability moderates the relationship between production layout and cost performance.
h	Technological upgrading capability moderates the relationship between setup-time reduction and cost performance.

Table 4.8 (*Continued*)

Hypo-theses	Statements
H_A 11:	**Technological acquiring capability moderates the relationship between manufacturing practices dimensions and delivery performance.**
a	Technological acquiring capability moderates the relationship between information technology and delivery performance.
b	Technological acquiring capability moderates the relationship between customer relationship and delivery performance.
c	Technological acquiring capability moderates the relationship between information sharing and delivery performance.
d	Technological acquiring capability moderates the relationship between strategic supplier partnership and delivery performance.
e	Technological acquiring capability moderates the relationship between human resource management and delivery performance.
f	Technological acquiring capability moderates the relationship between quality culture and delivery performance.
g	Technological acquiring capability moderates the relationship between production layout and delivery performance.
h	Technological acquiring capability moderates the relationship between setup-time reduction and delivery performance.
H_A 12:	**Technological upgrading capability moderates the relationship between manufacturing practices dimensions and delivery performance.**
a	Technological upgrading capability moderates the relationship between information technology and delivery performance.
b	Technological upgrading capability moderates the relationship between customer relationship and delivery performance.
c	Technological upgrading capability moderates the relationship between information sharing and delivery performance.
d	Technological upgrading capability moderates the relationship between strategic supplier partnership and delivery performance.
e	Technological upgrading capability moderates the relationship between human resource management and delivery performance.
f	Technological upgrading capability moderates the relationship between quality culture and delivery performance.
g	Technological upgrading capability moderates the relationship between production layout and delivery performance.
h	Technological upgrading capability moderates the relationship between setup-time reduction and delivery performance.

4.8 Descriptive Statistics

The descriptive statistics presented in Table 4.9 shows the minimum and maximum scores, mean values and standard deviation of main variables in the questionnaires using the six-point Likert scale criteria ranging from 1 (strongly disagree) to 6 (strongly agree).

Table 4.9
Descriptive Statistics for All Variables

Variables	Minimum	Maximum	Mean	Std. Deviation (SD)
Manufacturing Practices				
Information Technology	2.000	6.000	4.587	0.804
Customer Relationship	2.000	6.000	5.147	0.677
Information Sharing	2.000	6.000	4.711	0.752
Strategic Supplier Partnership	2.000	6.000	4.650	0.790
Human Resource Management	2.800	6.000	4.934	0.661
Quality Culture	2.000	6.000	5.194	0.665
Production Layout	2.000	6.000	4.988	0.731
Setup-Time Reduction	2.000	6.000	4.718	0.786
Technological Capability				
Technological Acquiring Capability	1.000	6.000	4.250	1.100
Technological Upgrading Capability	1.750	6.000	4.948	0.782
Manufacturing Performance				
Quality	3.000	6.000	5.202	0.662
Flexibility	2.000	6.000	4.674	0.779
Cost	1.000	6.000	4.454	0.986
Delivery	2.500	6.000	4.782	0.860

Source: Computed data analysis
Note: SD < 1.0 = very small, SD > 3.0 = very big (Badruddin, 2010).

Overall, the mean of manufacturing practices dimensions were between the range of 4.587 and 5.194. The highest mean of the manufacturing practices dimensions for the companies that participated in this study is Quality Culture, and the lowest is Information Technology. The mean for quality culture was 5.194 with a standard deviation of 0.665. Customer relationship scored the second highest mean of 5.147 with standard deviation of 0.677 followed by production layout (mean = 4.988, SD = 0.731), human resource management (mean = 4.934, SD = 0.661), information sharing (mean = 4.711, SD = 0.752), setup-time reduction (mean = 4.718, SD = 0.786), strategic supplier partnership (mean = 4.650, SD = 0.790), and finally information technology (mean = 4.587, SD = 0.804). The mean score for technological upgrading capability was 4.948 with a standard deviation of 0.782 while the technological acquiring capability scored a mean value of 4.250 with a standard deviation of 1.100. Similarly, the dependent variables is also assessed using a six-point Likert scale. The manufacturing performance is based on the perceived performance of the company for the last three years. The highest mean score among manufacturing performance dimensions is the quality performance with the score of 5.202 (SD = 0.662), followed by delivery performance (mean = 4.782, SD = 0.860), flexibility performance (mean = 4.674, SD = 0.779) and the least the cost performance (mean = 4.454, SD = 0.986).

With the purpose to classify the perception level of these variables, a computation was made on the mean using the middle point to differentiate between low, moderate, and high level (Healey, 2005). Thus, the derived means are classified into three levels i.e.: low (mean =1.00 to 2.66), moderate (mean = 2.67 to 4.33) and high (mean = 4.34 to 6.00). Referring to the outcomes of the calculation, the majority of the variables' mean scores were in the region of 4.454 to 5.194. In general, it can be summarized that each variable either independent, moderator or dependent have a high level of mean score except for technological acquiring capability which had moderate level of mean score (mean = 4.250).

4.9 Correlation Analysis

The correlation analysis was carried out before hypothesis testing to evaluate the degree of connection. Pearson's product-moment correlation test was conducted to examine the linearity association of two metric variables (Hair et al., 2006). Correlation analysis was conducted during this study to explore the strength and direction of the linear relationship between two variables.

Specifically, this analysis determined 1) the relationship between manufacturing practices dimensions and manufacturing performance dimensions, 2) the relationship between technological capability and manufacturing performance dimensions, and 3) the inter-correlation between variables. In defining the intensity to the affiliation, Pallant (2001) noted that a correlation of 0 denotes no relationship, a correlation of 1.0 indicates a perfect positive correlation and a value of -1.0 indicates a perfect negative correlation. The result of Pearson correlation is presented in Table 4.10. In explaining the values between 0 and 1, Davis (1971) had recommended guidelines for interpretation as follows;

If *r* is 1.0, the magnitude is perfect
If *r* is 0.85 – 0.99, the magnitude is very high
If *r* is 0.70 – 0.84, the magnitude is high
If *r* is 0.50 – 0.69, the magnitude is substantial
If *r* is 0.30 – 0.49, the magnitude is moderate
If *r* is 0.10 – 0.29, the magnitude is low, and
If *r* is 0.01 – 0.09, the magnitude is negligible

Before proceeding with multiple regression analysis, a correlation was performed to determine the direction and strength of the relationship between the variables (Appendix 11). The procedure was subjected to two-tailed test of statistical significance at two different levels: significant ($p < 0.01$) and significant ($p < 0.05$).

Overall, the results showed that all the variables between the manufacturing practices dimensions and MP dimensions were significant except for the relationship between Production Layout and cost performance (r = 0.141). While the majority of the relationships were significant at $p < 0.01$, only a few were significant at $p < 0.05$ which are the relationships between; Production Layout and Flexibility performance (r = 0.192), Production Layout and Delivery performance (r = 0.170), Information Sharing and Delivery performance (r = 0.160), and between Information Technology and Flexibility performance (r = 0.155). The strongest positive correlation was the relationship between Customer Relationship and Quality performance (r = 0.663, $p < 0.01$) with a high level of customer relationship associated to a high level

Table 4.10
Pearson's Correlation between the Constructs

	IT	CR	IS	SSP	HRM	QC	PL	STR	TAC	TUC	PQ	PF	PC	PD
IT	1													
CR	.447**	1												
IS	.260**	.484**	1											
SSP	.437**	.551**	.531**	1										
HRM	.451**	.449**	.164*	.457**	1									
QC	.387**	.436**	.312**	.447**	.482**	1								
PL	.252**	.318**	.276**	.279**	.300**	.360**	1							
STR	.224**	.369**	.251**	.304**	.387**	.383**	.338**	1						
TAC	.300**	.407**	.322**	.321**	.339**	.279**	0.061	.252**	1					
TUC	.405**	.518**	.347**	.488**	.526**	.505**	.333**	.486**	.401**	1				
PQ	.369**	.663**	.355**	.446**	.495**	.452**	.274**	.329**	.334**	.544**	1			
PF	.155*	.399**	.310**	.299**	.386**	.321**	.192*	.364**	.499**	.550**	.409**	1		
PC	.304**	.366**	.242**	.278**	.373**	.314**	0.141	.304**	.464**	.465**	.427**	.577**	1	
PD	.291**	.357**	.160*	.290**	.471**	.410**	.170*	.315**	.317**	.405**	.389**	.413**	.479**	1

Source: Computed data analysis

Note: **. Correlation is significant at the 0.01 level (2-tailed), *. Correlation is significant at the 0.05 level (2-tailed).

IT = Information Technology, CR = Customer Relationship, IS = Information Sharing, SSP = Strategic Supplier Partnership, HRM = Human Resource Management, QC = Quality Culture, PL = Production Layout, STR = Setup-Time Reduction, TAC = Technological Acquiring Capability, TUC = Technological Upgrading Capability, PQ = Quality, PF = Flexibility, PC = Cost, PD = Delivery of manufacturing quality performance of the organization. Followed by the next strongest relationship between Human Resource Management and Quality performance (r = 0.495, p < 0.01), Human Resource Management and Delivery performance (r = 0.471, p < 0.01), Quality Culture and Quality performance (r = 0.452, p < 0.01), Strategic Supplier Partnership and Quality performance (r = 0.446, p < 0.01), and between Quality Culture and Delivery performance (r = 0.410, p < 0.01).

Table 4.10 depicts the results of the inter-correlation between variables. The correlation analysis of TAC and TUC with MP were subjected to a two-tailed test of statistical significance at two different levels; significant (p < 0.01) and significant (p < 0.05). Overall, the results indicate that all the variables of TC dimensions and MP dimensions were significant at p < 0.01. For TAC, the strongest positive correlation was the relationship between TAC and Flexibility performance (r = 0.499, p < 0.01) with a high level of TAC associated with a high level of flexibility performance. The next strongest positive correlation was between TAC and Cost performance (r = 0.464, p < 0.01), subsequently between TAC and Quality performance (r = 0.334, p < 0.01), and followed by TAC and Delivery performance (r = 0.317, p < 0.01). While for TUC, the strongest positive correlation was between TUC and Flexibility performance (r = 0.550, p < 0.01) with a high level of TUC associated with a high level of flexibility performance. The next strongest positive correlation was between TUC and Quality performance (r = 0.544, p < 0.01). Followed by TUC and Cost performance (r = 0.465, p < 0.01) and finally, between TUC and Delivery performance (r = 0.405, p < 0.01).

According to Zikmund et al. (2010), even though the results of the correlation analysis are reliable and support majority of the hypotheses, the correlation analysis is unable to implicate cause and effect evidence. Hence, multivariate statistical analysis is suggested for testing the hypotheses in order to examine the effect of various interactions and combination of variables (Hair et al., 2007; Zikmund et al., 2010).

4.10 Testing Statistical Assumptions

This study employs the regression analysis method to analyse the data and test the hypotheses. It is a multivariate analysis by complying with the command of the normal assumptions of Ordinary Least Square (OLS). Thus, before regression analyses take place, the elements of normality, linearity, multicollinearity, homoscedasticity, and independence of observation are included in assumptions (Hair et al., 2010; Pallant, 2001). The minimum sample size for independent variables ratio is 5:1 (Hair et al., 2006).

4.10.1 Normality

Normality is the first and foremost assumption. In multivariate analysis, normality is the outline of the dispersal of data for a metric variable and its relation to the normal distribution (Hair et al., 2006). A statistical test could become invalid if the collected data deviates extensively from normal distribution shape. Normality was observed by skewness level (distribution symmetry) and kurtosis level (the clustering of scores toward the centre of a distribution) for all of measured variables.

Table 4.11 depicts the normality test results. The value of the skewness and kurtosis are in the region of -1.131 to -0.249 and from -0.504 to 2.523 respectively. The summary shows that the skewness and kurtosis values for research variables are in between ±2.00 (Field, 2000; Gravetter & Wallnau, 2014; Trochim & Donnelly, 2006) and ±3.00 (Byrne, 2010; Tabachnick & Fidell, 2013) respectively. Additionally, having run the test, the results display the histogram and P-P Plot between the independent variables and dependent variables dimensions. The histogram pictorially illustrates that the normality assumption is achieved since the bars make a normal curve. On top of that, the P-P Plot graph shows that all the points lie along a 45^0 diagonal line from bottom left to top right. The figures of histogram and P-P Plot can be seen in the Appendix 12.1 and Appendix 12.2 respectively. It clarifies that there is no violation of normality assumption and instead it complements the statistical assumptions. As such, the normality assumptions are established and founded which signifies the variables are ready for further analysis.

Table 4.11
Normality Analysis

Variable	Skewness	Kurtosis
Manufacturing Practices		
Information Technology	-0.400	0.279
Customer Relationship	-0.954	2.181
Information Sharing	-0.249	0.120
Strategic Supplier Partnership	-0.266	-0.038
Human Resource Management	-0.419	0.211
Quality Culture	-1.131	2.523
Production Layout	-0.606	1.057
Setup-Time Reduction	-0.375	0.259
Technological Capability		
Technological Acquiring Capability	-0.526	-0.304
Technological Upgrading Capability	-0.839	1.470
Manufacturing Performance		
Quality	-0.530	0.135
Flexibility	-0.486	0.435
Cost	-0.467	-0.027
Delivery	-0.381	-0.504

Source: Computed data analysis
Note: Standard Errors for Skewness and Kurtosis are 0.185 and 0.368 respectively

4.10.2 Linearity

Linearity refers to the degree to which change in dependent variable is associated with the independent variables. Linearity is examined by using multiple regression analysis. This assumption was assessed through the investigation of the scatter plot of residuals against predicted values and the normal plot of regression standardized residuals for the dependent variable. As a result, the standardized residual plots did not exhibit any nonlinear pattern to the residuals, thus ensuring that there was no violation of linearity. Hence the assumption of linearity was met. The evidence of linearity is provided in the Appendix 12.3.

4.10.3 Multicollinearity

For this study, two (2) types of multicollinearity tests were conducted by employing Pearson correlations and Tolerance Value and Variance Inflation Factors (VIF). Multicollinearity problem exists when the independent variables are too highly correlated, for instance Pearson's *r* between each pair of variables does not exceed 0.85 (Hair et al., 2010). The results in Table 4.10 indicate that none of the squared correlations was close to 0.85 to suggest a problem with multicollinearity among the research variables. Therefore, there is no evidence of significant multicollinearity among the research variables. The strength of correlation was interpreted based on the explanation provided by Davis (1971) (as provided earlier in the correlation analysis sub-chapter).

Table 4.12
Tolerance and VIF Values

Independent Variable	**Collinearity Statistics**	
	Tolerance	**VIF**
Information Technology	0.685	1.459
Customer Relationship	0.543	1.843
Information Sharing	0.623	1.604
Strategic Supplier Partnership	0.517	1.936
Human Resource Management	0.582	1.718
Quality Culture	0.630	1.588
Production Layout	0.789	1.267
Setup-Time Reduction	0.743	1.345

Source: Computed data analysis

Another approach is to look at the variance inflated factor (VIF) and tolerance value. It is generally believed and suggested that the tolerance value of each independent variable of less than 0.40 and the VIF value of greater than 2.50 are enough to indicate serious multicollinearity (Nawanir et al., 2013). The results of collinearity statistics from this study showed there was none that violated the recommended values of tolerance and VIF as presented in Table 4.12, thus prove multicollinearity is not a concern in the present study.

The results of the regression analyses revealed that there was no multicollinearity problem in the regression models used in this study except for those involve in testing the moderating effects. However, Disatnik and Sivan (2014) did argued on the multicollinearity illusion in moderated regression analysis, where they clarified that it is often in moderated regression the product term is often highly correlated with the independent variables, but they firmly highlighted that this multicollinearity does not create a multicollinearity problem. Thus, the results of hierarchical regression analyses is satisfied as can be seen in Appendix 13.

4.10.4 Homoscedasticity

Homoscedasticity is an assumption where such dependent variable(s) show identical level of variance throughout the range of predictor variable(s). Homoscedasticity is required because the variance of the dependent variable being explained in the dependence relationship should not be concentrated in only a limited range of the independent values (Hair et al., 2006). Homoscedasticity was investigated by using scatter plots and it is assumed when no available pattern in the distribution of data, and the residuals are dispersed arbitrarily all over the straight line through 0 (Norusis, 1999). The scatter plots indicate that there is no clear relationship between the regression standardized predicted values and the regression standardized residuals and it revealed an undistinguishable pattern, therefore demonstrating the presence of homoscedasticity (Appendix 12.4).

4.10.5 Independence of Observation

Independence of observation requires that the dependent measures for each respondents be totally uncorrelated with the response from other respondents in the sample (Hair et al., 2010). In other words, the errors in estimation are statistically independent whereby error in estimation for observation on respondent A could not be used to estimate the error in estimation for respondent B. Durbin-Watson can be used to test the independence of error terms (Norusis, 1999). The general rule of thumb is that if the Durbin-Watson value is between 1.50 and 2.50, the assumption of independence on the error terms is not violated (Norusis, 1999). The Durbin-Watson values in this study were reported to be in the range of 1.794 to 2.216 met the general rule of thumb, and ensures that the assumption of independence of error terms is not violated. The regression analyses revealed that there was no serious violation of the assumption of independent observations.

In a nutshell, assumptions of multiple regression analysis were tested by examining normal probability plots of residuals and scatter diagrams of residuals versus predicted value. No violations of normality, linearity, and homoscedasticity were spotted. However, according to casewise diagnostics, three cases were omitted for further analysis. Casewise diagnostics can be requested by checking the Casewise diagnostics box within Statistics in the SPSS dialogue box which proceeds to identify all cases that might be considered as outliers. Casewise diagnostics were requested and the threshold for defining outliers was set at 2.5 standard deviations in order to highlight cases that were in the 1 percent tail of the normal distribution. The three cases that were considered as outliers were only excluded from the analysis to avoid influence on the particular model that is being observed but the cases are remained in the data (Tarling, 2009).

4.11 Hypotheses Testing

The first part of hypotheses testing is to examine the influence of the independent variables (Information Technology – IT, Customer Relationship – CR, Information Sharing – IS, Strategic Supplier Partnership – SSP, Human Resource Management – HRM, Quality Culture – QC, Production Layout – PL, and Setup-Time Reduction – STR) on the dependent variables (Quality performance, Flexibility performance, Cost performance and Delivery performance). In order to test the direct hypotheses and answer the first research question, hypotheses H_1-a through H_4-h were tested using multiple regression analysis.

Later, this section investigated the moderating effects of technological capability on the relationships between manufacturing practices dimensions and manufacturing performance (MP) dimensions. In order to test the moderating hypotheses, hierarchical regression analysis was conducted. The outcomes of eight sets of hierarchical regression gave the answers to the second research question and hypotheses (H_5-a through H_{12}-h) of the study. Hierarchical regression has been suggested by many authors as the technique for analysing the moderating effect (Baron & Kenny, 1986; Frazier et al., 2004). Russ and McNeilly (1995) argued that a less stringent significance level of $p < 0.25$ should be used to resolve the lack of power in detecting the effect of the moderator. In this study, three levels of significance; 1 percent, 5 percent and 10 percent were used to detect the moderating effect of technological acquiring capability (TAC) and technological upgrading capability (TUC) on the relationship between manufacturing practices dimensions and manufacturing performance dimensions.

To test the moderator effect, a three (3) steps hierarchical was conducted to determine what proportion to the variance in a particular variable is explained by other variables when these variables are entered into the regression analysis in a certain order (Cramer, 2003). In the first step, the direct effect of the independent variables gauged, in the second step the moderator variable was entered to gauge whether the moderator (TAC and TUC) has a significant direct effect on the dependent variable (manufacturing performances) and in the third step the interaction terms (product of the independent variable and moderator variable) were entered to see any additional variance explained. For the moderator effect to be present, step 3 must show a significant R square increase with a significant F-change value. Once step 3 shows a significant R square increase, it can be concluded that there is a moderating effect. To know whether there is a moderation effect, we look at the t-value and p-value under the coefficient table of model 3 (Tabachnick & Fidell, 2013).

Figure 4.2 depicts the steps in regard to identify the moderator variable. According to Sharma, Durand, and Gur-Arie (1981), there are four steps for identifying moderator variables. In the first step through the moderated regression analysis, determine whether a significant interaction is present between the hypothesized moderator variable (technological capability), z, and the predictor variable (manufacturing practices). If a significant interaction is found, proceed to the second step. Otherwise, go to the third step. Next, determine whether z is related to the criterion variable (manufacturing performance). If it is, z is a quasi moderator. If not, z is a pure moderator variable. In either case, the moderator influences the form of the relationship in the classic validation model.

Further, the presence of pure moderator must satisfy two criteria; (1) the interaction variable is significant and (2) there is no significant relationship between the moderator and the dependent variables. Whereas, a quasi moderator is classified if (1) the interaction variable is significant and (2) there is significant relationship between the moderator and the dependent variables. Subsequently, determine whether z is related

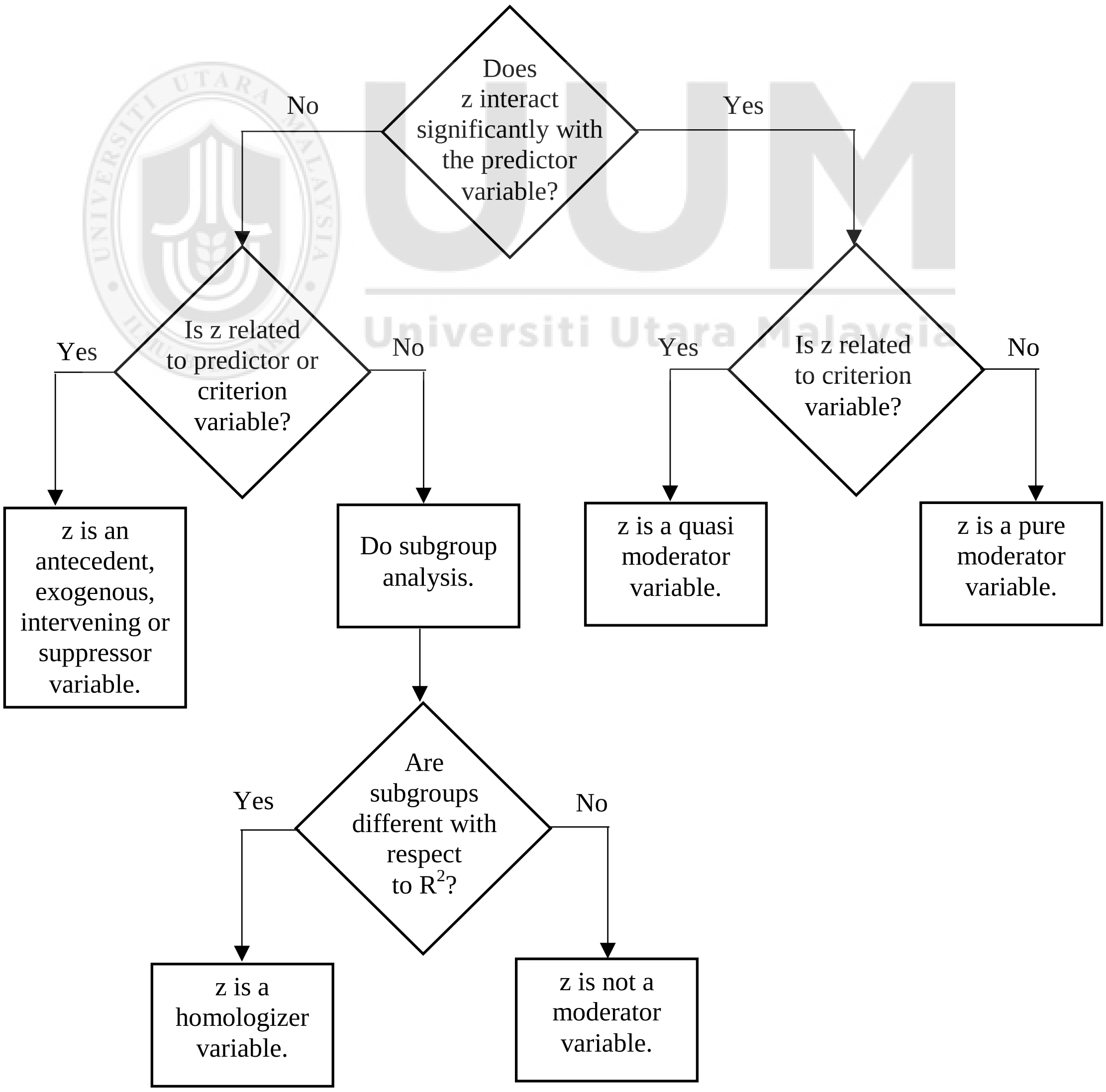


Figure 4.2
Framework for identifying moderator variables
Adopted from Sharma, Durand and Gur-Arie (1981), p. 297

to the criterion or predictor variable. If it is related, z is not a moderator but an exogenous, predictor, intervening, antecedent, or a suppressor variable. If z is not related to either the predictor or criterion variable, proceed to the forth step by using subgroup analysis. In regard of this study, z has been identified to be related to the criterion variable, thus the subgroup analysis was not performed.

4.11.1 Hierarchical Regression of Technological Capability Dimensions on the Relationship between Manufacturing Practices Dimensions and Quality Performance

A multiple linear regression was conducted to predict the firms' manufacturing performances based on their implementation of manufacturing practices. The result of the first set between manufacturing practices dimensions and Quality Performance are presented under Step 1 column in Table 4.13. A significant regression equation was found, $R^2 = 0.502$, R^2 adj = 0.478, F (8, 163) = 20.552, $p < 0.001$. In other words, the predictor accounted for 50.2 percent of the variance in the Quality Performance. The generalizability of this model in another population was 0.478. The value of R^2 dropped to only 0.024 (about 2.4 percent) in the adjusted R^2, which indicated that cross validity of this model was fine. The significant F-test revealed that the relationship between the dependent variable and the independent variables was linear and the model significantly predicted the dependent variable. The F-test (8, 163) = 20.552 , $p < 0.001$ indicates an overall significant prediction in the independent variables to the dependent variables, but it lacks information about the importance of each independent variable.

Table 4.13 shows the individual contributor of each predictor with a regression equation. Among the eight predictors, Customer Relationship (β = 0.497, t = 6.618, p = 0.000) had the highest standardized beta coefficient, which indicates that CR, was the most important variable in predicting the Quality Performance. The other important predictor in descending order were Human Resource Management (β = 0.205, t = 2.825, p = 0.005) and Quality Culture (β = 0.123, t = 1.769, p = 0.079). However, Information Technology (β = -0.007, t = -0.100, p = 0.920), Information Sharing (β = 0.041, t = 0.579, p = 0.563), Strategic Supplier Partnership (β = 0.003, t = 0.036, p = 0.971), Production Layout (β = -0.003, t = -0.042, p = 0.966) and Setup Time Reduction (β = 0.010, t = 0.163, p = 0.871) were not significantly related to Quality Performance. Three predictor variables influenced on the dependent variable in the direction hypothesized. Thus, a better Quality Performance can be obtained when the company has a better relationship with customer and a strong implementation of HRM and QC. Whilst hypotheses H_A 1b, 1e and 1f are supported, hypotheses H_A 1a, 1c, 1d, 1g, and 1h are not supported.

The interacting effect between TC dimensions (TAC and TUC) on the relationship between the independent variables and the dependent variables of manufacturing firms are presented. It was hypothesized that TAC and TUC moderates the relationship between manufacturing practices dimensions and Quality Performance. Table 4.13, under the Step 3 column indicates the result of the hierarchical regression analysis of the moderating effect of TAC on the relationship between manufacturing practices and Quality Performance (see Appendix 13.1).

Table 4.13
Hierarchical Regression Results: the Moderating Effects of Technological Acquiring Capability on the Relationship between Manufacturing Practices Dimensions and Quality Performance

Variables	Std Beta Step 1	Std Beta Step 2	Std Beta Step 3
Independent Variable			
Information Technology	-0.007	-0.008	0.205
Customer Relationship	0.497***	0.493	0.935
Information Sharing	0.041	0.037	0.124
Strategic Supplier Partnership	0.003	0.003	-0.539
Human Resource Management	0.205***	0.201	-0.189
Quality Culture	0.123*	0.122	0.031
Production Layout	-0.003	0.001	-0.082
Setup-Time Reduction	0.010	0.009	0.697
Moderator			
Technological Acquiring Capability		0.019	0.488
Interaction Terms			
IT x TAC			-0.366
CR x TAC			-1.122
IS x TAC			-0.257
SSP x TAC			1.214*
HRM x TAC			0.928
QC x TAC			0.142
PL x TAC			0.220
STR x TAC			-1.421**
R^2	0.502	0.502	0.536
Adjusted R^2	0.478	0.475	0.484
R^2 Change	0.502	0.000	0.033
F Change	20.552	0.087	1.372
Sig. F Change	0.000	0.769	0.213
Durbin-Watson			1.979

Source: Computed data analysis
Note: Dependent Variable: Quality
*Significant levels: ***p < 0.01, **p < 0.05, *p < 0.1*

Manufacturing practices dimensions were entered first in step 1, explaining 50.2 percent of the variance. After the entry of TAC at step 2, the total variance explained by the model as a whole was remained the same as the first model which is 50.2 percent. In step 3, the interaction terms were entered, which resulted in additional variance explaining up to 53.6 percent. The F change from step 1 to step 2 and from step 2 to step 3 were not significant. A thorough scanning of the individual interaction terms between TAC x Strategic Supplier Partnership (β = 1.214, t = 1.687, p = 0.094) and between TAC x Setup-Time Reduction (β = -1.421, t = -2.624, p =

0.010), indicate that SSP was significant at $\alpha = 0.1$ level while STR was significant at $\alpha = 0.05$ level. Whilst hypotheses H_A 5d and H_A 5h are supported, hypotheses H_A 5a, 5b, 5c, 5e, 5f and 5g are not supported.

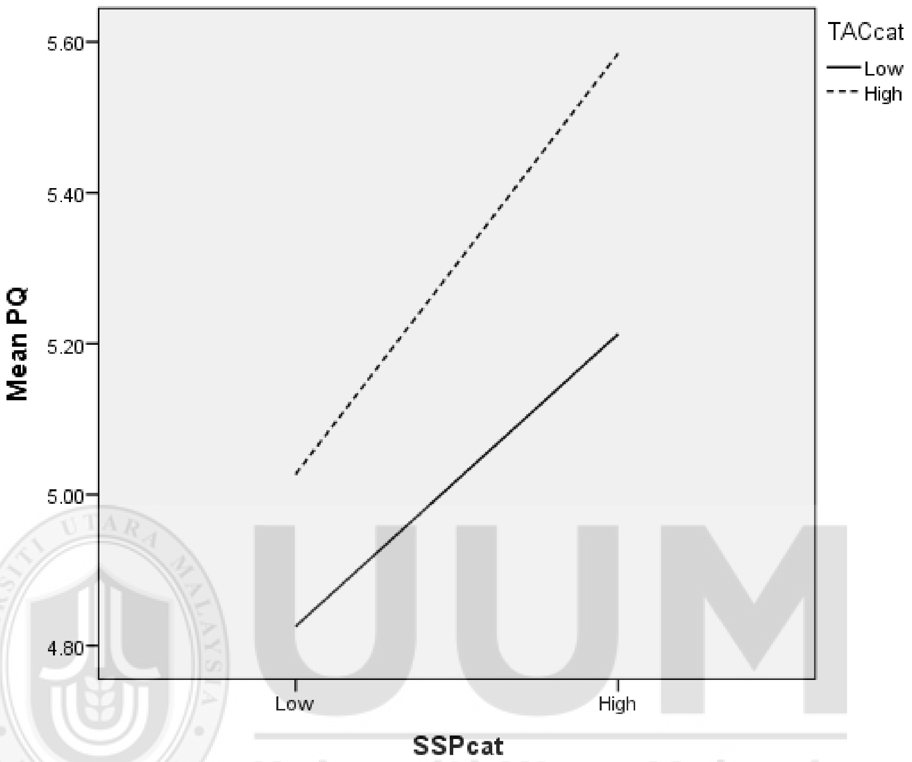


Figure 4.3
The moderating effects of technological acquiring capability on the relationship between strategic supplier partnership and quality performance

Referring to the hypothesis H_A 5d, Technological Acquiring Capability moderates the relationship between Strategic Supplier Partnership and Quality Performance. As depicted in Figure 4.3, the rate of change for TAC on the relationship between Quality Performance and SSP is stronger when the capability at high level as compared to the capability at the low level. Further, the high level of SSP had a larger difference of mean Quality Performance as compared when the practice at low level. For firms which have high level of SSP and TAC, the positive changes in Quality Performance is substantial. In other words, the implementation of SSP has a stronger effect on Quality Performance when the TAC is high.

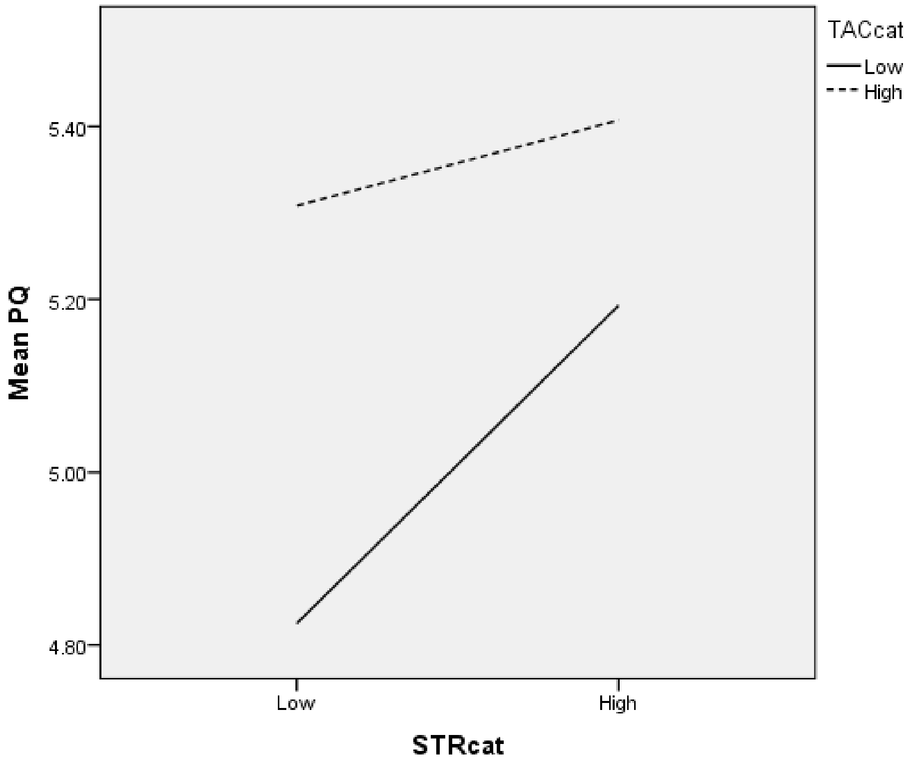


Figure 4.4
The moderating effects of technological acquiring capability on the relationship between setup-time reduction and quality performance

Based on the hypothesis H_A 5h, Technological Acquiring Capability moderates the relationship between Setup-Time Reduction and Quality Performance. As depicted in Figure 4.4, the rate of change for TAC on the relationship between Quality Performance and STR is stronger when the capability at low level as compared to when the capability is at high level. Further, the low level of STR had a bigger difference of mean Quality Performance as compared when STR at high level. For firms which have high level of STR but low level of TAC, the positive changes in Quality Performance is substantial. In other words, the implementation of STR has a stronger effect on Quality Performance when the TAC is low.

Table 4.14

Hierarchical Regression Results: the Moderating Effects of Technological Upgrading Capability on the Relationship between Manufacturing Practices Dimensions and Quality Performance

Variables	Std Beta Step 1	Std Beta Step 2	Std Beta Step 3
Independent Variable			
Information Technology	-0.007	-0.020	0.656
Customer Relationship	0.497***	0.467	0.060
Information Sharing	0.041	0.031	0.434
Strategic Supplier Partnership	0.003	-0.018	-0.662
Human Resource Management	0.205***	0.167	0.941
Quality Culture	0.123*	0.093	-0.318
Production Layout	-0.003	-0.009	-0.529
Setup-Time Reduction	0.010	-0.032	0.523
Moderator			
Technological Upgrading Capability		0.191**	0.383
Interaction Terms			
IT x TUC			-1.053
CR x TUC			0.813
IS x TUC			-0.719
SSP x TUC			1.043
HRM x TUC			-1.375
QC x TUC			0.771
PL x TUC			0.830
STR x TUC			-0.859
R^2	0.502	0.521	0.547
Adjusted R^2	0.478	0.495	0.497
R^2 Change	0.502	0.019	0.026
F Change	20.552	6.435	1.118
Sig. F Change	0.000	0.012	0.354
Durbin-Watson			2.092

Source: Computed data analysis

Note: Dependent Variable: Quality

*Significant levels: ***p < 0.01, **p < 0.05, *p < 0.1*

Table 4.14 indicates the result of the hierarchical multiple regression analysis of the moderating effect of TUC on the relationship between manufacturing practices and Quality Performance (see Appendix 13.2). Manufacturing practices dimensions were entered first in step 1, explaining 50.2 percent of the variance. After the entry of TUC at step 2, the total variance explained by the model as a whole is 52.1 percent. In the step 3, the interaction terms were entered, which resulted in additional variance explaining up to 54.7 percent. The F change from step 1 to step 2 are significant at 5 percent level whereas from step 2 to step 3 was not significant.

Further, the inspection of the individual interaction terms between manufacturing practices dimensions and TUC reveals that all interactions are not significant. The results indicate that TUC does not moderate the relationship between manufacturing practices dimensions and Quality Performance. Therefore, it can be concluded that all of the related hypotheses namely H_A 6a, 6b, 6c, 6d, 6e, 6f, 6g and 6h are not supported. Thus, H_A 6 is not supported.

4.11.2 Hierarchical Regression of Technological Capability Dimensions on the Relationship between Manufacturing Practices Dimensions and Flexibility Performance

Multiple regression was conducted to determine the relationship between manufacturing practices dimensions and the second manufacturing performance dimension namely Flexibility Performance. The result of the second set between manufacturing practices dimensions and Flexibility Performance are presented under the Step 1 column in Table 4.15. A significant regression equation was found, $R^2 = 0.279$, R^2 adj = 0.243, F (8, 163) = 7.867, $p < 0.001$. In other words, the predictor accounted for 27.9 percent of the variance in the Flexibility Performance. The generalizability of this model in another population was 0.243. The value of R^2 dropped to only 0.036 (about 3.6 percent) in the adjusted R^2, which indicated that cross validity of this model was fine. The significant F-test revealed that the relationship between the dependent variable and the independent variables was linear and the model significantly predicted the dependent variable. The F-test (8, 163) = 7.867, $p < 0.001$ indicates an overall significant prediction in the independent variables to the dependent variables, but it lacks information about the importance of each independent variable.

To observe deeper, Table 4.15 shows the individual contributor of each predictor with a regression equation. Among the eight predictors, Human Resource Management ($\beta = 0.254$, $t = 2.909$, $p = 0.004$) had the highest standardized beta coefficient, which indicates that HRM was the most important variable in predicting the Flexibility Performance. The other important predictors in descending order were Customer Relationship ($\beta = 0.197$, $t = 2.182$, $p = 0.031$), Setup-Time Reduction ($\beta = 0.175$, $t = 2.262$, $p = 0.025$), Information Sharing ($\beta = 0.168$, $t = 1.996$, $p = 0.048$), and Information Technology ($\beta = -0.136$, $t = -1.698$, $p = 0.091$). However, Strategic Supplier Partnership ($\beta = -0.031$, $t = -0.339$, $p = 0.735$), Quality Culture ($\beta = 0.073$, $t = 0.871$, $p = 0.385$) and Production Layout ($\beta = -0.035$, $t = -0.466$, $p = 0.642$) were not significantly related to Flexibility Performance. Five predictor variables influenced on the dependent variable in the direction hypothesized. Thus, a better Flexibility Performance can be obtained when the company has a strong implementation of HRM practices, good relationship with customer, better STR, and enhanced IS with the trading partners. But instead, a better used of IT reduce the Flexibility Performance. Whilst hypotheses H_A 2a, 2b, 2c, 2e and 2h are supported, hypotheses H_A 2d, 2f, and 2g are not supported.

Table 4.15

Hierarchical Regression Results: the Moderating Effects of Technological Acquiring Capability on the Relationship between Manufacturing Practices Dimensions and Flexibility Performance

Variables	Std Beta Step 1	Std Beta Step 2	Std Beta Step 3
Independent Variable			
Information Technology	-0.136*	-0.169	-0.731
Customer Relationship	0.197**	0.124	-0.324
Information Sharing	0.168**	0.101	-0.261
Strategic Supplier Partnership	-0.031	-0.028	0.744
Human Resource Management	0.254***	0.190	0.690
Quality Culture	0.073	0.057	0.717
Production Layout	-0.035	0.027	0.366
Setup-Time Reduction	0.175**	0.144	0.267
Moderator			
Technological Acquiring Capability		0.357***	2.520***
Interaction Terms			
IT x TAC			1.128*
CR x TAC			0.889
IS x TAC			0.886
SSP x TAC			-1.425*
HRM x TAC			-1.245
QC x TAC			-1.859**
PL x TAC			-0.773
STR x TAC			-0.163
R^2	0.279	0.374	0.438
Adjusted R^2	0.243	0.339	0.376
R^2 Change	0.279	0.095	0.064
F Change	7.867	24.651	2.202
Sig. F Change	0.000	0.000	0.030
Durbin-Watson			1.794

Source: Computed data analysis

Note: Dependent Variable: Flexibility

*Significant levels: ***p < 0.01, **p < 0.05, *p < 0.1*

Table 4.15 indicates the result of the hierarchical multiple regression analysis of the moderating effect of TAC on the relationship between manufacturing practices and Flexibility Performance (see Appendix 13.3). Manufacturing practices dimensions were entered first in step 1, explaining 27.9 percent of the variance. After the entry of TAC at step 2, the total variance explained by the model as a whole is 37.4 percent. In step 3, the interaction terms were entered, which resulted in additional variance explaining up to 43.8 percent. The F change from step 1 to step 2 is significant at 1 percent level and from step 2 to step 3 is significant 5 percent level. It shows that there is a moderating effects of TAC between manufacturing practices and Flexibility Performance.

A thorough checking of the individual interaction terms between TAC x Information Technology (β = 1.128, t = 1.780, p = 0.077), TAC x Strategic Supplier Partnership (β = -1.425, t = -1.800, p = 0.074) and between TAC x Quality Culture (β = -1.859, t = -2.086, p = 0.039), indicate that IT and SSP was significant at α = 0.1 level while QC was significant at α = 0.05 level. The results indicate that TAC significantly moderates the relationship between IT, SSP, QC on Flexibility Performance. Given that TAC does have direct influence on Flexibility Performance, it emerges as a quasi moderator rather than a pure moderator. Therefore, this study concludes that hypotheses H_A 7a, 7d and 7f are supported, while hypotheses H_A 7b, 7c, 7e, 7g and 7h are not supported.

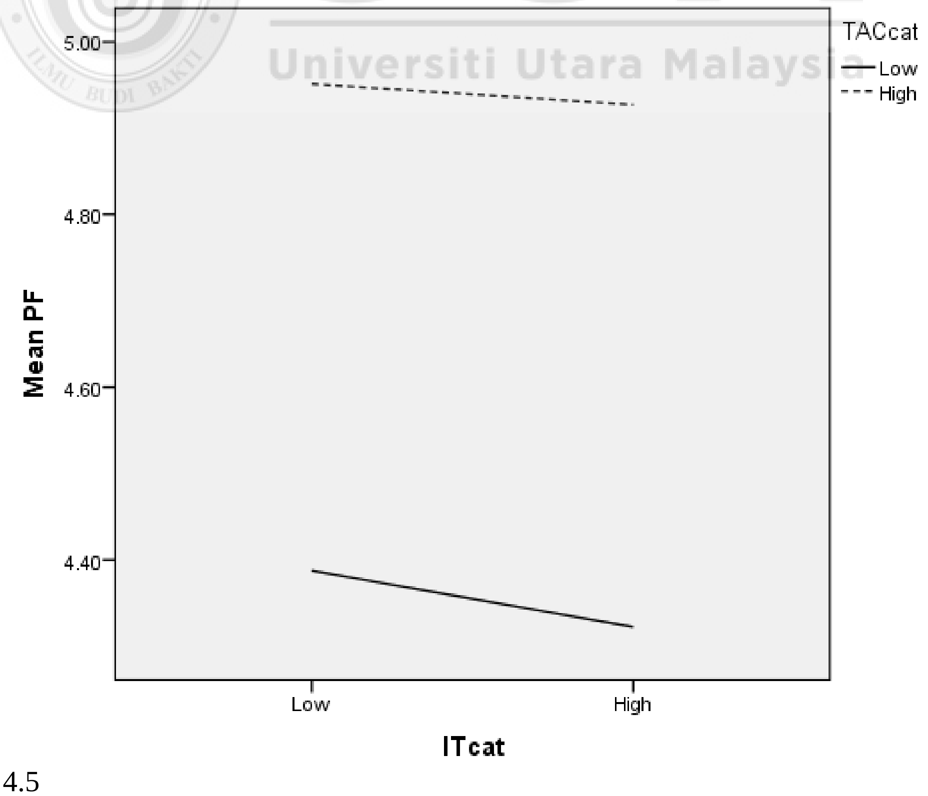


Figure 4.5
The moderating effects of technological acquiring capability on the relationship between information technology and flexibility performance

Based on the hypothesis H_A 7a, Technological Acquiring Capability moderates the relationship between Information Technology and Flexibility Performance. As depicted in Figure 4.5, the rate of change for TAC on the relationship between Flexibility Performance and IT is stronger when TAC at low level as compared to when the capability at high level. Furthermore, the difference of mean Flexibility Performance is bigger at high level implementation of IT as compared to low level. For firms which have high level of IT, the negative changes in flexibility performance is small and not substantial. In other words, the implementation of IT has a stronger effect on Flexibility Performance when TAC is low.

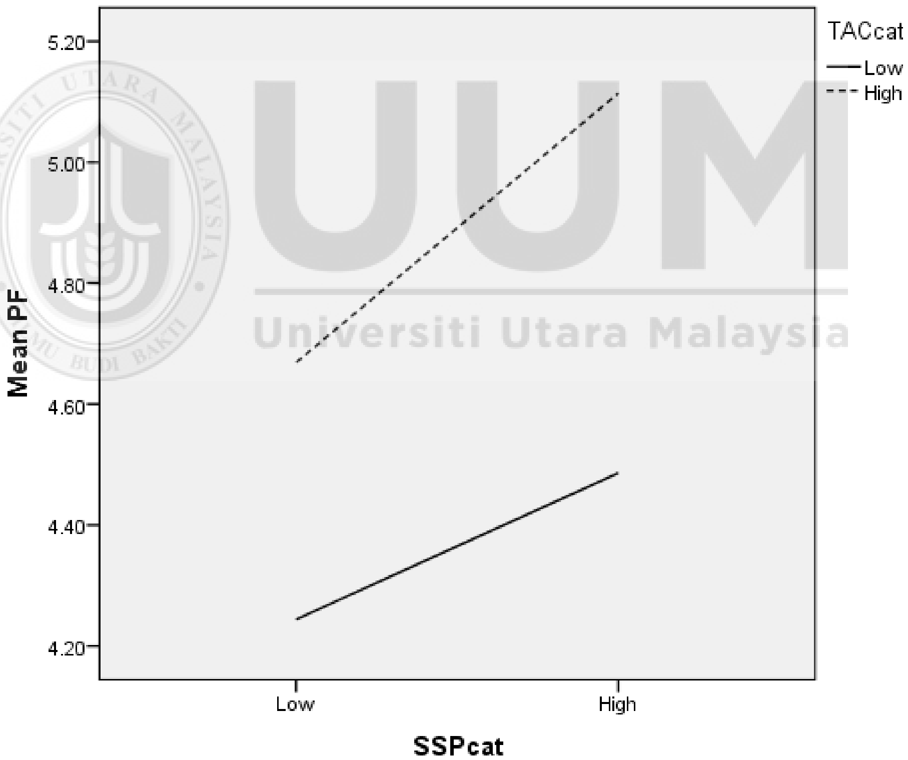


Figure 4.6
The moderating effects of technological acquiring capability on the relationship between strategic supplier partnership and flexibility performance

By referring to hypothesis H_A 7d, Technological Acquiring Capability moderates the relationship between Strategic Supplier Partnership practices and Flexibility

Performance. As depicted in Figure 4.6, the rate of change for TAC on the relationship between Flexibility Performance and SSP is stronger when the capability at high level as compared to the capability at the low level. Further, the high level of SSP had a larger difference of mean Flexibility Performance as compared when the practice at low level. For firms which have high level of SSP and TAC, the positive changes in Flexibility Performance is substantial. In other words, the implementation of SSP has a stronger effect on Flexibility Performance when the TAC is high.

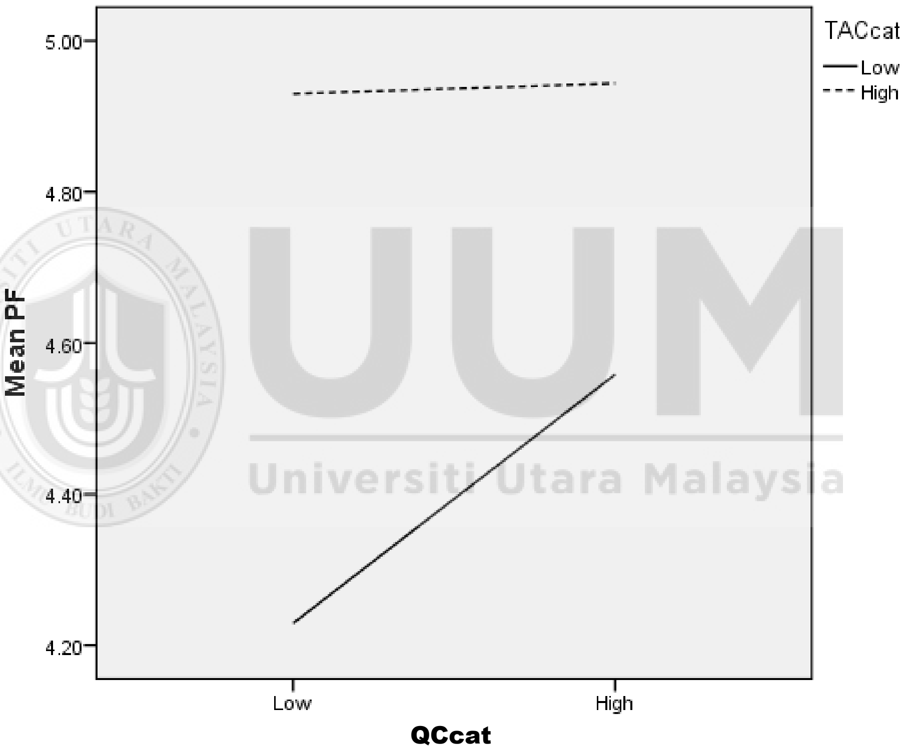


Figure 4.7
The moderating effects of technological acquiring capability on the relationship between quality culture and flexibility performance

Based on the hypothesis H_A 7f, Technological Acquiring Capability moderates the relationship between Quality Culture and Flexibility Performance. As depicted in Figure 4.7, the rate of change for TAC on the relationship between Flexibility Performance and QC is stronger when the capability at low level as compared to when the capability is at high level. Further, the low level of QC had a bigger difference of mean Flexibility Performance as compared when QC at high level. For firms which have high level of QC and low level of TAC, the positive changes in Flexibility Performance is substantial. In other words, the implementation of QC has a stronger effect on Flexibility Performance when the TAC is low.

Table 4.16
Hierarchical Regression Results: the Moderating Effects of Technological Upgrading Capability on the Relationship between Manufacturing Practices Dimensions and Flexibility Performance

Variables	Std Beta Step 1	Std Beta Step 2	Std Beta Step 3
Independent Variable			
Information Technology	-0.136*	-0.165	-0.373
Customer Relationship	0.197**	0.133	-0.323
Information Sharing	0.168**	0.147	0.493
Strategic Supplier Partnership	-0.031	-0.077	-0.601
Human Resource Management	0.254***	0.172	0.463
Quality Culture	0.073	0.009	0.378
Production Layout	-0.035	-0.048	0.048
Setup-Time Reduction	0.175**	0.083	0.171
Moderator			
Technological Upgrading Capability		0.415***	0.489
Interaction Terms			
IT x TUC			0.342
CR x TUC			0.863
IS x TUC			-0.568
SSP x TUC			0.995
HRM x TUC			-0.541
QC x TUC			-0.797
PL x TUC			-0.198
STR x TUC			-0.132
R^2	0.279	0.368	0.388
Adjusted R^2	0.243	0.333	0.321
R^2 Change	0.279	0.090	0.020
F Change	7.867	23.035	0.633
Sig. F Change	0.000	0.000	0.749
Durbin-Watson			1.954

Source: Computed data analysis
Note: Dependent Variable: Flexibility
*Significant levels: ***p < 0.01, **p < 0.05, *p < 0.1*

Table 4.16 indicates the result of the hierarchical multiple regression analysis of the moderating effect of Technological Upgrading Capability on the relationship between manufacturing practices and Flexibility Performance (see Appendix 13.4).

Manufacturing practices dimensions were entered first in step 1, explaining 27.9 percent of the variance. After the entry of TUC at step 2, the total variance explained by the model as a whole is 36.8 percent. In step 3, the interaction terms were entered, which resulted in additional variance explaining up to 38.8 percent. The F change from step 1 to step 2 are significant at 1 percent level whereas from step 2 to step 3 were not significant. This result denotes the nonexistence of moderating effect of TUC between manufacturing practices and Flexibility Performance.

Further inspection of the individual interaction terms between manufacturing practices dimensions and TUC reveals that all interactions are not significant. The results indicate that TUC does not moderate the relationship between manufacturing practices dimensions and Flexibility Performance. Therefore, it can be concluded that all of the related hypotheses namely H_A 8a, 8b, 8c, 8d, 8e, 8f, 8g and 8h are not supported. Thus, H_A 8 is not supported.

4.11.3 Hierarchical Regression of Technological Capability Dimensions on the Relationship between Manufacturing Practices Dimensions and Cost Performance

Multiple regression was performed again to determine the relationship between manufacturing practices dimensions and the third manufacturing performance dimension namely Cost Performance. Table 4.17 depicts the summary result of the third set between manufacturing practices dimensions and Cost Performance as shown under the Step 1 column. A significant regression equation was found, $R^2 = 0.226$, R^2 adj = 0.188, $F (8, 163) = 5.941$, $p < 0.001$. In other words, the predictor accounted for 22.6 percent of the variance in the Cost Performance. The generalizability of this model in another population was 0.188. The value of R^2 dropped to only 0.038 (about

3.8 percent) in the adjusted R^2, which indicated that cross validity of this model was fine. The significant F-test revealed that the relationship between the dependent variable and the independent variables was linear and the model significantly predicted the dependent variable. The F-test (8, 163) = 5.941 , $p < 0.001$ indicates an overall significant prediction in the independent variables to the dependent variables, but it lacks information about the importance of each independent variable.

Table 4.17 shows the individual contributor of each predictor with a regression equation. Among the eight predictors, Human Resource Management ($\beta = 0.198$, $t = 2.196$, $p = 0.030$) had the highest standardized beta coefficient, which indicates that HRM was the most important variable in predicting the Cost Performance. The other important predictor was Setup-Time Reduction ($\beta = 0.134$, $t = 1.678$, $p = 0.095$). Conversely, Information Technology ($\beta = 0.101$, $t = 1.211$, $p = 0.228$), Customer Relationship ($\beta = 0.151$, $t = 1.611$, $p = 0.109$), Information Sharing ($\beta = 0.099$, $t = 1.129$, $p = 0.261$), Strategic Supplier Partnership ($\beta = -0.048$, $t = -0.497$, $p = 0.620$), Quality Culture ($\beta = 0.082$, $t = 0.945$, $p = 0.346$), and Production Layout ($\beta = -0.080$, $t = -1.033$, $p = 0.303$) were not significantly affect the Cost Performance. Two predictor variables had influenced on the dependent variable in the direction hypothesized. Thus, a better Cost Performance can be obtained when the company has a strong implementation of HRM and a better reduction of production setup-times. Whilst hypothesis H_A 3e and 3h are supported, hypotheses H_A 3a, 3b, 3c, 3d, 3f, and 3g are not supported.

Table 4.17
Hierarchical Regression Results: the Moderating Effects of Technological Acquiring Capability on the Relationship between Manufacturing Practices Dimensions and Cost Performance

Variables	Std Beta Step 1	Std Beta Step 2	Std Beta Step 3
Independent Variable			
Information Technology	0.101	0.072	-0.451
Customer Relationship	0.151	0.086	0.304
Information Sharing	0.099	0.039	-0.392
Strategic Supplier Partnership	-0.048	-0.045	0.338
Human Resource Management	0.198**	0.142	-0.001
Quality Management	0.082	0.068	0.665
Production Layout	-0.080	-0.025	-0.284
Setup-Time Reduction	0.134*	0.107	0.005
Moderator			
Technological Acquiring Capability		0.316***	0.308
Interaction Terms			
IT x TAC			1.112
CR x TAC			-0.694
IS x TAC			1.002
SSP x TAC			-0.696
HRM x TAC			0.259
QC x TAC			-1.629*
PL x TAC			0.596
STR x TAC			0.181
R^2	0.226	0.301	0.351
Adjusted R^2	0.188	0.262	0.279
R^2 Change	0.226	0.075	0.050
F Change	5.941	17.341	1.484
Sig. F Change	0.000	0.000	0.167
Durbin-Watson			2.203

Source: Computed data analysis
Note: Dependent Variable: Cost
*Significant levels: ***p < 0.01, **p < 0.05, *p < 0.1*

Table 4.17 indicates the result of the hierarchical multiple regression analysis of the moderating effect of Technological Acquiring Capability on the relationship between manufacturing practices and Cost Performance (see Appendix 13.5). Manufacturing practices dimensions were entered first in step 1, explaining 22.6 percent of the variance. After the entry of TAC at step 2, the total variance explained by the model as a whole is 30.1 percent. In step 3, the interaction terms were entered, which resulted in additional variance explaining up to 35.1 percent. The F change from step 1 to step 2 is significant at 1 percent level, however the F change from step 2 to step 3 is not significant. Thus, proving the absence of moderating effect of TAC between manufacturing practices dimensions and Cost Performance.

A thorough scanning of the individual interaction terms between TAC x Quality Culture ($\beta = -1.629$, $t = -1.700$, $p = 0.091$), indicates that QC was significant at $\alpha = 0.1$ level. In other words, TAC significantly moderates the relationship between QC and Cost Performance. Whilst hypotheses H_A 9f is supported, hypotheses H_A 9a, 9b, 9c, 9d, 9e, 9g and 9h are not supported.

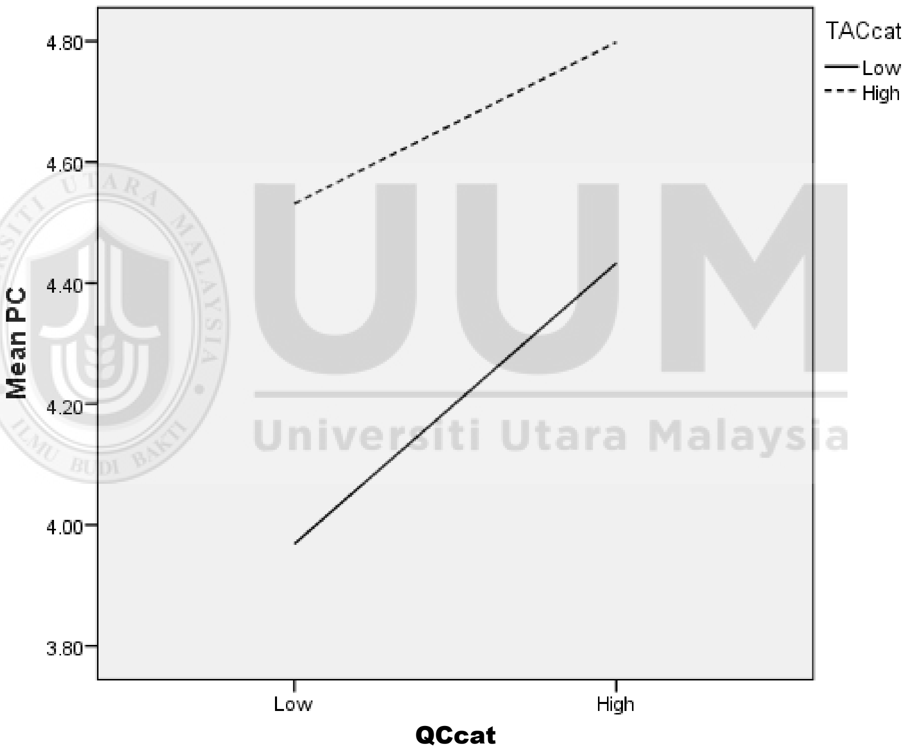


Figure 4.8
The moderating effects of technological acquiring capability on the relationship between quality culture and cost performance

Based on the hypothesis H_A 9f, Technological Acquiring Capability moderates the relationship between Quality Culture and Cost Performance. As depicted in Figure 4.8, the rate of change for TAC on the relationship between Cost Performance and QC is stronger when the capability at low level as compared to when the capability at the high level. Further, the mean difference of Cost Performance is bigger when QC is low compared to high implementation of QC. For firms which have high level of QC and low level of TAC, the positive changes in Cost Performance is larger. In other words, the implementation of QC has a stronger effect on Cost Performance when the TAC is low.

Table 4.18
Hierarchical Regression Results: the Moderating Effects of Technological Upgrading Capability on the Relationship between Manufacturing Practices Dimensions and Cost Performance

Variables	Std Beta Step 1	Std Beta Step 2	Std Beta Step 3
Independent Variable			
Information Technology	0.101	0.081	-0.907
Customer Relationship	0.151	0.106	0.541
Information Sharing	0.099	0.084	-0.753
Strategic Supplier Partnership	-0.048	-0.080	-0.459
Human Resource Management	0.198**	0.141	0.000
Quality Culture	0.082	0.037	1.281
Production Layout	-0.080	-0.089	0.281
Setup-Time Reduction	0.134*	0.070	-0.260
Moderator			
Technological Upgrading Capability		0.290**	0.198
Interaction Terms			
IT x TUC			1.664*
CR x TUC			-0.853
IS x TUC			1.406
SSP x TUC			0.836
HRM x TUC			0.238
QC x TUC			-2.585**
PL x TUC			-0.674
STR x TUC			0.538
R^2	0.226	0.270	0.346
Adjusted R^2	0.188	0.229	0.273
R^2 Change	0.226	0.044	0.076
F Change	5.941	9.731	2.237
Sig. F Change	0.000	0.002	0.028
Durbin-Watson			2.216

Source: Computed data analysis
Note: Dependent Variable: Cost
*Significant levels: ***p < 0.01, **p < 0.05, *p < 0.1*

Table 4.18 indicates the result of the hierarchical multiple regression analysis of the moderating effect of Technological Upgrading Capability on the relationship between manufacturing practices and Cost Performance (see Appendix 13.6). Manufacturing practices dimensions were entered first in step 1, explaining 22.6 percent of the variance. After the entry of TAC at step 2, the total variance explained by the model as a whole is 27.0 percent. In step 3, the interaction terms were entered, which resulted in additional variance explaining up to 34.6 percent. The F change from step 1 to step 2 is significant at 1 percent level and from step 2 to step 3 is significant 5 percent level. It shows the presence of moderating effects of TUC between manufacturing practices and Cost Performance.

A further checking of the individual interaction terms between TUC x Information Technology (β = 1.664, t = 1.803, p = 0.073) and between TUC x Quality Culture (β = -2.585, t = -2.344, p = 0.020), indicate that IT was significant at α = 0.1 level while QC was significant at α = 0.05 level. The results indicate that TUC significantly moderates the relationships between IT and QC on Cost Performance. These results thus indicating that hypotheses H_A 10a and 10f are supported, while hypotheses H_A 10b, 10c, 10d, 10e, 10g and 10h are not supported. Given that TUC does have direct relationship with Cost Performance, it emerges as a quasi moderator rather than a pure moderator.

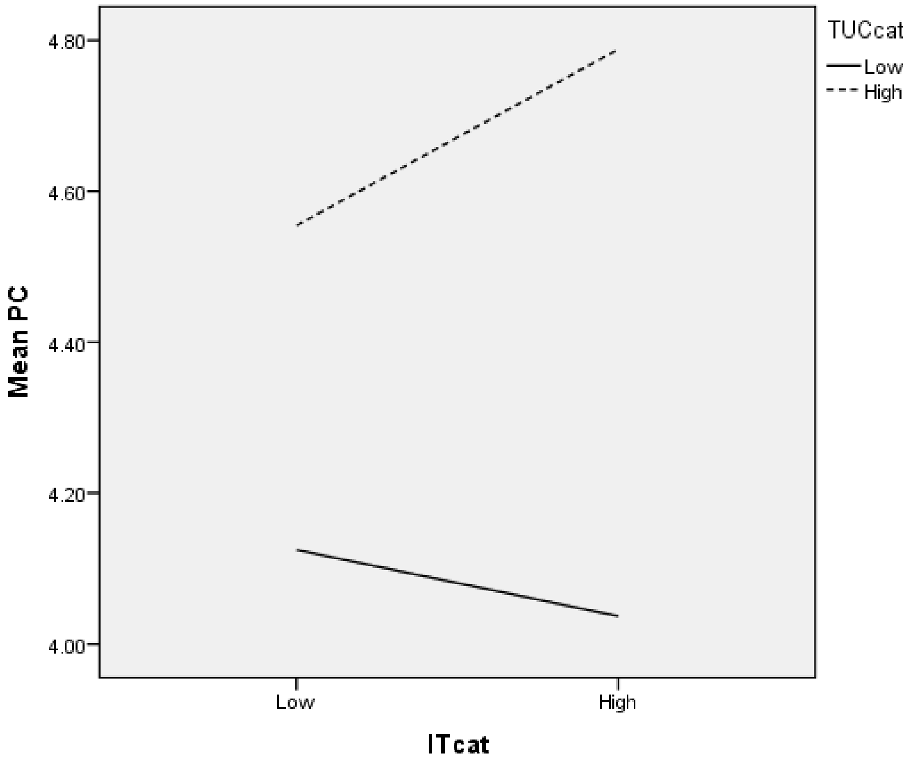


Figure 4.9
The moderating effects of technological upgrading capability on the relationship between information technology and cost performance

By referring to hypothesis H_A 10a, Technological Upgrading Capability moderates the relationship between Information Technology and Cost Performance. As depicted in Figure 4.9, the rate of change of TUC on the relationship between Cost Performance and IT is stronger when the capability at high level as compared to when the capability at low level. Further, the high implementation of IT had a bigger difference of mean Cost Performance as compared when the IT at low level. The effect of IT on Cost Performance is positive when TUC is high. When there is a presence of high TUC, level of Cost Performance tends to increase when level of IT becomes higher. Contradictingly, the effect of IT on Cost Performance becomes negative when TUC is low. When TUC level is low, the higher the IT, the lower the Cost Performance becomes.

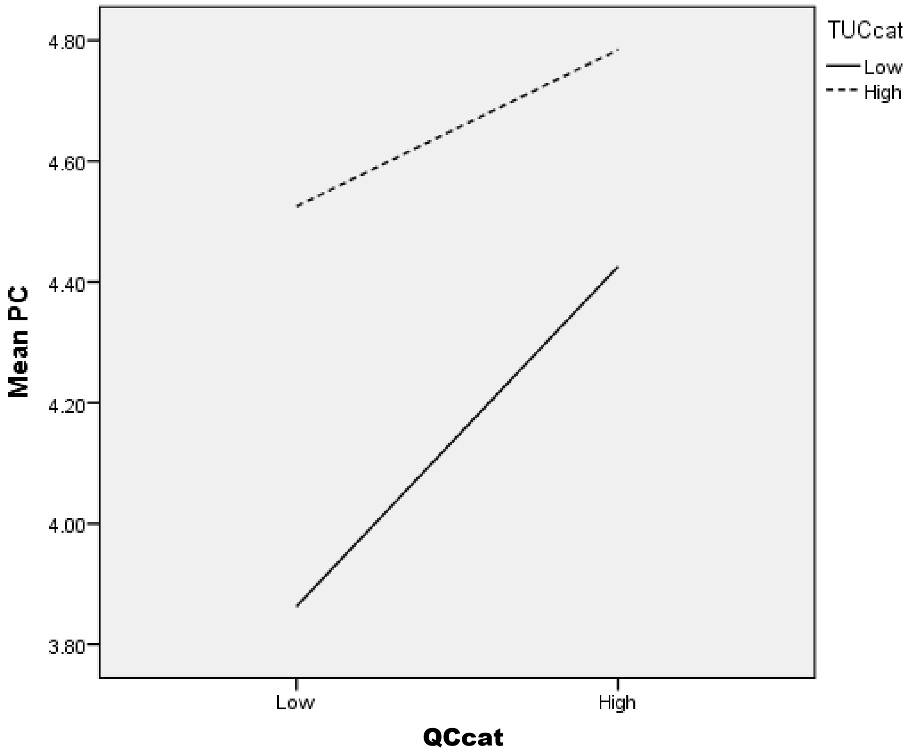


Figure 4.10
The moderating effects of technological upgrading capability on the relationship between quality culture and cost performance

Based on the hypothesis H_A 10f, Technological Upgrading Capability moderates the relationship between Quality Culture and Cost Performance. As depicted in Figure 4.10, the rate of change for TUC on the relationship between Cost Performance and QC is stronger when the capability at low level as compared to when the capability at the high level. Further, the mean difference of Cost Performance is bigger when QC is low compared to high implementation of QC. For firms which have high level of QC but low level of TUC, the positive changes in Cost Performance is larger. In other words, the implementation of QC has a stronger effect on Cost Performance when the TUC is low.

4.11.4 Hierarchical Regression of Technological Capability Dimensions on the Relationship between Manufacturing Practices Dimensions and Delivery Performance

A multiple linear regression was once more carried out to determine the firms' final manufacturing performance namely Delivery Performance, based on their implementation of manufacturing practices. The result of the fourth set between manufacturing practices dimensions and Delivery Performance are presented in Table 4.19 under the Step 1 column. A significant regression equation was found, R^2 = 0.288, R^2 adj = 0.253, F (8, 163) = 8.238, p < 0.001. In other words, the predictor accounted for 28.8 percent of the variance in the Delivery Performance. The generalizability of this model in another population was 0.253. The value of R^2 dropped to only 0.035 (about 3.5 percent) in the adjusted R^2, which indicated that cross validity of this model was fine. The significant F-test revealed that the relationship between the dependent variable and the independent variables was linear and the model significantly predicted the dependent variable. The F-test (8, 163) = 8.238, p < 0.001 indicates an overall significant prediction in the independent variables to the dependent variables, but it lacks information about the importance of each independent variable.

Table 4.19 shows the individual contributor of each predictor with a regression equation. Among the eight predictors, Human Resource Management (β = 0.297, t = 3.429, p = 0.001) had the highest standardized beta coefficient, which indicates that HRM was the most important variable in predicting the Delivery Performance. The other important predictor is Quality Culture (β = 0.198, t = 2.378, p = 0.019). However, Information Technology (β = 0.030, t = 0.380, p = 0.705), Customer

Relationship (β = 0.126, t = 1.407, p = 0.161), Information Sharing (β = -0.017, t = -0.206, p = 0.837), Strategic Supplier Partnership (β = -0.022, t = -0.234, p = 0.815), Production Layout (β = -0.062, t = -0.828, p = 0.409) and Setup-Time Reduction (β = 0.102, t = 1.335, p = 0.184) were not significantly affect the Delivery Performance. Two predictor variables influenced on the dependent variable in the direction hypothesized. Thus, a better Delivery Performance can be obtained when the company has a strong implementation of HRM and a better QC practices. Whilst hypotheses H_A 4e and 4f are supported, hypotheses H_A 4a, 4b, 4c, 4d, 4g, and 4h are not supported.

Table 4.19 depicts the result of the hierarchical regression analysis of the moderating effect of Technological Acquiring Capability on the relationship between manufacturing practices and Delivery Performance (see Appendix 13.7). Manufacturing practices dimensions were entered first in step 1, explaining 28.8 percent of the variance. After the entry of TAC at step 2, the total variance explained by the model as a whole is 29.9 percent. In step 3, the interaction terms were entered, which resulted in additional variance explaining up to 35.9 percent. The F change from step 1 to step 2 is not significant, however from step 2 to step 3 the F change is significant at 10 percent level.

A further inspection of the individual interaction terms between TAC x Customer Relationship (β = 1.913, t = 2.090, p = 0.038), TAC x Information Sharing (β = 1.285, t = 1.711, p = 0.089), TAC x Strategic Supplier Partnership (β = -1.778, t = -2.103, p = 0.037) and between TAC x Quality Culture (β = -1.856, t = -1.950, p = 0.053), indicate that IS and QC were significant at α = 0.1 level while CR and SSP were significant at α = 0.05 level.

Table 4.19
Hierarchical Regression Results: the Moderating Effects of Technological Acquiring Capability on the Relationship between Manufacturing Practices Dimensions and Delivery Performance

Variables	Std Beta Step 1	Std Beta Step 2	Std Beta Step 3
Independent Variable			
Information Technology	0.030	0.019	-0.362
Customer Relationship	0.126	0.101	-0.719
Information Sharing	-0.017	-0.040	-0.564
Strategic Supplier Partnership	-0.022	-0.020	0.858
Human Resource Management	0.297***	0.275	0.796
Quality Culture	0.198**	0.193	0.906
Production Layout	-0.062	-0.040	-0.014
Setup-Time Reduction	0.102	0.092	-0.166
Moderator			
Technological Acquiring Capability		0.122	0.598
Interaction Terms			
IT x TAC			0.792
CR x TAC			1.913**
IS x TAC			1.285*
SSP x TAC			-1.778**
HRM x TAC			-1.284
QC x TAC			-1.856*
PL x TAC			-0.117
STR x TAC			0.569
R^2	0.288	0.299	0.359
Adjusted R^2	0.253	0.260	0.288
R^2 Change	0.288	0.011	0.060
F Change	8.238	2.573	1.802
Sig. F Change	0.000	0.111	0.081
Durbin-Watson			2.084

Source: Computed data analysis
Note: Dependent Variable: Delivery
*Significant levels: ***p < 0.01, **p < 0.05, *p < 0.1*

The results show that TAC significantly moderates the relationship between CR, IS, SSP, and QC on Delivery Performance. These results indicate that hypotheses H_A 11b, 11c, 11d and 11f are supported, while hypotheses H_A 11a, 11e, 11g and 11h are not supported. Given that TAC does have direct relationship on Delivery Performance, it emerges as a quasi moderator rather than a pure moderator.

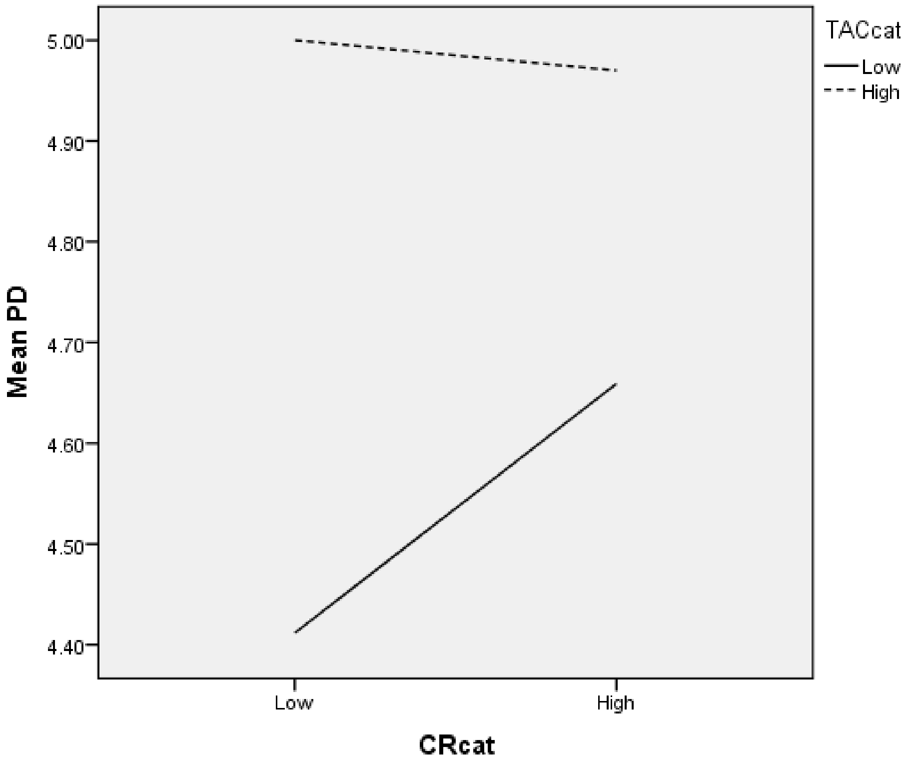


Figure 4.11
The moderating effects of technological acquiring capability on the relationship between customer relationship and delivery performance

Based on the hypothesis H_A 11b, Technological Acquiring Capability moderates the relationship between Customer Relationship and Delivery Performance. As depicted in Figure 4.11, the rate of change for TAC on the relationship between Delivery Performance and CR is stronger when the TAC at low level as compared to when the TAC at high level. Further, the difference of mean Delivery Performance is bigger when the CR is low compared to when CR is high. The effect of CR on Delivery Performance is positive when TAC is low. When there is a presence of low TAC, level of Delivery Performance tends to increase when level of CR becomes higher. Contradictingly, the effect of CR on Delivery Performance becomes negative when TAC is high. When TAC level is high, the higher the CR, the lower the Delivery Performance becomes.

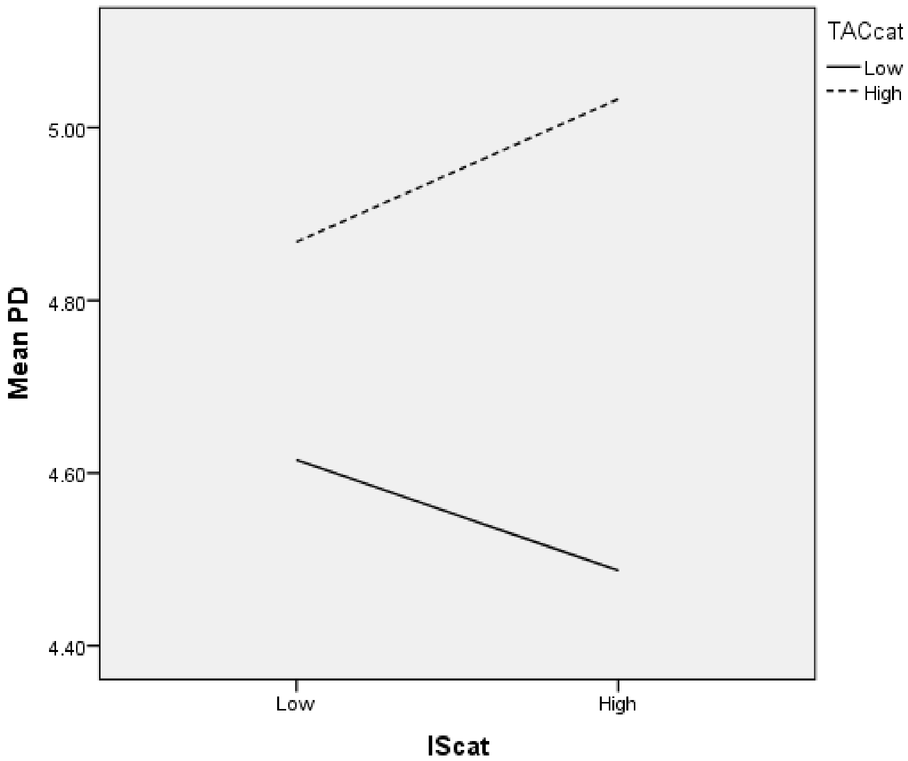


Figure 4.12
The moderating effects of technological acquiring capability on the relationship between information sharing and delivery performance

By referring to hypothesis H_A 11c, Technological Acquiring Capability moderates the relationship between Information Sharing practices and Delivery Performance. As depicted in Figure 4.12, the rate of change for TAC on the relationship between Delivery Performance and IS is stronger when the capability at high level compared to when the capability at low level. Further, the difference of mean Delivery Performance is bigger when IS is high. The effect of IS on Delivery Performance is positive when TAC is high. When there is a presence of high TAC, level of Delivery Performance tends to increase when level of IS becomes higher. Contradictingly, the effect of IS on Delivery Performance becomes negative when TAC is low. When TAC level is low, the higher the IS, the lower the Delivery Performance becomes.

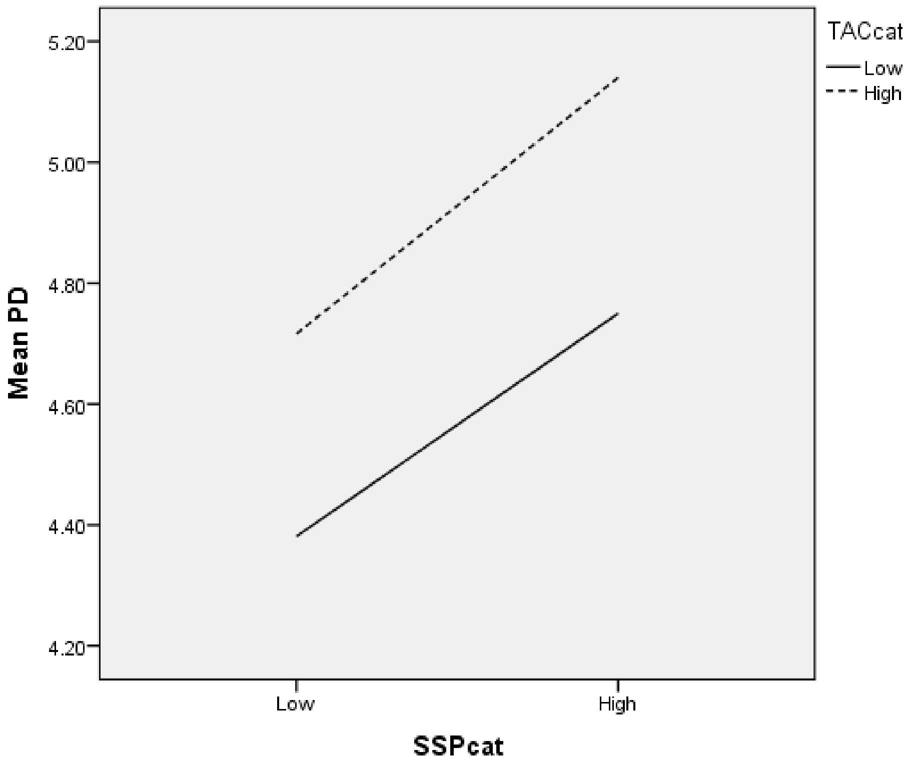


Figure 4.13
The moderating effects of technological acquiring capability on the relationship between strategic supplier partnership and delivery performance

Based on the hypothesis H_A 11d, Technological Acquiring Capability moderates the relationship between Strategic Supplier Partnership practices and Delivery Performance. As depicted in Figure 4.13, the rate of change for TAC is stronger when the capability at high level as compared to when the capability at low level. Further, the difference of mean Delivery Performance is bigger when SSP is high compared to the low SSP. For firms which have high level of SSP and TAC, the positive changes in Delivery Performance is substantial. In other words, the implementation of SSP has a stronger effect on Delivery Performance when the TAC is high.

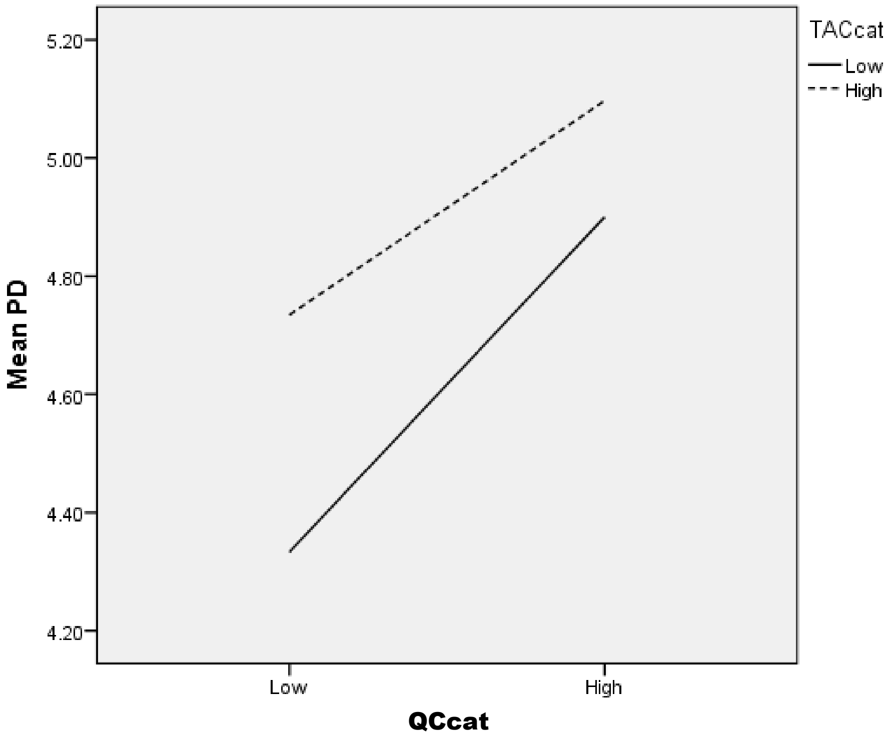


Figure 4.14
The moderating effects of technological acquiring capability on the relationship between quality culture and delivery performance

By referring to hypothesis H_A 11f, Technological Acquiring Capability moderates the relationship between Quality Culture practices and Delivery Performance. As depicted in Figure 4.14, the rate of change for TAC on the relationship between Delivery Performance and QC is stronger when the capability at low level as compared to when the capability at high level. Further, the difference of mean Delivery Performance is bigger when QC is low compared to high QC. For firms which have high level of QC and low level of TAC, the positive changes in Delivery Performance is substantial. In other words, the implementation of QC has a stronger effect on Delivery Performance when the TAC is low.

Table 4.20 represents the result of the moderated multiple regression analysis of the moderating effect of Technological Upgrading Capability on the relationship between manufacturing practices and Delivery Performance (see Appendix 13.8).

Manufacturing practices dimensions were entered first in step 1, explaining 28.8 percent of the variance. After the entry of TUC at step 2, the total variance explained by the model as a whole is 29.4 percent. In step 3, the interaction terms were entered, which resulted in additional variance explaining up to 36.1 percent. The F change from step 1 to step 2 is not significant, however from step 2 to step 3 is significant 5 percent level.

Table 4.20
Hierarchical Regression Results: the Moderating Effects of Technological Upgrading Capability on the Relationship between Manufacturing Practices Dimensions and Delivery Performance

Variables	Std Beta Step 1	Std Beta Step 2	Std Beta Step 3
Independent Variable			
Information Technology	0.030	0.023	0.994
Customer Relationship	0.126	0.109	-1.057
Information Sharing	-0.017	-0.023	-0.376
Strategic Supplier Partnership	-0.022	-0.034	-0.102
Human Resource Management	0.297***	0.275	-0.283
Quality Culture	0.198**	0.181	1.579
Production Layout	-0.062	-0.065	-0.920
Setup-Time Reduction	0.102	0.078	0.554
Moderator			
Technological Upgrading Capability		0.111	-0.294
Interaction Terms			
IT x TUC			-1.476
CR x TUC			2.322**
IS x TUC			0.592
SSP x TUC			0.090
HRM x TUC			1.037
QC x TUC			-2.693**
PL x TUC			1.374*
STR x TUC			-0.787
R^2	0.288	0.294	0.361
Adjusted R^2	0.253	0.255	0.291
R^2 Change	0.288	0.006	0.067
F Change	8.238	1.462	2.012
Sig. F Change	0.000	0.228	0.048
Durbin-Watson			2.067

Source: Computed data analysis
Note: Dependent Variable: Delivery
*Significant levels: ***p < 0.01, **p < 0.05, *p < 0.1*

A further inspection of the individual interaction terms between TUC x Customer Relationship (β = 2.322, t = 2.042, p = 0.043), TUC x Quality Culture (β = -2.693, t = -2.471, p = 0.015) and between TUC x Production Layout (β = 1.374, t = 1.781, p = 0.077), indicate that PL was significant at α = 0.1 level while CR and QC were significant at α = 0.05 level. The results indicate that TAC significantly moderates the relationship between the CR, QC, and PL on Delivery Performance. Given that TUC does have direct relationship on Delivery Performance, it emerges as a quasi moderator rather than a pure moderator. Therefore these findings concludes that hypotheses H_A 12b, 12f and 12g are supported, while hypotheses H_A 12a, 12c, 12d, 12e and 12h are not supported.

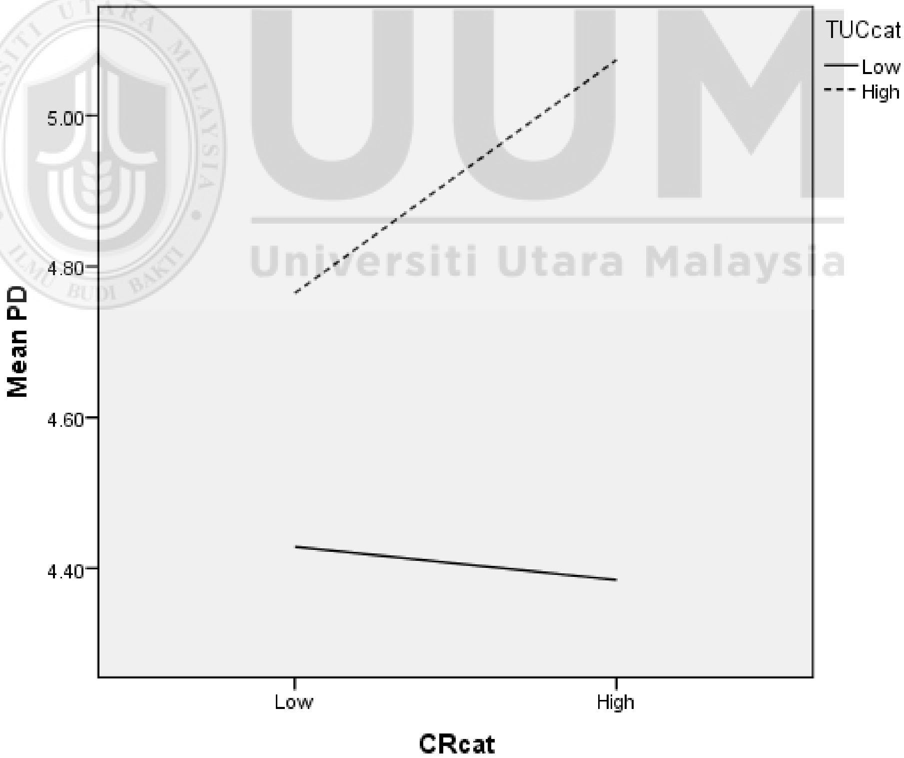


Figure 4.15
The moderating effects of technological upgrading capability on the relationship between customer relationship and delivery performance

Based on hypothesis H_A 12b, Technological Upgrading Capability moderates the relationship between Customer Relationship practices and Delivery Performance. As depicted in Figure 4.15, the rate of change for TUC on the relationship between Delivery Performance and CR is stronger when the capability is at high level as compared to the capability at low level. Further, the difference of mean Delivery Performance is bigger when CR is high compared when the practice is low. The effect of CR on Delivery Performance is positive when TUC is high. When there is a presence of high TUC, level of Delivery Performance tends to increase when level of CR becomes higher. Contradictingly, the effect of CR on Delivery Performance becomes negative when TUC is low. When TUC level is low, the higher the CR, the lower the Delivery Performance becomes.

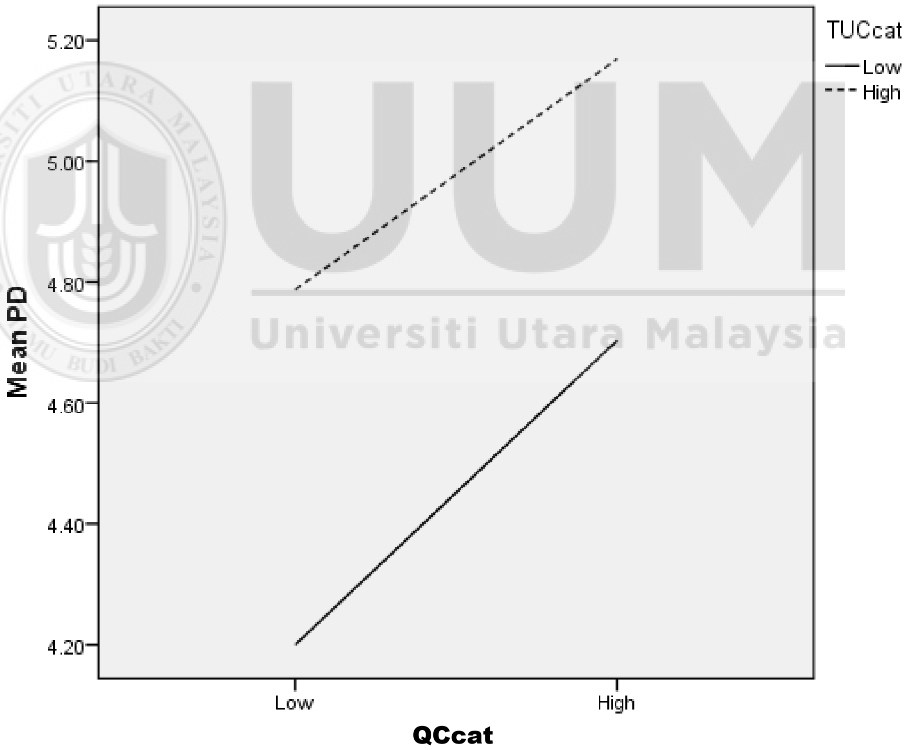


Figure 4.16
The moderating effects of technological upgrading capability on the relationship between quality culture and delivery performance

By referring to hypothesis H_A 12f, Technological Upgrading Capability moderates the relationship between Quality Culture practices and Delivery Performance. As depicted in Figure 4.16, the rate of change for TUC on the relationship between

Delivery Performance and QC is stronger when the capability at low level as compared to when the capability at high level. Further, the low QC had a bigger difference of mean Delivery Performance compared to when the practice is high. For firms which have high level of QC but low level of TUC, the positive changes in Delivery Performance is significant. In other words, the implementation of QC has a stronger positive effect on Delivery Performance when the TUC is low.

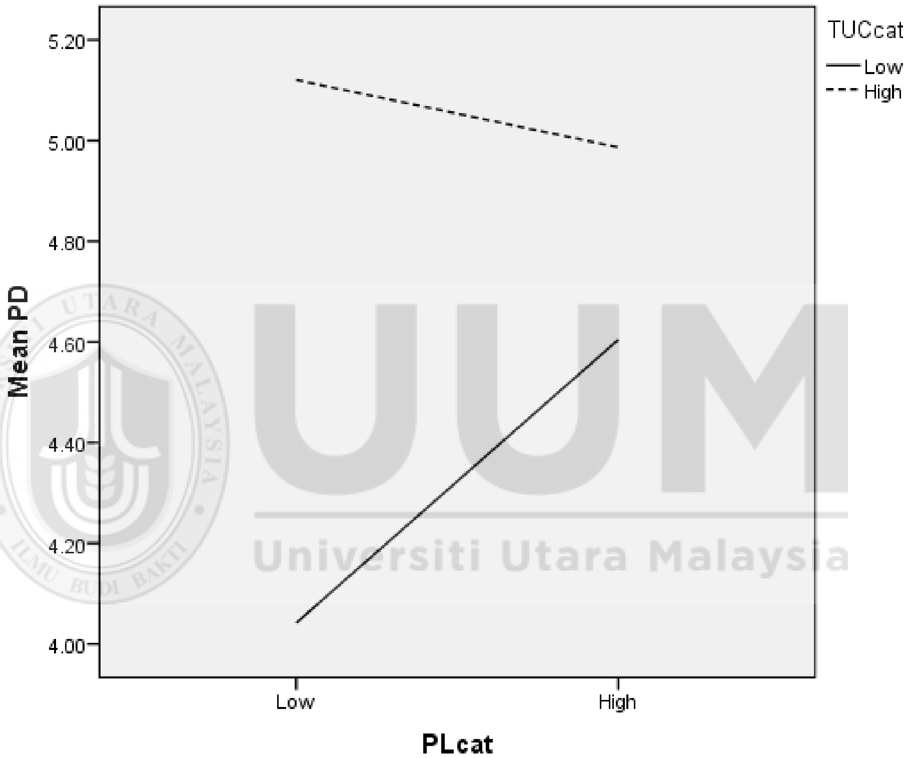


Figure 4.17
The moderating effects of technological upgrading capability on the relationship between production layout and delivery performance

Based on hypothesis H_A 12g, Technological Upgrading Capability moderates the relationship between Production Layout and Delivery Performance. As depicted in Figure 4.17, the rate of change for TUC on the relationship between Delivery Performance and PL is stronger when the capability at low level as compared to when the capability at high level. Further, the low PL practice had a bigger difference of mean Delivery Performance as compared when the practice is high. The effect of PL on Delivery Performance is positive when TUC is low. When there is a presence of low TUC, level of Delivery Performance tends to increase when level of PL becomes higher. Contradictingly, the effect of PL on Delivery Performance becomes negative when TUC is high. When TUC level is high, the higher the PL, the lower the Delivery Performance becomes.

4.11.5 Summary of Hypotheses Testing

The summary of hypotheses testing results for the relationship between the independent variables and the dependent variables are shown in Table 4.21.

Table 4.21
Summary of the Hypotheses Testing between the Manufacturing Practices Dimensions on the Manufacturing Performance Dimensions

Hypo-theses	Statements	Remarks
H_A 1	**Manufacturing practices dimensions significantly affect the quality performance.**	
H_A 1a	Information technology significantly affect the quality performance.	Not supported
H_A 1b	Customer relationship significantly affect the quality performance.	**Supported**
H_A 1c	Information sharing significantly affect the quality performance.	Not supported
H_A 1d	Strategic supplier partnership significantly affect the quality performance.	Not supported
H_A 1e	Human resource management significantly affect the quality performance.	**Supported**
H_A 1f	Quality culture significantly affect the quality performance.	**Supported**
H_A 1g	Production layout significantly affect the quality performance.	Not supported
H_A 1h	Setup-time reduction significantly affect the quality performance.	Not supported
H_A 2	**Manufacturing practices dimensions significantly affect the flexibility performance.**	
H_A 2a	Information technology significantly affect the flexibility performance.	**Supported**
H_A 2b	Customer relationship significantly affect the flexibility performance.	**Supported**
H_A 2c	Information sharing significantly affect the flexibility performance.	**Supported**
H_A 2d	Strategic supplier partnership significantly affect the flexibility performance.	Not supported
H_A 2e	Human resource management significantly affect the flexibility performance.	**Supported**
H_A 2f	Quality culture significantly affect the flexibility performance.	Not supported
H_A 2g	Production layout significantly affect the flexibility performance.	Not supported
H_A 2h	Setup-time reduction significantly affect the flexibility performance.	**Supported**
H_A 3	**Manufacturing practices dimensions significantly affect the cost performance.**	
H_A 3a	Information technology significantly affect the cost performance.	Not supported
H_A 3b	Customer relationship significantly affect the cost performance.	Not supported
H_A 3c	Information sharing significantly affect the cost performance.	Not supported
H_A 3d	Strategic supplier partnership significantly affect the cost performance.	Not supported
H_A 3e	Human resource management significantly affect the cost performance.	**Supported**
H_A 3f	Quality culture significantly affect the cost performance.	Not supported
H_A 3g	Production layout significantly affect the cost performance.	Not supported
H_A 3h	Setup-time reduction significantly affect the cost performance.	**Supported**
H_A 4	**Manufacturing practices dimensions significantly affect the delivery performance.**	
H_A 4a	Information technology significantly affect the delivery performance.	Not supported
H_A 4b	Customer relationship significantly affect the delivery performance.	Not supported
H_A 4c	Information sharing significantly affect the delivery performance.	Not supported
H_A 4d	Strategic supplier partnership significantly affect the delivery performance.	Not supported
H_A 4e	Human resource management significantly affect the delivery performance.	**Supported**
H_A 4f	Quality culture significantly affect the delivery performance.	**Supported**
H_A 4g	Production layout significantly affect the delivery performance.	Not supported
H_A 4h	Setup-time reduction significantly affect the delivery performance.	Not supported

Meanwhile, Table 4.22 depicts the summary of hypotheses testing for the interacting effects of TAC and TUC on the relationships between manufacturing practices and manufacturing performances.

Table 4.22
Summary of the Hypotheses Testing of the Moderating Effects

Hypo-theses	Statements	Remarks
H_A 5	**Technological acquiring capability moderates the relationship between manufacturing practices dimensions and quality performance.**	
H_A 5a	Technological acquiring capability moderates the relationship between information technology and quality performance.	Not supported
H_A 5b	Technological acquiring capability moderates the relationship between customer relationship and quality performance.	Not supported
H_A 5c	Technological acquiring capability moderates the relationship between information sharing and quality performance.	Not supported
H_A 5d	Technological acquiring capability moderates the relationship between strategic supplier partnership and quality performance.	**Supported**
H_A 5e	Technological acquiring capability moderates the relationship between human resource management and quality performance.	Not supported
H_A 5f	Technological acquiring capability moderates the relationship between quality culture and quality performance.	Not supported
H_A 5g	Technological acquiring capability moderates the relationship between production layout and quality performance.	Not supported
H_A 5h	Technological acquiring capability moderates the relationship between setup-time reduction and quality performance.	**Supported**
H_A 6	**Technological upgrading capability moderates the relationship between manufacturing practices dimensions and quality performance.**	
H_A 6a	Technological upgrading capability moderates the relationship between information technology and quality performance.	Not supported
H_A 6b	Technological upgrading capability moderates the relationship between customer relationship and quality performance.	Not supported
H_A 6c	Technological upgrading capability moderates the relationship between information sharing and quality performance.	Not supported
H_A 6d	Technological upgrading capability moderates the relationship between strategic supplier partnership and quality performance.	Not supported
H_A 6e	Technological upgrading capability moderates the relationship between human resource management and quality performance.	Not supported
H_A 6f	Technological upgrading capability moderates the relationship between quality culture and quality performance.	Not supported
H_A 6g	Technological upgrading capability moderates the relationship between production layout and quality performance.	Not supported
H_A 6h	Technological upgrading capability moderates the relationship between setup-time reduction and quality performance.	Not supported

Table 4.22 (*Continued*)

Hypo-theses	Statements	Remarks
H_A 7	**Technological acquiring capability moderates the relationship between manufacturing practices dimensions and flexibility performance.**	
H_A 7a	Technological acquiring capability moderates the relationship between information technology and flexibility performance.	**Supported**
H_A 7b	Technological acquiring capability moderates the relationship between customer relationship and flexibility performance.	Not supported
H_A 7c	Technological acquiring capability moderates the relationship between information sharing and flexibility performance.	Not supported
H_A 7d	Technological acquiring capability moderates the relationship between strategic supplier partnership and flexibility performance.	**Supported**
H_A 7e	Technological acquiring capability moderates the relationship between human resource management and flexibility performance.	Not supported
H_A 7f	Technological acquiring capability moderates the relationship between quality culture and flexibility performance.	**Supported**
H_A 7g	Technological acquiring capability moderates the relationship between production layout and flexibility performance.	Not supported
H_A 7h	Technological acquiring capability moderates the relationship between setup-time reduction and flexibility performance.	Not supported
H_A 8	**Technological upgrading capability moderates the relationship between manufacturing practices dimensions and flexibility performance.**	
H_A 8a	Technological upgrading capability moderates the relationship between information technology and flexibility performance.	Not supported
H_A 8b	Technological upgrading capability moderates the relationship between customer relationship and flexibility performance.	Not supported
H_A 8c	Technological upgrading capability moderates the relationship between information sharing and flexibility performance.	Not supported
H_A 8d	Technological upgrading capability moderates the relationship between strategic supplier partnership and flexibility performance.	Not supported
H_A 8e	Technological upgrading capability moderates the relationship between human resource management and flexibility performance.	Not supported
H_A 8f	Technological upgrading capability moderates the relationship between quality culture and flexibility performance.	Not supported
H_A 8g	Technological upgrading capability moderates the relationship between production layout and flexibility performance.	Not supported
H_A 8h	Technological upgrading capability moderates the relationship between setup-time reduction and flexibility performance.	Not supported
H_A 9	**Technological acquiring capability moderates the relationship between manufacturing practices dimensions and cost performance.**	
H_A 9a	Technological acquiring capability moderates the relationship between information technology and cost performance.	Not supported
H_A 9b	Technological acquiring capability moderates the relationship between customer relationship and cost performance.	Not supported
H_A 9c	Technological acquiring capability moderates the relationship between information sharing and cost performance.	Not supported
H_A 9d	Technological acquiring capability moderates the relationship between strategic supplier partnership and cost performance.	Not supported
H_A 9e	Technological acquiring capability moderates the relationship between human resource management and cost performance.	Not supported
H_A 9f	Technological acquiring capability moderates the relationship between quality culture and cost performance.	**Supported**

Table 4.22 (*Continued*)

Hypo-theses	**Statements**	**Remarks**
H_A 9g	Technological acquiring capability moderates the relationship between production layout and cost performance.	Not supported
H_A 9h	Technological acquiring capability moderates the relationship between setup-time reduction and cost performance.	Not supported
H_A 10	**Technological upgrading capability moderates the relationship between manufacturing practices dimensions and cost performance.**	
H_A 10a	Technological upgrading capability moderates the relationship between information technology and cost performance.	**Supported**
H_A 10b	Technological upgrading capability moderates the relationship between customer relationship and cost performance.	Not supported
H_A 10c	Technological upgrading capability moderates the relationship between information sharing and cost performance.	Not supported
H_A 10d	Technological upgrading capability moderates the relationship between strategic supplier partnership and cost performance.	Not supported
H_A 10e	Technological upgrading capability moderates the relationship between human resource management and cost performance.	Not supported
H_A 10f	Technological upgrading capability moderates the relationship between quality culture and cost performance.	**Supported**
H_A 10g	Technological upgrading capability moderates the relationship between production layout and cost performance.	Not supported
H_A 10h	Technological upgrading capability moderates the relationship between setup-time reduction and cost performance.	Not supported
H_A 11	**Technological acquiring capability moderates the relationship between manufacturing practices dimensions and delivery performance.**	
H_A 11a	Technological acquiring capability moderates the relationship between information technology and delivery performance.	Not supported
H_A 11b	Technological acquiring capability moderates the relationship between customer relationship and delivery performance.	**Supported**
H_A 11c	Technological acquiring capability moderates the relationship between information sharing and delivery performance.	**Supported**
H_A 11d	Technological acquiring capability moderates the relationship between strategic supplier partnership and delivery performance.	**Supported**
H_A 11e	Technological acquiring capability moderates the relationship between human resource management and delivery performance.	Not supported
H_A 11f	Technological acquiring capability moderates the relationship between quality culture and delivery performance.	**Supported**
H_A 11g	Technological acquiring capability moderates the relationship between production layout and delivery performance.	Not supported
H_A 11h	Technological acquiring capability moderates the relationship between setup-time reduction and delivery performance.	Not supported
H_A 12	**Technological upgrading capability moderates the relationship between manufacturing practices dimensions and delivery performance.**	
H_A 12a	Technological upgrading capability moderates the relationship between information technology and delivery performance.	Not supported
H_A 12b	Technological upgrading capability moderates the relationship between customer relationship and delivery performance.	**Supported**
H_A 12c	Technological upgrading capability moderates the relationship between information sharing and delivery performance.	Not supported

Table 4.22 (*Continued*)

Hypo-theses	**Statements**	**Remarks**
H_A 12d	Technological upgrading capability moderates the relationship between strategic supplier partnership and delivery performance.	Not supported
H_A 12e	Technological upgrading capability moderates the relationship between human resource management and delivery performance.	Not supported
H_A 12f	Technological upgrading capability moderates the relationship between quality culture and delivery performance.	**Supported**
H_A 12g	Technological upgrading capability moderates the relationship between production layout and delivery performance.	**Supported**
H_A 12h	Technological upgrading capability moderates the relationship between setup-time reduction and delivery performance.	Not supported

4.12 Chapter Summary

This chapter elaborates the data analyses and outcomes of the study. It started with the presentation of response rate, demographic profile of respondents and non-response bias analysis. There were mainly 175 usable responses representing 58 percent of the sampled population that have been used throughout the analyses. In terms of the demographic profiles, the respondents are differentiated by their company ownership, industry they served, the number of employees, their current position and job function in the company, and the number of years of experiences working in the industry. Factor analyses were performed resulting in the revised of research model and hypotheses statements. Correlation analyses revealed that most of the variables are positively related to each other.

Furthermore, after complied all of the fundamental statistical assumptions, the empirical results of hypotheses testing were presented. In general, H_1 until H_4 serve to answer the first research question and concludes the first research objective by undergone multiple linear regression analysis. The findings showed that some of the manufacturing practices dimensions significantly affect the manufacturing performance dimensions, while some others were not. Table 4.23 depicted the recapitulation of the overall findings of revised hypotheses statements, research question and objectives.

Table 4.23
Recapitulated of the Research Findings between Revised Hypotheses Statements, Research Questions and Research Objectives

	Hypotheses (H)	**Research questions (RQ)**	**Research objectives (RO)**
H_1	Manufacturing practices dimensions of CR, HRM and QC significantly affect the quality performance.	**RQ1:** Do manufacturing practices have significant effect on manufacturing performance in Malaysian manufacturing companies?	**RO1:** To determine the effect of manufacturing practices on manufacturing performance of Malaysian manufacturing companies.
H_2	Manufacturing practices dimensions of IT, CR, IS, HRM, and STR significantly affect the flexibility performance.		
H_3	Manufacturing practices dimensions of HRM and STR significantly affect the cost performance.		
H_4	Manufacturing practices dimensions of HRM and QC significantly affect the delivery performance.		
H_5	TAC significantly moderates the relationship between SSP and STR with quality performance.	**RQ2:** Does technological capability moderates the relationship between manufacturing practices and manufacturing performance in Malaysian manufacturing companies?	**RO2:** To examine the moderating effect of technological capability on the relationship between manufacturing practices and manufacturing performance of Malaysian manufacturing companies.
H_6	TUC did not significantly moderates the relationship between manufacturing practices dimensions and quality performance.		
H_7	TAC significantly moderates the relationship between IT, SSP and QC with flexibility performance.		
H_8	TUC did not significantly moderates the relationship between manufacturing practices dimensions and flexibility performance.		
H_9	TAC significantly moderates the relationship between QC and cost performance.		
H_{10}	TUC significantly moderates the relationship between IT and QC with cost performance.		
H_{11}	TAC significantly moderates the relationship between CR, IS, SSP and QC with delivery performance.		
H_{12}	TUC significantly moderates the relationship between CR, QC and PL with delivery performance.		

Note: CR = Customer Relationship, HRM = Human Resource Management, IS = Information Sharing, IT = Information Technology, PL = Production Layout, QC = Quality Culture, SSP = Strategic Supplier Partnership, STR = Setup-time Reduction, TAC = Technological Acquiring Capability, TUC = Technological Upgrading Capability

Next, the moderating effect hypotheses (hypotheses H_5 until H_{12}) were analyzed using hierarchical regression analysis to answer the second research question and completed the second objective. The outcomes revealed a few supports for the moderating effect of technological acquiring capability and technological upgrading capability on the relationships between manufacturing practices and manufacturing performances, except for two hypotheses, H_6 and H_8; because of there is not enough evidence to support both hypotheses. Along with it, the moderating effect graphs were alternately displayed and described throughout the hierarchical regression analysis reporting. Additionally, both moderators were found to be quasi moderators. Quasi moderator is a moderator that interacts with predictor variable and also related with the criterion or the predictor (Sharma et al., 1981). Figure 4.18 summarizes the moderators involved in this study. The findings in this study were interesting as it pointed to several stimulating relationships between the variables. Further discussion and conclusion in the next chapter will elaborate more on the result and their implication to the theory and practice.

	Related to Criterion and/or Predictor	Not Related to Criterion and Predictor
No Interaction with Predictor	1 Intervening/ Exogeneous/ Predictor variables	2 Moderator: Homologizer
Interaction with Predictor Variable	3 Moderator: Quasi moderator Technological Acquiring Capability Technological Upgrading Capability	4 Moderator: Pure moderator

Figure 4.18
The moderators identified in the study based on typology of specification variables by Sharma et al. (1981)

CHAPTER FIVE

DISCUSSION AND CONCLUSION

5.1 Introduction

Chapter five discusses on the research findings. It started with the recapitulation of the findings presented in the previous chapter. Followed by the discussions on the outcomes resulting from the hypotheses testing of direct relationships between manufacturing practices dimensions and manufacturing performance dimensions, and testing of moderation effects of technological capability. Furthermore, the chapter discusses on the study's implications in terms of theoretical and practical contributions, boundaries that limit the study and recommendations for forthcoming research. The chapter ends with the conclusions of research findings and concluding remarks.

5.2 Recapitulation of Research Findings

This study investigated the influence of manufacturing practices dimensions on manufacturing performances of a company. The study also examined the role of technological capability as a moderator in affecting the relationship between predictors and the criterion variables. By studying these connections, the firm's manufacturing performance may be enhanced. This research model was supported by the RBV, which states that firm's competitive advantage is influenced by organizational resources and capabilities. In this case, manufacturing practices were the intangible resources or routines while the technological capability was the organizational capability that will have an effect on firm's manufacturing performance.

While considering organization as the unit of analysis, a survey method was applied to achieve the looked-for objectives of the research. The population of this study included the manufacturing firms from four industries of food products, chemicals and chemical products, rubber and plastic products, and computer, electronic and optical products in Malaysia. Data were collected from senior executives, department managers, senior managers, plant managers, general managers and the top executive management within the organization. The survey method strategy using self-administration of the survey questionnaire approach was used to collect the data with regard to respondent's perception of the firm's manufacturing performance and implementation of practices and capabilities. A total of 302 questionnaires were distributed. Only 175 usable questionnaires were collected representing a response rate of 58 percent of the total questionnaire distributed.

Factor analysis was conducted for the three main variables namely manufacturing practices (independent variable), technological capability (moderating variable), and manufacturing performance (dependent variable). From the analysis, it was concluded there were eight (8) factors emerged for manufacturing practices. Some of these factors were renamed accordingly to the revised model. These practices were categorized and renamed into 1) Information Technology (Chong et al., 2011), 2) Customer Relationship (Chong et al., 2011), 3) Information Sharing (Chong et al., 2011), 4) Strategic Supplier Partnership (Chong et al., 2011), 5) Human Resource Management (Dal Pont et al., 2008; Ahmad & Schroeder, 2003), 6) Quality Culture (Narasimhan et al., 2005), 7) Production Layout (Bayo-Moriones et al., 2008), and 8) Setup-Time Reduction (Bayo-Moriones et al., 2008). On technological capability, two (2) factors emerged which in line with Chantanaphant et al., (2013) classification: 1) Acquiring Capability and 2) Upgrading Capability. The four (4) named factors or construct of manufacturing performance are 1) Quality (Chi, 2010), 2) Flexibility (Chi, 2010), 3) Cost (Boyer & Pagell, 2000), and 4) Delivery (Chi, 2010).

The Pearson's correlation, multiple regression and hierarchical regression analysis were later applied to answer the research questions and achieve the objectives of the study. Results from these analyses have established the important roles of human resource management, customer relationship, quality culture, setup-time reduction, information sharing, and information technology in moving the firm towards excellence. The stakeholders in the firm should recognize the crucial roles of these practices play in the manufacturing companies. The implementation of human resource management has been proven in this study among other practices, as the most important variables that contributed to enhance firm's manufacturing performance. Managing the human resource efficiently are promised to enhance manufacturing performance in all aspect of quality, flexibility, cost, and delivery.

5.3 Discussion of Findings – Manufacturing Practices and Manufacturing Performance

This section presents the overall discussions on the research outcomes based on the first research objective and to answer the first research question (*Do manufacturing practices have significant effect on manufacturing performance in Malaysian manufacturing companies?*). The results involve direct relationships between eight manufacturing practices and four dimensions of manufacturing performance.

Based on the outcomes of the correlation analysis, all dimensions of manufacturing practices indicate significant positive relationship with all dimensions of manufacturing performance, except for Production Layout which did not correlate with Cost Performance. The majority of the correlation coefficients fall within low to moderate magnitude. These results imply that manufacturing practices are related to manufacturing performance.

Further, multiple regression analysis was performed to identify the most contributory variables among manufacturing practices that best predict the dimensions of MP namely Quality Performance, Flexibility Performance, Cost Performance and Delivery Performance. For this purpose, four standard multiple regression analysis models were developed and the outcomes indicate that all models are statistically significant. In overall, the results show that Information Technology, Customer Relationship, Information Sharing, Strategic Supplier Partnership, Human Resource Management, Quality Culture, Production Layout, and Setup Time Reduction jointly explain 47.8 percent of the variance of Quality Performance, 24.3 percent of the variance of Flexibility Performance, 18.8 percent of the variance of Cost Performance, and 25.3 percent of the variance of Delivery Performance. Therefore, the models propose that the effect of manufacturing practices on Quality Performance is the highest, followed by Delivery Performance, Flexibility Performance, and then Cost Performance.

Three predictor variables namely Customer Relationship, Human Resource Management, and Quality Culture are proven significantly influence the Quality Performance. Next, five predictor variables namely Information Technology, Customer Relationship, Information Sharing, Human Resource Management, and Setup-Time Reduction are proven significantly influence the Flexibility Performance. However, only two predictor variables are found to have statistically significant influence on both Cost Performance and Delivery Performance which are; Human

Resource Management and Setup-Time Reduction, and Human Resource Management and Quality Culture respectively.

5.3.1 Manufacturing Practices and Quality Performance

Hypotheses H_1-a to H_1-h postulate statistically significant relationships between manufacturing practices and Quality Performance. For the purpose of this study, Quality Performance reflects a focus on the conformance dimension of quality such as improvement in conformance to product specification, improvement in high performance product features, and offer consistence and reliable product quality. The descriptive statistic shows that the respondents perceived that their companies have achieved a high level of Quality Performance contributed by the manufacturing practices implementation over the last three years (mean = 5.202). Based on the results of multiple regression analysis, the study discovers that only Customer Relationship, Human Resource Management, and Quality Culture have significant effect on Quality Performance while other dimensions of manufacturing practices are not. The regression results between the individual dimensions of manufacturing practices and Quality Performance are proven to be mixed.

Customer Relationship practice was found to have significant effects on Quality Performance which supports the hypothesis H_1-b. It shows that an adequate relationship with customer is significantly related to firm's manufacturing quality performance. With such close relationship with key customers, firms are able to recognize and evaluate what are their customers' preferences and expectations on the end products, thus complying the products' quality as align with study of Chong et al. (2011). Similarly, this statistical results supports the findings from several studies that evidenced a significant positive relationship between customer relationship and quality performance (Chavez et al., 2015; Ketokivi & Schroeder, 2004a; Koufteros, Vonderembse, & Jayaram, 2005; Wong et al., 2011). It is expected that a good relationship with customers will lead to greater levels of quality as customers are the source of valuable information and they could have an input in many of the parameters that can affect quality.

Human Resource Management practice was found to have a significant influence on Quality Performance which proves the hypothesis H_1-e. Eventhough there was reported that human resource management practices were being moderately practiced by most firms in Malaysia (Osman, Ho, & Carmen Galang, 2011), while in this study, the good implementation of people management was revealed to positively significantly effect the quality performance. Similarly, the result is supported by the study of (Bello-Pintado, 2015; Delaney & Huselid, 1996; Wickramasinghe & Gamage, 2011), where they found a significant posititve effect of human resource practices on the firm's quality performance. This finding suggesting that firms with a higher level of human resource management practices score higher on quality results.

Hypothesis H_1-f was satisfied when the Quality Culture practice was found to have significantly impact the manufacturing firm' Quality Performance. In this study, the implementation of quality culture reflects the level of quality performance, as suggested in prior study that quality management practices generally indicated strong and positive relationship with quality performance (Bello Pintado et al., 2015; Zehir et al., 2012). Similarly, this finding is in line with previous studies that found the direct effect of quality practices on quality performance (Ng & Jee, 2012; Wiengarten et al., 2011). Therefore, suggesting the importance for firm to adopt the culture of quality management for firm to enjoy a better and enhanced quality performances.

However, this study reveals that other dimensions of manufacturing practices namely Information Technology, Information Sharing, Strategic Supplier Partnership, Production Layout, and Setup-Time Reduction were found to have no significant relationship with Quality Performance when they were ran together in the analysis. Hence, the hypotheses related to these practices and Quality Performance i.e. H_1-a, H_1-c, H_1-d, H_1-g, and H_1-h are not supported. These findings contradicts with previous studies on the relationship between these manufacturing practices and quality performance (Chen, 2015; Khanchanapong et al., 2014; Lee et al., 2015).

With such findings, first, this study evidences that the implementation of information system technology does not directly influence quality performance. A plausible explanation for this finding may be due to the fact that IT system implemented in the factory was basically concerned to the process itself internally and externally that make it less related to the quality performance per se (Wu, Yeniyurt, Kim, & Cavusgil, 2006). Second, information sharing was found insignificant towards the quality performance. It suggests that having an effort and getting external information with business partners will not necessarily influence the quality performance (Lotfi, Mukhtar, Sahran, & Zadeh, 2013). This is because, to realize the benefit of information sharing on quality performance, the firm must engage with sharing a real-time information data (Tsung, 2000). If the information shared is only general and descriptive due to information privacy, thus it will not influence the product quality (Lotfi et al., 2013). Third, strategic supplier partnership was found not significant on quality performance. This finding is supported by Koufteros et al. (2005), Robb et al. (2008) and Swink, Narasimhan, and Wang (2007), where they found that relationship with suppliers did not significantly influenced the measures of quality performance. A possible explanation is because, supplier integration actually impedes improvements in quality performance. The firm may become unmotivated to provide high quality performance if they feel that their business interests are secured (Swink et al., 2007). Next, it was confirmed that the relationship between firm's production layout and quality performance is insignificant. It is supported by a study of He and Hayya (2002) which reported the insignificant relationship between manufacturing layout and product quality. The result suggests that layout of the production did not directly related to the enhancement in product quality.

Finally, setup-time reduction was found insignificant towards quality performance. This argument is supported by Ketokivi and Schroeder (2004a) and He and Hayya (2002) who did researched on the manufacturing practices-strategic fit-performance of the manufacturing companies. They did not found any significant relationship between setup-time reduction and quality performance. Their findings suggested that setup-time reduction which was measured under the JIT production practices is not related to the competitive conformance quality and product quality. A possible explanation is, firm should not expect to enhance quality conformance by installing a JIT practices component of setup-time reduction alone. It should be implemented together with other components such as equipment layout, pull system support, Kanban (Sakakibara et al., 1997).

5.3.2 Manufacturing Practices and Flexibility Performance

Hypotheses H_2-a to H_2-h postulate statistically significant relationships between manufacturing practices and Flexibility Performance. For the purpose of this study, Flexibility Performance reflects an emphasis on the production related process and product dimension of flexibility such as adjustment to production capacity, adjustment to product mix, rapid equipment changeover, and rapid volume changes.

The descriptive statistic shows that the respondents perceived that their companies have achieved a high level of Flexibility Performance contributed by the manufacturing practices implementation over the last three years (mean = 4.674). Based on the results of multiple regression analysis, the study discovers that Information Technology, Customer Relationship, Information Sharing, Human Resource Management, and Setup-Time Reduction have significant effect on Flexibility Performance while three other dimensions are not.

Information Technology practice was found to have significant effects on Flexibility Performance which supports the hypothesis H_2-a. The result from this study shows that implementation of information technology system within the manufacturing operations is proven to influence flexibility performance. It is proven that for this particular study, the more advanced and fully utilized IT system is, the more inflexible the firm be. The result from this study showed that implementation of information technology system within the manufacturing operations is proven to influence flexibility performance ("Bryan" Jean, Sinkovics, & Kim, 2008). However, the result portrayed that the effect between IT practices and flexibility is negative. It is proven that for this particular study, the more advanced and fully utilized IT system in the firm is, the less flexible the firm be. The reason why IT has effected negatively to flexibility performance most probably due to the fact that when companies are using a standard developed IT system in the supply chain, they are less flexible to adjust in any changes according to market demand. The system implemented need to be modified or adjust to cope with the changes which happened to consume time. Inability to adjust to any changes due to IT system, consequently contribute to the negative relationship between IT practices and flexibility performance (Wu et al., 2006).

Customer Relationship practice was found to have significant effects on Flexibility Performance which supports the hypothesis H_2-b. For the current study, it was found that a good practicing relationship with customer will significantly enhance manufacturer's flexibility performance. Similarly, Wong et al. (2011) and Chavez et al. (2015) had research on the customer integration and production flexibility and found a significant positive association between the two. This finding was also supported by Robb et al. (2008) who studied on customer relationship and flexibility. They put emphasize on the firm flexibility that was influence with a high degrees of customer relationship. Thus suggesting that managers seeing that a good relationship with customers will improve flexibility and it is important for the firm to consider both the inside and outside the firm for support.

Information Sharing practice was found to have significant influence on Flexibility Performance that prove the connotation of hypothesis H_2-c. By sharing information with trading partners, it was found to have significantly impact the flexibility of the firm. From the practical point of view, the managers considered not only the internal production but also the external information that come from trading partners were deemed as important to improve the flexibility performance (Prajogo & Olhager, 2012). It shows that companies' are more aware of current information in the industry through trading partners that make them ready for immediate changes of the production.

Human Resource Management practice was found to have a significant influence on Flexibility Performance which proves the hypothesis H_2-e. In this study, managers considered that flexibility performance of a factory dependend on the people management practice. A study by Robb et al. (2008) evaluated the relationship between HR practices and flexibility importance and the result showed a positive relationship which later influence the flexibility performance. The relationship was found significant and it supports the results of this study. A same support also came from Urtasun-Alonso et al. (2012) and Bello-Pintado (2015) where their results also shows a positive relationship between HRM practices and manufacturing flexibility. Consequently, the current results support the conjecture that more flexible plants have implemented HRM practices in a great extent than less flexible plants.

Hypothesis H_2-h was satisfied when the Setup-Time Reduction practice was found to significantly impact the manufacturing firm' Flexibility Performance. This study found that managers believed that the lower setup-time reduction of equipment in the plant will make the firm to be more flexibile. Evidence from the global manufacturing research group (GMRG) suggests that investments in plant equipment practices such for setup-time reduction were positively affect the operational performance of flexibility to change product mix (Wiengarten et al., 2011). Moreover, the previous findings found that JIT practices of setup-time reduction was reported to have significant positive association with manufacturing flexibility (Mackelprang & Nair, 2010), hence supports the current findings.

Nevertheless, this study discloses that other dimensions of manufacturing practices namely Strategic Supplier Partnership, Quality Culture, and Production Layout have no significant influence on Flexibility Performance. Hence, the hypotheses related to these practices and Flexibility Performance i.e. H_2-d, H_2-f, and H_2-g are not supported. The current findings contradict with the previous findings, however, a believable explanation for these outcomes are supported by a few of previous studies. First, strategic supplier partnership was found insignificant towards flexibility performance of this study. The managers believed that relationship and integration with suppliers did not directly influence the firm's manufacturing flexibility. This connotation is supported by quite a number of studies conducted on practices-performance relationship in manufacturing companies, see for examples (Flynn, Huo, & Zhao, 2010; Ketokivi & Schroeder, 2004a; Robb et al., 2008; Swink et al., 2005; Swink et al., 2007), where the outcomes showed supplier relationship did not significantly influence flexibility performance. Next, quality culture was found to have insignificant relationship with flexibility performance. This argument is consistent with Swink et al. (2005), where their study had suggested that quality management did not significantly associated with flexibility performance. McKone, Schroeder, and Cua (2001) also confirmed the insignificant relationship between quality-related management practices with manufacturing flexibility. Lastly, the managers believed that improvement in factory's flexibility performance is not directly influenced by the layout of the production floor. This results is in line with previous study that the flow of JIT production was confirmed to not have significant association with flexibility (Swink et al., 2005). It is explained that the insignificant relationship between quality culture and flexibility performance happened due to the association of the quality practices to manufacturing performance are dependent on the presence or absence of strategy integration of product-process, suppliers and customers (Swink et al., 2005), and lacking in the process variance reduction, standardized processes, and increased conformance of the company which associated with quality management may hinder process stability on which to build flexibilities (Swink et al., 2007).

5.3.3 Manufacturing Practices and Cost Performance

Hypotheses H_3-a to H_3-h postulate statistically significant relationships between manufacturing practices and Cost Performance. For the purpose of this study, Cost Performance reflects a center on the reduction of inventory level and production costs. The descriptive statistic shows the respondents perceived that their companies have achieved a high level of Cost Performance contributed by the manufacturing practices implementation over the last three years (mean = 4.454). Based on the results of multiple regression analysis, the study discovers that only Human Resource Management and Setup-Time Reduction have significant effect on Cost Performance while the rest of six other dimensions are not.

Human Resource Management practice was found to have a significant impact on Cost Performance which proves the hypothesis H_3-e. In this study, managers considered that cost performance of a factory dependend on the people management practice. The result supports a study on HRM practices and cost-quality performance outcomes, where the bundles of HRM practices were shown to be strongly related to cost performance (Bello-Pintado, 2015). It showed that HRM practices encouraging the production workers' motivation to become effective and productive. Similarly, HRM was found to achieve statistically significant positive influence on manufacturing performance which considered on the cost of product manufactured (Challis et al., 2005).

Hypothesis H_3-h was satisfied when the Setup-Time Reduction practice was found to statistically significantly impact the manufacturer's Cost Performance. A meta-analysis investigation between the relationship of JIT practices and performance outcomes revealed that not all individual JIT practices are associated with all types of performance outcomes such as inventory, cycle time, delivery, quality, cost, or flexibility performance (Mackelprang & Nair, 2010). They discovered that cost performance is positively associated with setup-time reduction. It indicated that considering the setup-time reduction of factory's equipment will eventually have an influence in reducing the manufacturing cost. The current finding is supported by Wiengarten et al. (2011), where their results confirmed that investments in plant and equipment practices such as setup-time reduction were positively significantly affect manufacturing cost performance. Similarly, there was also a significant positive impact of setup-time reductions on reducing product cost manufactured of manufacturing firms in Australia and New Zealand context (Challis et al., 2005). Accordingly, the current finding suggests, even though the influence of setup-time reduction is very minimal at $p < 0.1$, it still have in some way to effect the cost reduction where improvement in reducing equipments' setup-time will save time and making sure the productions is ongoing uninterrupted.

Yet, this study reveals that other dimensions of manufacturing practices namely Information Technology, Customer Relationship, Information Sharing, Strategic Supplier Partnership, Quality Culture, and Production Layout have no significant effect on Cost Performance when they were analyzed together. Hence, the hypotheses related to these practices and Cost Performance i.e. H3-a, H3-b, H3-c, H3-d, H3-f, and H3-g are not supported. These results contradict with past findings i.e. (Bello Pintado et al., 2015; Chong et al., 2011; Khanchanapong et al., 2014; Lee, 2015; Prajogo & Olhager, 2012; Ye & Wang, 2013) and they are consistent with only a few as discussed afterward.

First, information technology did not found to statistically influence the cost performance. This result is in line with a study by Ye and Wang (2013), which they found there is no significant relationship between IT alignment and cost efficiency among the Chinese manufacturing firms. Other study by Li, Yang, Sun, and Sohal (2009) also confirmed that there is no significant effect of the implementation of IT on supply chain performance cost which measured the inventory visibility and opportunity and total logistics costs. Although more and more manufacturers are pursuing efficient ways to improve the plant performances and often make huge investments in IT systems, it is still uncertain whether the implementation of IT has a direct effect on cost performances. Second, it was found that there is no significant effect of customer relationship practice on cost performance. This finding is parallel with previous study that proved the insignificant effect of customer integration and production costs which was measured under the value variable (Robb et al., 2008). The same scenario happened to a study by Swink et al. (2007) where they found that none of the parameters linking customer integration to five manufacturing competitive capabilities including the cost performance was significant at $p < 0.10$. This result suggests the non-significant effect between customer integration and cost performance is may be that cost performance is important for only certain, narrowly defined practices.

Third, the insignificant influence findings of information sharing on cost performance contradicts with Ye and Wang (2013). Sharing the required information with trading partners did not directly influence the inventory levels and production costs. It is explained that information sharing by itself may not fully exert its influence on the achievement of cost performance (Wu, Chuang, & Hsu, 2014). Another reason is that information sharing practices can be expressed as a behavioral intention at the supply chain. Because of this character, it required an intervening factor i.e. collaboration effort. With the existence of collaboration effort resulting in a significant influence on cost performance (Wu et al., 2014). Forth, strategic supplier partnership did not significantly effects the cost performance. This result is supported by Swink et al. (2005) and Robb et al. (2008), where relationship with supplier did not statistically significantly influenced the cost efficiency and production costs. Their result was further confirmed that strategic supplier partnership was non-associated with cost performance (Swink et al., 2007).

Next, the relationship between the cultures of practicing quality practices does not seem to have influence on manufacturing cost performance. This outcome is similar to the previous study by Swink et al. (2005) that established the non-significant relationship between quality management practices and cost efficiency. The finding suggests that the adoption quality culture in the factory by production workers do not affect the cost of production and inventory reduction directly. Instead, the quality culture is found to have an impact on quality and delivery performances. Perhaps quality culture, as measured in this study, considers the socially accepted characteristics of the practices rather than the instrumental characteristics of the practices that would directly improve cost performance (McKone et al., 2001). This helps clarify why quality culture practices, as measured in this study, does not contribute to cost performance. Finally, the analysis discovered that production layout practices did not significantly have an impact towards cost performance. The result is consistent with Swink et al. (2005)'s findings that indicated the JIT flow practice which also measuring almost similar to production layout practice to have insignificant effects towards the cost performance. Thus, from a theory development viewpoint, this outcome emphasize the importance of identifying the focused elements of JIT production practices from the commonly associated infrastructural practices, which may have more to do with cost improvements.

5.3.4 Manufacturing Practices and Delivery Performance

Hypotheses H_4-a to H_4-h postulate statistically significant relationships between manufacturing practices and Delivery Performance. For the purpose of this study, Delivery Performance reflects a concentration on the improvement in fast delivery and on-time delivery. The descriptive statistic shows that the respondents perceived their companies have achieved a high level of Delivery Performance contributed by the manufacturing practices implementation over the last three years (mean = 4.782). Based on the results of multiple regression analysis, the study discovers that only Human Resource Management and Quality Culture have significant effect on Delivery Performance while six other practices are not.

Human Resource Management practice was found to have a significant impact on Delivery Performance which proves the hypothesis H_4-e. In this study, managers considered that delivery performance of a factory is highly dependend on how the people is being manage. The finding is supported by a previous study which highlights that an emphasized on human resource management will enhance the delivery in full on-time to the customers (Challis et al., 2005). Bundles of human resource management practices were not only improving efficiency and quality, but also in reducing the time-related task in the factory such as delivery time to the customers (Bello-Pintado, 2015). This finding thus suggesting that improvement in delivery performance highly depending on how well the implementation and management of production personnel in the factory.

Hypothesis H_4-f is supported when the Quality Culture practice was found to significantly influence the manufacturer's Delivery Performance. The result is in line with previous studies conducted on the implementation impact of quality management practices on firm's delivery manufacturing performance (Challis et al., 2005; Ismail Salaheldin, 2009; Wiengarten et al., 2011). It is evidently that culture of production workers to believe that quality is their responsibility and persuing continuous improvement have a significant positive effect in improving delivery performance. Likewise, quality responsibility of the workers under the workforce management was also found to have significant impact on improving on-time and fast delivery to the customers (Naor, Goldstein, Linderman, & Schroeder, 2008).

However, this study exposes that other dimensions of manufacturing practices namely Information Technology, Customer Relationship, Information Sharing, Strategic Supplier Partnership, Production Layout, and Setup-Time Reduction have no significant result on Delivery Performance when they were analyzed together. Therefore, the hypotheses related to these practices and Delivery Performance i.e. H_4-a, H_4-b, H_4-c, H_4-d, H_4-g, and H_4-h are not supported. First, information technology practice was found non-significant towards delivery performance. This finding is supported by Li et al. (2009) through their analysis on the implementation of IT impact towards supply chain performance which also measuring the delivery performance. The possible explanation is, for firm to realize the effect of IT on delivery performance, the element of supply chain integration must be practiced throughout the chain. It is because, the implementation of IT system itself without the capacity to integrate and embed the IT will not directly influenced the delivery (Li et al., 2009; Wu et al., 2006). A higher level of IT does not necessarily imply better use of firm resources. Most often, huge expenditures in information and communication technology do not necessarily result in much anticipated benefits of delivery performance for the firm (Wu et al., 2006).

Next, the effect of customer relationship and strategic supplier partnership practices on delivery performance were found statistically not significant. A prior study in supply chain and operations practices on manufacturer's operational performance indicated the non-significant relationship between customer and supplier relationship and speed performance that was measuring on the delivery time (Robb et al., 2008). Similarly, Ketokivi and Schroeder (2004a) and Swink et al. (2007) did also found the insignificant associations between customer and supplier relationship with delivery performance. Third, the insignificant influence of information sharing on delivery performance could be due to the fact that getting and sharing more proprietary information and business knowledge from trading partners will not immediately make the delivery of finished goods to the customer even faster (Lotfi et al., 2013). A tolerable explanation for this finding may be because companies often will benefit from the practice of sharing information to plan for future operational and business strategies instead of directly influencing the delivery time (Flynn et al., 2010).

Lastly, the outcomes showed that there are no significant effect for both JIT production practices of the production layout and setup-time reduction on the delivery performances. He and Hayya (2002) for example, had shown that the implementation of manufacturing cells negatively correlated with on-time delivery, while setup-time reduction correlated positively with on-time delivery, however the statistics are not significant. Similarly, Mackelprang and Nair (2010) had also found that the equipment layout of the factory is not significantly related to delivery performance. This discovery is interesting because by implementing JIT production-layout and setup-time reduction in the factory should reduce and shorten the production time, indirectly will save delivery time compared to the original schedule, but the opposite happens. It is justified that the setup-time reduction practice is important factor related to operational performance outcomes, however, it was identified as less influential as compared to the others JIT-production practices such as equipment layout, pull system support, Kanban, and supplier quality level (Sakakibara et al., 1993). Except for setup-time reduction, these four practices is considered as the major driving forces in performance improvement. The first three practices control the flow of production in the factory while the supplier quality level controls the quality of supplies from the suppliers.

5.4 Discussion of Findings – Moderating Effects of Technological Capability

This section offers the overall discussions on the research outcomes based on the second research objective and to answer the second research question (*Does technological capability moderates the relationship between manufacturing practices and manufacturing performance in Malaysian manufacturing companies?*). For answering the question, hierarchical multiple regression analysis was conducted to analyze the interaction terms between the independent variables (manufacturing practices) and the moderating variables (TAC and TUC) in order to test the moderating effects.

The results reveal mixed findings of the moderating effects of acquiring capability and upgrading capability on the relationships between eight manufacturing practices and four dimensions of manufacturing performance. Table 5.1 presented a summary of overall moderating effect results. Hypotheses H_5-a through H_6-h postulate if TC (TAC and TUC) moderates the relationship between manufacturing practices and

Quality Performance. Hypotheses H_7-a through H_8-h postulate if TC (TAC and TUC) moderates the relationship between manufacturing practices and Flexibility Performance. Hypotheses H_9-a through H_{10}-h postulate if TC (TAC and TUC) moderates the relationship between manufacturing practices and Cost Performance.

Table 5.1
Summary of the Moderators

Predictors	**Moderator: Technological Acquiring Capability (TAC)**				**Moderator: Technological Upgrading Capability (TUC)**			
	Quality H_5	Flexibility H_7	Cost H_9	Delivery H_{11}	Quality H_6	Flexibility H_8	Cost H_{10}	Delivery H_{12}
<u>Manufacturing Practices Dimensions</u>								
a) Information Technology (IT)		1.128*					1.664*	
b) Customer Relationship (CR)				1.913**				2.322**
c) Information Sharing (IS)				1.285*				
d) Strategic Supplier Partnership (SSP)	1.214*	-1.425*		-1.778**				
e)Human Resource Management (HRM)								
f) Quality Culture (QC)		-1.859**	-1.629*	-1.856*			-2.585*	-2.693**
g) Production Layout (PL)								1.374*
h) Setup-Time Reduction (STR)	-1.421**							
Type of moderator	Quasi moderator	Quasi moderator	Quasi moderator	Quasi moderator			Quasi moderator	Quasi moderator

Note: Significant levels: **p < 0.05, *p < 0.1

Hypotheses H_{11}-a through H_{12}-h postulate if TC (TAC and TUC) moderates the relationship between manufacturing practices and Delivery Performance. Based from the hierarchical regression analysis results as presented in Table 5.1, this study finds that there is a moderating effect of TAC on the relationship between some manufacturing practices and certain manufacturing performances. All in all, the TAC moderates the relationship; between SSP practice with quality, flexibility, and delivery; between QC with flexibility, cost, and delivery; between IT and flexibility; between CR and delivery; between STR and quality; and between IS and delivery. However, TUC was found to have significant moderating impact on the relationship between some manufacturing practices with only two performance measures namely cost and delivery. All in all, the TUC moderates the relationship; between QC with cost and delivery; between IT and cost; between CR and delivery; and between PL and delivery performance. Both moderators were identified as quasi moderator.

Some of the results proposed that it is not a guarantee for firm who have high capability to excel in the manufacturing-related performances. At the same time, it is their operational strategy that will lead the manufacturing practices to have an encouraging influence on performance and each practices are seem to have complementing each other since some of the practices might overlapping between the theories (Khanchanapong et al., 2014). Many of the results were not as expected. The insignificant relationships occurred due to various reasons; the use of different analytical elements influencing the strength of the moderating variable technological capability; the sample size of the study; geographical restriction of the search and segment; size of the companies surveyed; and the complexity of the relationship between the analysis variables (de Almeida Guerra & Camargo, 2016). All of the significant findings are further discussed in the next section, one after the other.

5.4.1 Technological Capability, Manufacturing Practices and Quality Performance

Hypothesis H_5-d postulates that Technological Acquiring Capability (TAC) moderates the relationship between Strategic Supplier Partnership (SSP) and Quality Performance. The result described that the positive impact of SSP on quality performance is much stronger when TAC is high as compared to when TAC is low. In this case, a firm which has higher capability in technological acquiring shows more apparent increase in quality performance as compared to another firm which has lower acquiring capability. In a scenario where firms possess high level of SSP, the level of TAC influences its quality outcome. This result is supported by Prajogo and Olhager (2012), where building a strong relationship and close coordination with suppliers is very important. A close relationship increases the willingness of both parties to absorb and share variations in goal-setting activities through continuous improvement programs, thus, increases the firm awareness in respond to produce with better quality. As supported by Haeussler et al. (2012), the impact of supplier relationship of so called strategic alliance on performance become stronger when the firm has a better capability in acquiring technological knowledge from outsource such as research institutions and technology suppliers. With this knowledge, the high TAC firm will benefit the accumulated new knowledge from internal and external channels. By sharing the technological knowledge with the suppliers, it improves the suppliers' product quality, hence improving the firm's product quality better.

Hypothesis H_5-h postulates that TAC moderates the relationship between Setup-Time Reduction (STR) and Quality Performance. The result revealed that the positive impact of STR on Quality Performance is much stronger when TAC is low as compared to when TAC is high. In this case, a firm which has lower TAC shows wider increase in Quality Performance as compared to another firm which has higher TAC. The occasion that STR improves quality performance is supported by Alcaraz, Maldonado, Iniesta, Robles, and Hernández (2014), Bortolotti, Danese, and Romano (2013), and (Chen, 2015). Yet, as the result in this study showed that low capability firm in acquiring technological had bigger influence on the relationship between STR and quality performance. The scenario happened when low TAC firms are complacent with the routine in reducing their setup time, the regular practices makes the smooth production flow thus improves the product quality. However, when the firm started to have a higher capability in acquiring external technological knowledge, it somehow load the firm with abundance of knowledge and information. These knowledge and information are intentionally used to improve the routines. But, when there is often interruption happened to the routines in reducing the setup time, it directly affects the production of goods which effect to quality performance of products.

5.4.2 Technological Capability, Manufacturing Practices and Flexibility Performance

Hypothesis H_7-a postulates Technological Acquiring Capability (TAC) moderates the relationship between Information Technology (IT) and Flexibility Performance. The results showed that the negative impact of IT on Flexibility Performance is much stronger when TAC is low as compared to when TAC is high. The results on significant impact of the IT system on flexibility performance is supported by "Bryan" Jean et al. (2008). However, the results showed that IT system has a significant negative impact towards flexibility performance. The practical views believes, this situation is explainable. When the firms are applying a standard IT system into the production processes, the ability of the firm to adjust the production processes according to market demand is lessen because the prior system implemented must be adjusted earlier. The effort in system adjustment is not a simple task, where it will acquire the exact personnel to modify or develop a new IT system in order to cope with the changes. However, if the firms have high technological acquiring capability, they can highly cooperate with the technology suppliers in the market to gain the technological knowledge in changing the system. Therefore, the decremental in flexibility performance is lessen. To put forward on another view, when the firms have a low capability in acquiring technological knowledge, the flexibility become much lessen. It is due to the incapability of the firm to respond to the changes in production processes according to the market demand in a certain period of time. This situation further strengthen that a firm which has lower acquiring capability shows wider reduction in flexibility performance as compared to another firm which has higher acquiring capability.

Hypothesis H_7-d suggested that Technological Acquiring Capability (TAC) moderates the relationship between Strategic Supplier Partnership (SSP) and Flexibility Performance. The result presented that the positive impact of SSP on flexibility performance is much stronger when TAC is high as compared to when TAC is low. In this case, a firm which has higher TAC shows more apparent increase in flexibility performance as compared to another firm which has lower acquiring capability. The result of significant impact between SSP and flexibility performance is supported by previous studies. The impact become stronger when the firm has a higher level of acquiring capability. The strategic alliances and close cooperation with suppliers is considered essential when it is presumed that a close relationship increases the preparedness of suppliers to absorb variations in demand. Thus, for firm which has higher capacity and insist on acquiring the technological knowledge from the outside such as from the suppliers itself, the higher capability will increase the firm's ability to respond to the customer requirement, therefore enhances the flexibility performance (Prajogo & Olhager, 2012).

Hypothesis H_7-f postulates Technological Acquiring Capability (TAC) moderates the relationship between Quality Culture and Flexibility Performance. The result showed that the positive impact of QC on flexibility performance is much stronger when TAC is low as compared to when TAC is high. In a scenario where firms implement high QC, the low TAC improves its flexibility outcome. The embedded quality culture in the company comprises of employees involvements, top management support, continuous improvement, and standard method of operating procedures. The size of company is believed to contribute to moderating effects of TAC on the relationship between QC and flexibility performance. Because of the rate of change of low TAC firms between QC and flexibility is stronger than high TAC firms, thus showed that small capability firms have a better improvement in flexibility performance compared to larger firms with higher TAC. However, the flexibility performance of the larger capability firms is still better than the small firms. Small-sized firm tend to have simple standard of operating procedure and process. Even though the small firm is incapable to acquire technological capability, it still can control the flexibility performance since there is less complexity of processes. Top management can easily access and maintain the production process needed. Due to the simplicity of the process, any changes in the process is faster and better than the firms with high-end machines with complex production processes.

5.4.3 Technological Capability, Manufacturing Practices and Cost Performance

Hypothesis H_9-f suggests Technological Acquiring Capability (TAC) moderates the relationship between Quality Culture (QC) and Cost Performance. The result showed that the positive impact of QC on cost performance is much stronger when TAC is low as compared to when TAC is high. Quality culture have known of its significant impact to cost performance. The embedded quality culture in the company comprises of employees involvements, top management support, continuous improvement, and standard method of operating procedures. The results showed that when the company has low acquiring capability, the high implementation of quality culture improved the cost performance. The size of company is believed contributes to moderating effects of TAC on the relationship between QC and cost performance. Because of the rate of change of low TAC firms between QC and cost performance is stronger than high TAC firms, thus showed that small capability firms have a better improvement in cost performance compared to larger firms with higher acquiring capability. However, the cost performance of the larger capability firms is still better than the small firms. In the practice views, this situation is explainable. Small-sized firm tend to have a lesser number of employees. Even though the small firm is incapable to acquire technological capability, it can control the cost performance since there is less number of employees. Top management can easily monitor production workers and indirectly the productivity will increase. With the improvement in productivity, reduction in processing time and unit manufacturing cost, eventually improved the cost performance of the firm.

Hypothesis H_{10}-a postulates there is a moderating effect of Technological Upgrading Capability (TUC) on the relationship between Information Technology (IT) and Cost Performance. The result showed the rate of change differs between two TUC levels. Improvement in cost performance is much more apparent in high TUC situation than the decreases incurred in cost performance in low TUC environment. In other words, the implementation of IT system has a stronger effect on cost performance when the upgrading capability is high. In a situation where the firms implement an IT system in the factory, and they have high capability in upgrading the system embedded i.e. in the production process, the cost performance will improved. This situation happened when the existing IT system is upgraded based on the firm's own ideas of the production processes, the cycle time and processing time will be reduced and minimized resulting to the enhancement in productivity. When these happened, the unit cost of manufacturing will reduce hence reduce its production cost. The reduction in production costs apparently improves the cost performance of the firm. However, in the case where firms have low upgrading capability, the implementation of IT system practices in the factory will lowering the cost performance. This condition occurred due to the inability of the firm to maintain and upgrade the technology, thus IT system becomes an obligation to the firm and reduce the cost performance. The most probable reason because with the existing IT system, the productivity will not be improved and there is a possibility lower in productivity due to old system practiced. The unproductive productions will increase processing time. With the longer processing time, the unit of manufacturing cost increased so as the productions costs, hence reduced its cost performance. Thus, these situations explained the upward or downward effect of IT system on firm cost performance is highly contingent upon the TUC level.

Hypothesis H_{10}-f postulates the Technological Upgrading Capability (TUC) moderates the relationship between Quality Culture (QC) and Cost Performance. The result showed that the positive impact of QC on cost performance is much stronger when TUC is low as compared to when TUC is high. Quality Culture have known for its significant effect on cost performance. The embedded quality culture in the company comprises of employees involvements, top management support, continuous support, and standard method operating procedures. The results indicated that when a company has low upgrading capability, the high implementation of quality culture improved the cost performance. The size of company is believed contributes to moderating effects of TUC on the relationship between QC and cost performance. Because of the rate of change of low TUC firms between QC and cost performance is larger than high TUC firms, thus proved that small capability firms have a better improvement in cost performance compared to larger firms with higher upgrading capability. However, the cost performance of the larger capability firms is still better than the small firms. In practice views, this situation is understandable. Small-sized firm tend to have lesser number of machines and complexity of processes. Even though the small firm is incapable to upgrade technological capability, it can control the cost performance since there is less complex machines and processes. The management team can easily monitor the production processes and indirectly increases the productivity. With the increased in productivity, indirectly the cost performance will improved.

5.4.4 Technological Capability, Manufacturing Practices and Delivery Performance

Hypothesis H_{11}-b postulates Technological Acquiring Capability (TAC) moderates the relationship between Customer Relationship and Delivery Performance. The results showed that the rate of change differs between two TAC levels. Improvement in delivery performance is more apparent in low TAC situation than the decrease incurred in delivery performance in high TAC environment. In other words, the implementation of CR has a stronger effect on delivery performance when the TAC is low. This situation happened when a firm which has good customer relationship with low acquiring capability, the delivery performance is improved. On the other hand, when the firm has high capability to acquire technological from external sources, the effect of high implementation of customer relationship towards delivery performance is slightly affected. The most probable reason on why the contradicting effect happened due to the element of transparency and trust. For example, when high TAC firm highly cooperate with other sources i.e. the customer, in developing technologies, the transparency between both parties become greater. With such transparency, a better trust is developed between the firm and the customer. The slight postponement of delivery time did not place the firm in detriments since the customer has already put the trust on the firm. Because of trust from the customer, the delay is acceptable. Whereas, when the firm has low TAC, high customer relationship implementation improves the impact on delivery performance. Finally, the upward or downward effect of CR on delivery performance is highly dependent upon the level of TAC.

Hypothesis H_{11}-c postulates Technological Acquiring Capability (TAC) moderates the relationship between Information Sharing (IS) and Delivery Performance. The findings showed that the rate of change differs between two TAC levels. Improvement in delivery performance is more apparent in high TAC situation than the reduction incurred in delivery performance in low TAC environment. The result also shows the implementation of IS has a stronger effect on delivery performance when the TAC is high. The situation explains that, firm with high capability in acquiring technologies and high information sharing between the firm and business partners, thus improved delivery performance. The relationship between information sharing and delivery performance have known for its significancy (Flynn et al., 2010; Lotfi et al., 2013). There are a lot of knowledge sharing method with the business partners such as through the enterprise resource planning (ERP) for the suppliers and customer relationship management (CRM) for the customers (Bagchi & Skjøtt-Larsen, 2004). These are few examples for information sharing happened in the firm throughout the supply chain. By sharing information with business partners, it particularly reducing the uncertainties involved around schedules. The minimization in uncertainties leads to improvements in the scheduling and establishment in business planning, thus improves delivery time (Ulusoy, 2003). In the case of high TAC firm, delivery performance is improved when high acquiring capability advances the firm in managing the shared knowledge on real time information with the business partners. On the other hand, in a situation where firm has low acquiring capability, the high implementation of information sharing will reduced it delivery performance. This is happened because an abundance of shared information and shared knowledge with the business partners is unexploited when the firm unable to manage the big data due to the incapability to acquire the relevant technology, thus indirectly will affect its delivery performance. Consequently, the increasing or decreasing effect of IS on delivery performance is highly depending upon the level of TAC.

Hypothesis H_{11}-d proposed that Technological Acquiring Capability (TAC) moderates the relationship between Strategic Supplier Partnership (SSP) and Delivery Performance. The result presented that the positive impact of SSP on delivery performance is much stronger when TAC is high as compared to when TAC is low. In this case, a firm which has higher TAC shows better improvement in delivery performance as compared to other firm which has lower capability in technological acquiring. In a scenario where firms possess high level of SSP, the level of TAC effects its delivery performance. It is supported that SSP has a significant influences on delivery performance. The perspective of practice believed, the results of high TAC firms have a better improvement in delivery by the implementation of strategic supplier partnership. This is because, when firms have high capability to cooperate with external sources in developing technologies and tie with the technology suppliers in the market, they tend to build a strong relationship such as suppliers collaborations in sharing technological information. This technological knowledge with strong cooperation in turns effect the delivery performance, where authors like Prajogo and Olhager (2012) have argued that maintaining long-term relationships with suppliers improves manufacturing delivery time due to the better management of delivery scheduling.

Hypotheses H_{11}-f postulates that Technological Acquiring Capability (TAC) moderates the relationship between Quality Culture (QC) and Delivery Performance. The result showed that the positive impact of QC on delivery performance is much stronger when TAC is low as compared to when TAC is high. Quality culture have known for its impact on delivery performance. The embedded quality culture in the companies involved the standard method of operating procedures. The result showed that when the company has low acquiring capability, the high implementation of quality culture improved the delivery performance. The size of company is believed to contribute to moderating effects of TAC on the relationship between QC and delivery. Because of the rate of change of low TAC firms between QC and delivery is stronger than high TAC firms, thus showed that small capability firm have a better improvement in delivery performance compared to larger firms with higher TAC. However, the delivery performance of the larger capability firms is still better than the small firms. In the practical views, this situation is explainable. Small-sized firm tend to have customization process. Even though the small firm has low capability to acquire technological capability, it can control the delivery performance since there is low volume of product produced. Since the management can easily control the production, this will ensure that the delivery time to customers is met.

Hypothesis H_{12}-b postulates that Technological Upgrading Capability (TUC) moderates the relationship between Customer Relationship (CR) and Delivery Performance. The results showed that the rate of change differs between two TUC levels on the relationship between CR and delivery. Changes in delivery performance is more apparent in high TUC situation as compared to the reduction incurred in delivery performance in low TUC environment. In other words, the implementation of CR has a stronger effect on delivery performance when the TUC is high. In the case of large companies which possess a high capability in upgrading their technologies, the companies are able to improve the delivery performance substantially when the relationship with the customers is good. This is because the large companies are also intended to maintain their good image. However, in some situations where small companies with low capacity to upgrade its technologies, the companies tend to delay the delivery time. This is happened because the existing technologies in the small companies cannot handle when a good relationship with customer who has possibility changing the demand in product requirements from time-to-time. The challenges for small companies, they are competing in getting businesses, thus they are willing to accept as many orders requirement without considering their level of technological capabilities and resources. This inconsideration leads to the postponement of product delivery due to longer queuing and waiting time. With these discussions, it is believable that the upward or downward effect of CR on delivery performance is highly reliant upon the situation of TUC levels.

Hypotheses H_{12}-f postulates that Technological Upgrading Capability (TUC) moderates the relationship between Quality Culture (QC) and Delivery Performance. The result showed that the positive impact of QC on delivery performance is much stronger when TUC is low as compared to when TUC is high. Quality culture have known for its impact on delivery performance. The embedded quality culture in the companies involved the standard method of operating procedures. The result showed that when the company has low upgrading capability, the high implementation of quality culture improved the delivery performance. The size of company is believed to contribute to moderating effects of TUC on the relationship between QC and delivery. Because of the rate of change of low TUC firms between QC and delivery is stronger than high TUC firms, thus showed that small capability firm have a better improvement in delivery performance compared to larger firms with higher TUC. However, the delivery performance of the larger capability firms is still better than the small firms. In the practical views, this situation is explainable. Small-sized firm tend to have customization process. Even though the small firm has low capability to upgrade the technology, it can control the delivery performance since there is low volume of product produced with existing machines available. Since the management can easily control the production and the process with existing machines, this will ensure the firm to meet the delivery time promised.

Hypothesis H_{12}-g suggests that Technological Upgrading Capability (TUC) moderates the relationship between Production Layout (PL) and Delivery Performance. The result showed that the effect of PL on delivery performance changed when the level of TUC differed. In details, as the rate of change differs between the two TUC levels, the gain in delivery performance is much more apparent in low TUC situation than the losses incurred in delivery performance in high TUC environment. In other word, the implementation of PL has a stronger positive effect on delivery when the TUC is low. However, when the TUC is high, the effect became negative. It is supported by Danese, Romano, and Bortolotti (2012) and Green Jr, Inman, Birou, and Whitten (2014) that practicing the production layout has an impact towards the delivery performance of on-time and fast delivery. However, the findings indicated the impact of PL on firm's delivery performance in the low level TUC firm is stronger and positive. This is because, a factory which implements the JIT production layout i.e. a cellular manufacturing, is practically performing better because the factory is applying an efficient layout and processes with a large number of operations in a small area which purposely aimed to minimize the material movement and handling (Heizer & Render, 2011). The low upgrading capability benefit the firm who practice the minimization of material movement and handling which expedites the processing time and consequently speed up the delivery time. On the other hand, firms with high TUC will delay its delivery time, since they are frequently and strongly upgrading the production processes and products according to market demand which may slow the production activities due to interruption. As a result, it is proven that the upward or downward effect of PL on Delivery Performance is highly dependent upon the level of TUC level.

5.5 Conclusions

As a summary, in response to the main objectives, this study has determine the relationship between manufacturing practices and manufacturing performances, with the moderating effect of technological capability (TC) on this relationship. The current findings validated the significant effect of manufacturing practices on manufacturing performances in Malaysian manufacturing companies only on certain variables. The result of moderating effect proved a few significant impact but the impact varied on different performance measures. The results have shown mixed findings of TC on the relationship between eight manufacturing practices and four manufacturing performance.

To summarize the findings, first, it is proved that TC had moderated the relationship between information technology and manufacturing performance of flexibility and cost performance. Second, TC moderates the relationship between customer relationships on delivery performance. Third, TC moderates the relationship between information sharing on delivery performance. Fourth, TC moderates the relationship between strategic supplier partnership on quality, flexibility, and delivery performance. Fifth, TC moderates the relationship between quality culture with flexibility, cost, and delivery performance. Sixth, TC moderates the relationship between production layout and delivery performance. And finally, TC moderates the relationship between setup-time reduction and quality performance. However, in the case of human resource management practices, TC did not shows any influences on the HRM relationship towards manufacturing performance. This scenario is supported by Khan and Haleem (2008) where it is the people who will effects the TC of the firm in achieving an advanced manufacturing performance operationally.

5.6 Contributions of the Study

The main concern of this study is to investigate the relationship between manufacturing practices and manufacturing performance with the moderating effect of technological capability of manufacturing companies in Malaysia. The results are found to be mixed. Summing up, these results and findings have contributed to the literature on manufacturing performance, manufacturing practices and technological capability in several important ways which will be highlighted in the next sub-sections. While contributing to the body of knowledge, the outcomes from this study were also provided several contributions to practitioners and academicians. Accordingly, this section will discusses and categorized the contribution theoretically and practically.

5.6.1 Theoretical Contributions

As deliberated in Chapter One where the gap in the literatures, first; lies in the scarcity studies on linking the complex relationship of organizational resources and capabilities with performance achievement, particularly the manufacturing practices, technological capability and manufacturing performance (Lazim & Ramayah, 2010; Ortega, 2010). It is clearly deemed that manufacturing practices are one of the sources of competitive advantages for manufacturing companies to achieve their operational excellences (Lee et al., 2015; Wiengarten et al., 2011; Wu et al., 2012a), as well as the technological capability which also plays a as critical roles in organization that runs with technological sources (Prasnikar et al., 2008; Wang et al., 2006). In response to the shortfall, this study attempts to develop a theoretical research framework that could explain the influence of level of technological capability on the relationship between manufacturing practices and manufacturing performance of manufacturers in Malaysian context. Existing operation management literature does not elaborate adequately upon the implementation of TC in the firm's strategic planning that involves the manufacturing practices implementation and performance achievement in quality, flexibility, cost and delivery.

This study has established a few empirical evidences on the theoretical relationships as postulated in the developed research framework. According to the analyzed data in the context of studied small, medium, and large manufacturers, the findings reveal that two types of TC; technological acquiring capability and technological upgrading capability did not moderate most of the relationships between manufacturing practices dimensions and performance. Although the results contradict the findings of literature review, this situation suggest that size of the company had played some roles towards the inaccurate findings (de Almeida Guerra & Camargo, 2016), since the studied samples were dominated by small and medium manufacturers which are known for its low technological capacities as compared to the large companies (Islam & Karim, 2011). Despite the insignificant findings, there are a few that showed significant moderating influence which the researcher finds it interesting and encouraging. For example, one of the finding revealed that a company will improve its quality performance after implementing a strategic partnership with supplier if the company equipped with better acquiring capability. It explained that when a company has a capacity to cooperate with scientific research institutions, suppliers or customers, and the technology suppliers, it added value to the strategic relationship with the supplier where the continuous improvement programs between the two firms has mutually benefited in term of goal-setting activities, new product development, and product quality. Thus, when the company receives a better product quality from the supplier, it inadvertently improves the performance of quality of the products. This result has in some point emphasized the alignment in practices-capability-performance theory development (Peng et al., 2008).

The emphasis on practices-capability-performance relationship has leads to the second contribution of theoretical point of view in complementing the RBV theory. As the RBV is a theory that continues to be the essential principle in the strategic management research (Barney et al., 2011; Ketokivi, 2016), thus underpin the study which encompassed the areas of manufacturing practices, technological capability and, manufacturing performance with RBV is more than appropriate (DeSarbo et al., 2007; Schroeder et al., 2002). It contributes new insight to the body of knowledge with the presence of technological capability's moderating effect on the relationship between manufacturing practices and manufacturing performance, which is little known thus far and open up to the new perspective of contingency relationship among the variables under studied (Ortega, 2010; Zou et al., 2010).

The study expands that by implementing manufacturing practices such as Information Technology, Customer Relationship, Information Sharing, Strategic Supplier Partnership, Human Resource Management, Quality Culture, Production Layout, and Setup-Time Reduction, and developing technological capability namely, Technological Acquiring Capability and Technological Upgrading Capability supports the theoretical claims that firm resources are heterogeneous (Barney, 1991;

Ketokivi, 2016), which means that firms have different resources, routines, capabilities and other assets that differentiate one firm from another (Peng et al., 2008). The linking between practices and capabilities helps to create diverse strategies i.e. quality, cost, delivery, and flexibility thus sustained competitive advantage (Peng et al., 2008; Peng et al., 2011).

Third, the use of multidimensional constructs of manufacturing performance have enriched the study and contributed to the dispersion of manufacturing strategy knowledge as it addressed the most importance operational measures of manufacturing performance of quality, delivery flexibility, and cost (Cagliano & Spina, 2002; Chi, 2010). The exposure and understanding of each dimension become widened and excavated as compared to previous studies, see for examples (Chen, 2015; Vivares-Vergara et al., 2016) which mostly discovered the practice-performance's effect as a composite indicators, in other words they operationalize the performance measures as unidimensional.

Finally, the present study contributes to the knowledge by exploring the moderating effects of TC which is expressed by technological acquiring capability and technological upgrading capability. From one angle, this study expands the line of research in perspective measure of these two capabilities. Previously, these capabilities were measured on its effect towards firm upgrading of product and process upgrading performance (Guifu & Hongjia, 2009), later the capabilities were tested on the export performance measures; export intensity and export growth (Chantanaphant et al., 2013), and recently study had investigated these capabilities on the SMEs performance of customer satisfaction, sales growth, profit growth, return on investment, and market share (chepkemboi Limo, 2016). All of these instances are proving that TC has an impact towards firm's upgrading, export and financial performance. Thus by examining these TCs in this study on non-financial operational performance measures have enlarge the propensity of TC being an important variables in the operation strategic management research.

Furthermore, the findings suggest that, in addition to their direct effects towards various performance measures, it also interacts with all dimensions of manufacturing practices (except for human resource management practices) to influence on certain measures of manufacturing performance. Unlike previous studies that focus on the moderating effects of types of innovation (Ng & Jee, 2012) and characteristics of national culture (Wiengarten et al., 2011), evidence in this study support the notion that a firm's technological capability can also act as an contingency factor affecting the practices-performance relationship even though the impact was found to be at minimal.

5.6.2 Practical Contributions

From a managerial point of view, the results of this study will benefit the manufacturers by providing a comprehensive analysis on the effect of manufacturing practices implementation towards factory operational performance. Managers will be provided by the statistical data on how the implementation of some practices into the factories can improve the performance of the plant from the perspective of production and operation. For example, the analysis has shown that human resource practices is the only practices that have a significant impact towards all operational performance of quality, cost, delivery, and flexibility. It proposed to the managers that, by managing the production personnel prudently can contribute to an enhanced operational performance. Beside human resource practices, other manufacturing practices also contributed to the improvement in operational performance, but the significant impact is specific to certain performance measures only. With this information, the managers are able to analyze on which performance measure that the company are focusing as it manufacturing strategy's priority. Without information on which practices that influencing operational performances, the firm will be left behind the competitors due to the declining on quality of the product, reduction in cost performance, increasing inflexibility, and interruption in the delivery time. Manufacturers nowadays are no longer just targets on cost reduction, but also strive to offer products that meet customer satisfaction in terms of quality, delivery time and flexibility to adapt to changing market needs. Some manufacturing practices is suggested not to be functioning in isolation rather they complement each other.

Beside the component of manufacturing practices and manufacturing performance, technological capability is identified as another component in operation strategy that contributes to the enhancement of manufacturers' performance. As investigated in this study, the findings revealed that manufacturers in Malaysia are developing more on the technological upgrading capability as compared to the technological acquiring capability. Impact from the evolution of industrialization in Malaysia, it has transform the manufacturing sector towards innovating to meet the innovation-driven economies. The majority of the respondents that fall under the category of small and medium sized manufacturer showed that technological capability status of acquiring capability is still low, due to the incapacity of them to invest and cooperate with external sources in developing the capability. Consequently, the low level of technological capability among manufacturers in Malaysia contributed to the mixed findings on its effect towards operational performance.

Another aspect that should be considered and assessed clearly by every manufacturer is how technological capability in the factory will be able to affect the relationship between manufacturing practices and manufacturing performance. The results from this study showed that the two type of technological capability have affected the relationship between manufacturing practices and performance differently. For example, the high capability of acquiring technology by firm had influenced the relationship between strategic supplier partnership and three operational performances; quality, flexibility, and delivery. The influence of acquiring capability has been seen to improve these performances better. Thus, the challenge for managers would be to balance their practices and technological capability investments within the production floor. This is because, every investment made to develop or implement manufacturing practices or technological capabilities are enormous. If the managers did not determine in advance the right manufacturing strategy for the company, this will cause a great loss if the investments made did not succeeded in the way it should be.

Going back to the main business of a return to the benefit of the country's GDP, a sound strategy and rich information will encourage companies to continue to compete and assess the current and future market. Manufacturers nowadays are facing a risky business in an ever-changing environment. This study has highlighted on the strategy that have a possibility to overcome the future business challenges in manufacturing sector. For example, the emphasizing on the most critical issues of the firm, namely; operational excellences. There are five strategies highlighted in the Malaysia's productivity report to cope with operational excellences challenge. First, the strategy embedded to the issue are by raising an employee engagement and activity. This measure was investigated through the implementation of human resource management and quality culture. Next, the strategy is focusing on the reduction of baseline cost. This measure was investigated through the cost performance in term of inventory level and production costs. Third, the strategy in making continual improvement through practices. This measure was investigated through the implementation of quality culture practices. Fourth, the strategy in seeking a better alignment between strategy, objectives and organization capabilities. These components were measured through the implementation of manufacturing practices as the strategy, manufacturing performance as the firm objectives, and technological capability as the organization capability. Lastly, the strategy in improving capital investment decision process. The final strategy which relates to the decision process in investment is answered when all the findings appeared and discussed.

5.7 Limitations of the Present Study and Suggestions for Future Studies

The empirical analyses conducted in the current study is based on data from quite a number of establishments in the manufacturing sector. Though this study has attained several significant understandings, implications, and contains some methodological strengths in the manufacturing strategy body of knowledge, it is not free of limitations and have some shortcomings. These shortcomings are important and should be considered along with the findings where some valuable future research directions for enhancement later be identified.

First, the research setting of this study only includes four manufacturing industries (food, chemical, rubber and plastic, and computer, electronic and optical products) in Malaysia. Since the empirical validation of the study's model is based specifically on these industries, thus restricted the scope of study and the utilization of some data analysis techniques. For example, the study could not utilize the path analysis technique to examine interrelations among manufacturing practices and performance with industry effect. Furthermore, observing population of companies from other countries with different sub-sectors or technological-base, where comparisons of investment or implementation activities in manufacturing firms crossed countries may be providing more meaningful results and insights.

Secondly, the study employed a quantitative research design. The survey-based approach was adopted using a self-report method where there is no qualitative data available. Therefore, future research could be benefited by adopting a more qualitative approach and complement the questionnaire survey with interviews or secondary data. As the arguments in the findings section aroused only when the study has completed, thus it open up to the new research endeavors. The research objectives are only to determine the relationship and impact among variables, and the results have answered all the research questions and achieved the research objectives. Carrying out an in-depth interview to get a broader understanding regarding the findings demand the author to extend the research. Thus, it is very appropriate to carried out an in-depth interview as the other future research. Carrying out an in-depth interview with the respondent would have enriched the study by providing a better understanding of the causal mechanisms between manufacturing practices, technological capability and manufacturing performance. For example, conducting multiple-cases-base will help to understand how the implementation of these practices and capabilities may be effecting the performance differently in different kind of manufacturing setting (i.e., types of manufacturing processes) or crossed countries.

Next, given that cross-sectional nature of the data to test the research model and the hypotheses, it prevents the study from making definitive statements on causality relationship among variables. It may be desirable to conduct a longitudinal data in the future. A longitudinal study can enrich the understanding by offering information on the causal or effect relationship between the predictors and the criterion variables. Thereupon, the longitudinal nature of data may also be able to supplement this research endeavor by exploring the long-term effects of manufacturing practices and technological capability implementation and investment on firms' manufacturing performances.

Further, the present study measured manufacturing performance by the perceptions of key respondents. The study cannot avoid the disadvantages inherent when the answers to the questionnaire are of a subjective measures. As discussed in the research methodology chapter, this study was decided to use perceptual and relative measures of performance in comparison to the firm's performance three years back. Although this choice has some advantages, but the reliance on self-reported perceptual data of the respondents' point of views are also subject to some biases (i.e., self-reporting or individual biases) which related to their personal interests in the success implementation of those practices and capabilities. Thus, the use of both objective and subjective performance measures in the future must benefited the present study. Moreover, future study should capture the perception from only the top-level management with longer experiences to get the most relevant and reliable perceptions on the company's production and operation activities, since the current study may be lacked due to the mixed perceptions from both middle-level and top-level personnel. In addition, the study can be enhanced by making the comparison and benchmark of the firms' performance to their competitors instead of self-benchmark.

Finally, this research investigated only the relationships between a few dimensions of manufacturing practices and technological capabilities. Further research can extend this study by including more relevant theoretical constructs. For instance, it would be interesting to include some variables relating to sustainability to understand their collective association with the manufacturing environment. It would be of interest though, to identify and to investigate further the reasons behind the effect of firms' technological capabilities in the plant. In addition, since manufacturing practices and technological capability are both developing concepts, more other elements and activities are being implemented in practice. In the case of current study, it was only based on previous literatures to set the measures of variables under concern. Thus, it cannot fully reflect the dynamic relationship among the manufacturing practices, technological capabilities and manufacturing performance. Consequently in future, more developed and refined measurement for the constructs to capture current situations in industrializing will offer with better reasonable conclusions.

5.8 Concluding Remarks

This study in general points out to the need for seriously considering the deteriorating effects of some potential impediments to the effective implementation of manufacturing practices and its impact on the firm's manufacturing performance with the existence of firm's technological capability. As the overall, quality culture is shown to be the most practiced manufacturing practices by manufacturers in Malaysia, followed by customer relationship and production layout. While, the least manufacturing practices practiced is information technology. Between the two technological capabilities, manufacturers concerned more on upgrading capability instead of acquiring capability. Furthermore, the findings showed that manufacturers are focusing most on quality performance followed by delivery, flexibility and the least on cost performance. There are results that showed statistically significant at 90 percent confidence level ($p < 0.10$). As recommended by Hair, Ringle, and Sarstedt (2011), these theories can be viewed as legitimate yet with a factual unwavering reliability that is less than for the model's different hypotheses. Hence recommended for more thorough and qualitative investigation in order to gain knowledge and understanding for the relationships among practices, technological capability and manufacturing performance. The current research urges for further in-depth clarification on the results conclusively in the future research undertakings. Consequently, it could be concluded that manufacturing companies in Malaysia are facing a hard time in realizing the implemented practices and abundant effort of developing technological capability in the factory towards an excellence operational achievements.

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APPENDICES

Appendix 1: Survey Questionnaire

Appendix 1.1: Survey Questionnaire in English Version

A SURVEY ON MANUFACTURING PRACTICES, TECHNOLOGICAL CAPABILITY AND MANUFACTURING PERFORMANCE

A SURVEY ON MANUFACTURING PRACTICES, TECHNOLOGICAL CAPABILITY AND MANUFACTURING PERFORMANCE

Dear Respondents,
Thank you for participating in this study.

INTRODUCTION

The purpose of the survey is to determine how technological capability and manufacturing practices influence the company manufacturing performance. Your response will help to understand the extent of manufacturing strategies and capabilities being effectively practiced in the Malaysian manufacturing sector. In addition, this study aims to improve the company's competitive advantage and to sustain an advanced competitive strategy for the long run.

INSTRUCTIONS

1. This questionnaire should take about **20 minutes** to complete.
2. There are **4 SECTIONS**.
3. Please answer **ALL** questions based on your best estimates. If the exact data are not available, select the number that best represents your opinion.
4. **CIRCLE** or **HIGHLIGHT** the appropriate scales. There is no right or wrong answer.
5. Please **RETURN** the completed questionnaire at your earliest convenience as possible through: directly handed to the researcher (personally administered by the researcher), or postal mail (self-addressed envelope provided) or email as below:

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SECTION ONE : MANUFACTURING PRACTICES

Direction:
This section of questionnaire focuses on manufacturing practices implemented in the company. On the following scale, please circle or highlight the appropriate number that best represents your opinion.

Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
1	2	3	4	5	6

Total Quality Management		Agreement level					
1	All production workers believe that quality is their responsibility.	1	2	3	4	5	6
2	We have well established methods to measure the quality of our products.	1	2	3	4	5	6
3	At our company, we proactively pursue continuous improvement rather than reacting to crisis.	1	2	3	4	5	6
4	Customer requirements are disseminated/ understood throughout the workforce.	1	2	3	4	5	6
5	We have effective processes for resolving customer complaints.	1	2	3	4	5	6
6	Customer complaints are used to initiate process improvements.	1	2	3	4	5	6
7	We use the statistical process control in factory operations for quality control.	1	2	3	4	5	6

Just-In-Time		Agreement Level					
1	Production facilities are arranged in relation to each other, so that material handling is minimized.	1	2	3	4	5	6
2	Production processes are located close together, so that material movement is minimized.	1	2	3	4	5	6
3	Our equipment are grouped according to the product family to which they are dedicated.	1	2	3	4	5	6
4	We emphasize putting all tools and fixtures in their places.	1	2	3	4	5	6
5	We are aggressively working to lower production lot sizes.	1	2	3	4	5	6
6	Our company producing many different products.	1	2	3	4	5	6
7	We frequently change the product models produced in our factory.	1	2	3	4	5	6
8	We have low set-up times of equipment in our factory.	1	2	3	4	5	6
9	We are aggressively working on reducing equipment's set-up times.	1	2	3	4	5	6
10	We use the Kanban pull system (producing in response to demand from the next stage of production process) to control our production.	1	2	3	4	5	6

Human Resource Management		Agreement Level					
1	We encourage the production workers to work together to achieve common goals, rather than encourage competition among individuals.	1	2	3	4	5	6
2	In the past 3 years, many problems have been solved through small group sessions.	1	2	3	4	5	6
3	Our company has developed a reasonable reward and punishment system for production workers who achieve factory goals and who do not achieve factory goals.	1	2	3	4	5	6
4	The production workers have received training and development in work-place skills on a regular basis.	1	2	3	4	5	6
5	The production workers are cross-trained to perform several difference tasks (so they can fill in for other task if necessary).	1	2	3	4	5	6
6	In our company, goals, objectives and strategies are communicated throughout the workforce.	1	2	3	4	5	6

Supply Chain Management		Agreement Level					
1	We include our key suppliers in our planning and goal-setting activities.	1	2	3	4	5	6
2	We actively involve our key suppliers in new product management.	1	2	3	4	5	6
3	We have continuous improvement programs that include our key suppliers.	1	2	3	4	5	6
4	We have helped our key suppliers to improve their product quality.	1	2	3	4	5	6
5	We frequently interact with customers to set our customer satisfaction standards (such as reliability, responsiveness, etc.)	1	2	3	4	5	6
6	We frequently evaluate customer satisfaction.	1	2	3	4	5	6
7	We frequently evaluate future customer expectations.	1	2	3	4	5	6
8	We provide easy access to customer to seek assistance.	1	2	3	4	5	6
9	We periodically evaluate our relationship with customers.	1	2	3	4	5	6
10	Our trading partners share business knowledge of core business processes with us.	1	2	3	4	5	6
11	Our trading partners keep us fully informed about issues that affect our business.	1	2	3	4	5	6
12	Our trading partners share proprietary information with us.	1	2	3	4	5	6
13	We and our trading partners exchange information that helps establishment of business planning.	1	2	3	4	5	6
14	Our IT technology throughout the supply chain is up to date.	1	2	3	4	5	6
15	Our ordering system from major customers is IT enabled and automated.	1	2	3	4	5	6
16	We use IT-based automated ordering to send purchase order to major suppliers.	1	2	3	4	5	6
17	The IT systems throughout the supply chain are adequate.	1	2	3	4	5	6
18	We use IT based automated production process.	1	2	3	4	5	6
19	Our main products are innovative.	1	2	3	4	5	6
20	The management has sufficient knowledge in supply chain effectiveness process.	1	2	3	4	5	6
21	There are continuous improvements in the production delivery system.	1	2	3	4	5	6

SECTION TWO : TECHNOLOGICAL CAPABILITY

Directions:
This section of questionnaire focuses on the level of technological capability of the company. On the following scale, please circle or highlight the appropriate number that best represents your opinion.

Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
1	2	3	4	5	6

Technological Capability		Agreement Level					
1	We intensely cooperate with scientific research institutions to develop technologies.	1	2	3	4	5	6
2	We cooperate with others (suppliers/customer) to develop technologies.	1	2	3	4	5	6
3	We tie with the technology suppliers in the market.	1	2	3	4	5	6
4	We manufacture with advanced technologies.	1	2	3	4	5	6
5	We have more skillful technical workers and operational workers.	1	2	3	4	5	6
6	We have less operation discontinuity.	1	2	3	4	5	6
7	We frequently upgrade our production process.	1	2	3	4	5	6
8	We strongly upgrade our products according to market demand.	1	2	3	4	5	6
9	We improve greatly on production process based on our own ideas.	1	2	3	4	5	6
10	We develop and test our own new product design.	1	2	3	4	5	6

SECTION THREE : MANUFACTURING PERFORMANCE

Directions:
On the following scale, please circle or highlight the appropriate number that best represents your opinion to indicate the performance of your company **during the past three (3) years**.

Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
1	2	3	4	5	6

Quality		Agreement Level					
1	Improve high performance product features.	1	2	3	4	5	6
2	Offer consistence and reliable product quality.	1	2	3	4	5	6
3	Improve conformance to product specification.	1	2	3	4	5	6

Cost		Agreement Level					
1	Reduce inventory.	1	2	3	4	5	6
2	Increase capacity utilization.	1	2	3	4	5	6

3	Reduce production costs.	1	2	3	4	5	6
4	Increase labor productivity.	1	2	3	4	5	6

Delivery		**Agreement Level**					
1	Improve fast delivery.	1	2	3	4	5	6
2	Improve delivery on time.	1	2	3	4	5	6
3	Reduce production lead time.	1	2	3	4	5	6

Flexibility		**Agreement Level**					
1	Make rapid volume changes.	1	2	3	4	5	6
2	Adjust capacity quickly.	1	2	3	4	5	6
3	Adjust product mix quickly.	1	2	3	4	5	6
4	Improve rapid equipment changeover.	1	2	3	4	5	6

SECTION FOUR : GENERAL INFORMATION

Please provide us with some basic information about the company and yourself.

1. Please indicate your company ownership:
☐ Malaysia owned
☐ Foreign owned (please indicate the country of origin): ....
☐ Others (please specify): ....

2. Area of manufacturing:
☐ Food products
☐ Chemicals and chemicals products
☐ Rubber and plastic products
☐ Computer, electronic and optical products

3. Age of company's establishment in Malaysia (please specify):
☐ Less than 5 years
☐ Between 5 to 10 years
☐ More than 10 years

4. Number of full-time employees:
☐ Less than 75 workers
☐ Between 75 to 200 workers
☐ More than 200 workers

5. Please indicate your designation in the company:
☐ Managing director or above
☐ Director
☐ General manager
☐ Plant manager

☐ Senior manager
☐ Department manager
☐ Senior executive

6. Please indicate the primary area of your job function:
☐ Corporate executive or managing director
☐ Operation or production
☐ Planning and inventory
☐ Purchasing
☐ Quality control
☐ Supply chain management

7. Number of years of experiences in your current job function:
☐ Less than 5 years
☐ Between 5 to 10 years
☐ More than 10 years

8. Please indicate if you would like to receive a copy of executive summary of the study:
☐ No
☐ Yes (please provide email address):
....

Thank you for your participation and the time contribution in answering the survey questionnaire. All response will be treated with **utmost confidentiality** and no single set of responses will be readily identifiable.

Comments (optional):
....
....
....
....
....
....
....
....

THANK YOU FOR YOUR PARTICIPATION

Appendix 1.2: Survey Questionnaire in Bahasa Version

KAJI SELIDIK KEATAS AMALAN PENGILANGAN, KEUPAYAAN TEKNOLOGIKAL DAN PRESTASI PEMBUATAN

KAJI SELIDIK KEATAS AMALAN PENGILANGAN, KEUPAYAAN TEKNOLOGIKAL DAN PRESTASI PEMBUATAN

Responden yang dihormati,
Terima kasih kerana mengambil bahagian dalam kajian ini.

PENGENALAN

Tujuan kajian ini adalah untuk mengkaji bagaimana keupayaan teknologikal dan amalan pengilangan mempengaruhi prestasi pembuatan sesebuah syarikat. Maklum balas anda membantu untuk memahami sejauh mana keupayaan dan strategi pembuatan yang berkesan yang diamalkan dalam sektor pembuatan di Malaysia. Di samping itu, kajian ini bertujuan untuk meningkatkan kelebihan daya saing syarikat serta mengekalkan strategi persaingan untuk jangka masa panjang.

ARAHAN

1. Soal selidik ini mengambil masa lebih kurang **20 MINIT**.
2. Terdapat **4 BAHAGIAN**.
3. Sila jawab **SEMUA** soalan. Jika tiada data yang tepat, sila pilih nombor yang paling hampir mewakili pendapat anda.
4. **BULATKAN** atau **TANDAKAN** skala yang sesuai. Tidak ada jawapan yang betul atau salah.
5. Sila **KEMBALIKAN** borang yang telah siap diisi melalui cara berikut: penyerahan terus kepada penyelidik (soal selidik dilakukan sendiri oleh penyelidik), atau melalui surat (menggunakan sampul surat beralamat yang telah disediakan), atau melalui emel seperti di bawah:

Nurazwa Ahmad Penyelidik PhD	nurazwaahmad@gmail.com s92222@student.uum.edu.my	+6019-799 6885 +6018-212 5859
Assoc. Prof. Dr. **Siti Norezam Othman** Penyelia Utama	norezam@uum.edu.my	+604-928 6954
Dr. Halim Mad Lazim Penyelia bersama	mlhalim@uum.edu.my	+604-928 4034

BAHAGIAN SATU : AMALAN PENGILANGAN

Arahan:
Bahagian ini memberi tumpuan kepada amalan pengilangan yang dilaksanakan di syarikat. Pada skala yang berikut, sila bulatkan atau tandakan nombor yang sesuai yang terbaik mewakili pendapat anda.

Sangat Tidak Bersetuju	Tidak Bersetuju	Agak Tidak Bersetuju	Agak Bersetuju	Bersetuju	Sangat Bersetuju
1	**2**	**3**	**4**	**5**	**6**

Pengurusan Kualiti Menyeluruh (*Total Quality Management*)		**Tahap Persetujuan**					
1	Semua pekerja pengeluaran percaya bahawa kualiti adalah tanggungjawab mereka.	1	2	3	4	5	6
2	Kami mempunyai kaedah yang mantap untuk mengukur kualiti produk kami.	1	2	3	4	5	6
3	Di syarikat kami, kami melaksanakan penambahbaikan yang berterusan secara proaktif dan bukannya hanya bertindak balas kepada krisis.	1	2	3	4	5	6
4	Keperluan pelanggan disebarkan/difahami oleh seluruh tenaga kerja.	1	2	3	4	5	6
5	Kami mempunyai proses-proses yang berkesan untuk menyelesaikan aduan pelanggan.	1	2	3	4	5	6
6	Aduan pelanggan digunakan untuk memulakan proses penambahbaikan.	1	2	3	4	5	6
7	Kami menggunakan statistik carta kawalan proses dalam operasi kilang untuk kawalan kualiti.	1	2	3	4	5	6

Just-In-Time (*Just-In-Time*)		**Agreement Level**					
1	Fasiliti pengeluaran disusun berhubung kait antara satu sama lain, supaya pengendalian bahan dapat dikurangkan.	1	2	3	4	5	6
2	Proses-proses pengeluaran diletakkan secara berdekatan, supaya pergerakan bahan dapat diminimumkan.	1	2	3	4	5	6
3	Peralatan-peralatan dikumpulkan mengikut kumpulan produk yang dikhaskan.	1	2	3	4	5	6
4	Kami menekankan meletakkan semua peralatan dan kelengkapan di tempat yang sepatutnya.	1	2	3	4	5	6
5	Kami bekerja secara agresif untuk mengurangkan saiz lot pengeluaran.	1	2	3	4	5	6
6	Syarikat kami menghasilkan pelbagai jenis produk.	1	2	3	4	5	6
7	Kami kerap menukar model produk yang dihasilkan di kilang kami.	1	2	3	4	5	6
8	Kami mempunyai masa persediaan peralatan yang singkat di kilang kami.	1	2	3	4	5	6
9	Kami secara agresif berusaha mengurangkan masa persediaan peralatan.	1	2	3	4	5	6
10	Kami menggunakan sistem kanban (*kanban pull system* – membuat penghasilan/pengeluaran hanya apabila terdapat permintaan daripada peringkat seterusnya dalam proses pengeluaran) untuk mengawal pengeluaran di kilang kami.	1	2	3	4	5	6

Pengurusan Sumber Manusia (*Human Resource Management*)		Tahap Persetujuan					
1	Kami menggalakkan pekerja pengeluaran untuk bekerja bersama-sama untuk mencapai matlamat yang sama, bukannya menggalakkan persaingan di kalangan individu.	1	2	3	4	5	6
2	Sepanjang 3 tahun yang lalu, banyak masalah berjaya diselesaikan melalui sesi perbincangan dalam kumpulan kecil.	1	2	3	4	5	6
3	Syarikat kami telah membangunkan sistem ganjaran dan hukuman yang bersesuaian.	1	2	3	4	5	6
4	Pekerja pengeluaran telah menerima latihan dan pembangunan dalam kemahiran di tempat kerja secara berkala.	1	2	3	4	5	6
5	Pekerja pengeluaran dilatih-silang (*cross-trained*) untuk melaksanakan beberapa tugas yang berbeza (supaya mereka boleh mengisi tempat di tugasan lain jika perlu).	1	2	3	4	5	6
6	Di syarikat kami, matlamat, objektif dan strategi dimaklumkan kepada seluruh tenaga kerja.	1	2	3	4	5	6

Pengurusan Rantaian Bekalan (*Supply Chain Management*)		Tahap Persetujuan					
1	Kami melibatkan pembekal-pembekal utama dalam aktiviti perancangan dan penetapan matlamat.	1	2	3	4	5	6
2	Kami secara aktif melibatkan pembekal utama kami dalam pengurusan produk baru.	1	2	3	4	5	6
3	Kami mempunyai program penambahbaikan berterusan yang melibatkan pembekal utama kami.	1	2	3	4	5	6
4	Kami telah membantu pembekal utama kami untuk meningkatkan kualiti produk mereka.	1	2	3	4	5	6
5	Kami kerap berinteraksi dengan pelanggan untuk menetapkan piawaian kepuasan pelanggan kami (seperti kebolehpercayaan, responsif, dan lain-lain).	1	2	3	4	5	6
6	Kami kerap menilai kepuasan pelanggan.	1	2	3	4	5	6
7	Kami kerap menilai kehendak bakal pelanggan.	1	2	3	4	5	6
8	Kami menyediakan akses yang mudah kepada pelanggan untuk mendapatkan bantuan.	1	2	3	4	5	6
9	Kami secara berkala menilai hubungan pelanggan dengan syarikat kami.	1	2	3	4	5	6
10	Rakan dagangan kami berkongsi pengetahuan perniagaan tentang teras proses perniagaan dengan syarikat kami.	1	2	3	4	5	6
11	Rakan dagangan kami memastikan bahawa kami dimaklumkan sepenuhnya mengenai isu-isu yang memberi kesan kepada perniagaan kami.	1	2	3	4	5	6
12	Rakan dagangan kami berkongsi maklumat proprietari dengan syarikat kami.	1	2	3	4	5	6
13	Kami dan rakan-rakan dagangan kami bertukar-tukar maklumat yang dapat membantu pembentukan perancangan perniagaan.	1	2	3	4	5	6
14	Teknologi IT kami di seluruh rantaian bekalan adalah yang terkini.	1	2	3	4	5	6
15	Sistem pesanan kami daripada pelanggan utama adalah berasaskan IT dan automatik.	1	2	3	4	5	6
16	Kami menggunakan pesanan automatik berasaskan IT untuk menghantar pesanan belian kepada pembekal utama.	1	2	3	4	5	6

17	Sistem IT di seluruh rantaian bekalan adalah mencukupi.	1	2	3	4	5	6
18	Kami menggunakan proses pengeluaran automatik berasaskan IT.	1	2	3	4	5	6
19	Produk utama kami adalah inovatif.	1	2	3	4	5	6
20	Pihak pengurusan mempunyai pengetahuan yang mencukupi dalam keberkesanan proses rantaian bekalan.	1	2	3	4	5	6
21	Terdapat penambahbaikan berterusan dalam sistem penghantaran pengeluaran.	1	2	3	4	5	6

BAHAGIAN DUA : KEUPAYAAN TEKNOLOGIKAL

Arahan:
Bahagian ini memberi tumpuan kepada tahap keupayaan teknologikal syarikat. Pada skala yang berikut, sila bulatkan atau tandakan nombor yang sesuai yang terbaik mewakili pendapat anda.

Sangat Tidak Bersetuju	Tidak Bersetuju	Agak Tidak Bersetuju	Agak Bersetuju	Bersetuju	Sangat Bersetuju
1	**2**	**3**	**4**	**5**	**6**

Keupayaan Teknologikal (*Technological Capability*)		**Tahap Persetujuan**					
1	Kami sangat bekerjasama dengan institusi penyelidikan saintifik untuk membangunkan teknologi.	1	2	3	4	5	6
2	Kami bekerjasama dengan pihak lain (pembekal/pelanggan) untuk membangunkan teknologi.	1	2	3	4	5	6
3	Kami bekerjasama dengan pembekal teknologi di pasaran.	1	2	3	4	5	6
4	Kami menghasilkan produk dengan teknologi termaju.	1	2	3	4	5	6
5	Kami mempunyai ramai pekerja teknikal dan pekerja operasi yang mahir.	1	2	3	4	5	6
6	Kami mempunyai kurang ketakselanjaran operasi (*operation discontinuity*).	1	2	3	4	5	6
7	Kami kerap menaiktaraf proses pengeluaran kami.	1	2	3	4	5	6
8	Kami cenderung menaiktaraf produk kami sesuai dengan permintaan pasaran.	1	2	3	4	5	6
9	Kami banyak menambah baik pada proses pengeluaran berdasarkan kepada idea-idea kami sendiri.	1	2	3	4	5	6
10	Kami membangunkan dan menguji sendiri reka bentuk produk baru.	1	2	3	4	5	6

BAHAGIAN TIGA : PRESTASI PEMBUATAN

Arahan:
Pada skala yang berikut, sila bulatkan atau tandakan nombor yang sesuai yang terbaik mewakili pendapat anda untuk menunjukkan prestasi pembuatan syarikat **<u>anda dalam tempoh tiga (3) tahun yang lalu</u>**.

Sangat Tidak Bersetuju	Tidak Bersetuju	Agak Tidak Bersetuju	Agak Bersetuju	Bersetuju	Sangat Bersetuju
1	**2**	**3**	**4**	**5**	**6**

Kualiti (*Quality*)		**Tahap Persetujuan**					
1	Meningkatkan ciri-ciri produk berprestasi tinggi.	1	2	3	4	5	6
2	Menawarkan kualiti produk yang konsisten dan boleh dipercayai.	1	2	3	4	5	6
3	Meningkatkan pematuhan kepada spesifikasi produk.	1	2	3	4	5	6

Kos (*Cost*)		**Tahap Persetujuan**					
1	Mengurangkan inventori.	1	2	3	4	5	6
2	Meningkatkan penggunaan kapasiti.	1	2	3	4	5	6
3	Mengurangkan kos pengeluaran.	1	2	3	4	5	6
4	Meningkatkan produktiviti pekerja.	1	2	3	4	5	6

Penghantaran (*Delivery*)		**Tahap Persetujuan**					
1	Memperbaiki penghantaran cepat.	1	2	3	4	5	6
2	Memperbaiki penghantaran dalam tempoh masa.	1	2	3	4	5	6
3	Mengurangkan *production lead time*.	1	2	3	4	5	6

Fleksibiliti (*Flexibility*)		**Tahap Persetujuan**					
1	Membuat perubahan kuantiti secara cepat.	1	2	3	4	5	6
2	Menyesuaikan kapasiti secara cepat.	1	2	3	4	5	6
3	Mengubah komposisi produk dengan cepat.	1	2	3	4	5	6
4	Memperbaiki pertukaran peralatan dengan cepat.	1	2	3	4	5	6

BAHAGIAN EMPAT : MAKLUMAT UMUM

Sila berikan kami beberapa maklumat asas mengenai syarikat dan diri anda.

1. Sila nyatakan pemilikan syarikat anda:
☐ Syarikat milik Malaysia
☐ Syarikat milik negara luar (sila nyatakan negara asal): ....
☐ Lain-lain (sila nyatakan): ....

2. Bidang pembuatan:
☐ Produk makanan
☐ Kimia dan produk kimia
☐ Produk getah dan plastik
☐ Produk komputer, elektronik dan optik

3. Usia penubuhan syarikat di Malaysia:

- ☐ Kurang daripada 5 tahun
- ☐ Antara 5 ke 10 tahun
- ☐ Lebih daripada 10 tahun

4. Bilangan pekerja sepenuh masa:

- ☐ Kurang daripada 75 pekerja
- ☐ Antara 75 ke 200 pekerja
- ☐ Lebih daripada 200 pekerja

5. Sila nyatakan jawatan anda di dalam syarikat:

- ☐ Pengarah Urusan atau keatas
- ☐ Pengarah
- ☐ Pengurus Besar
- ☐ Pengurus Kilang
- ☐ Pengurus Kanan
- ☐ Pengurus Jabatan
- ☐ Eksekutif Senior

6. Sila nyatakan bidang utama peranan kerja anda:

- ☐ Eksekutif korporat atau pengarah urusan
- ☐ Operasi atau pengeluaran
- ☐ Perancangan dan inventori
- ☐ Pembelian
- ☐ Kawalan kualiti
- ☐ Pengurusan rantaian bekalan

7. Bilangan tahun pengalaman dalam peranan kerja semasa anda:

- ☐ Kurang daripada 5 tahun
- ☐ Antara 5 ke 10 tahun
- ☐ Lebih daripada 10 tahun

8. Sila nyatakan jika anda ingin menerima satu salinan ringkasan eksekutif kajian:

- ☐ Tidak
- ☐ Ya (sila berikan alamat e-mel):

  ....

Terima kasih atas penyertaan anda dan sumbangan masa dalam menjawab soal selidik ini. Semua jawapan akan dijaga dengan **penuh kerahsiaan** dan tiada set jawapan yang akan boleh dikenalpasti.

Komen (optional):

……………………………………………………………………………………
……………………………………………………………………………………
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……………………………………………………………………………………

TERIMA KASIH DIATAS PENYERTAAN ANDA

Appendix 2: Invitation Letter to Validate Content of Survey

PUSAT PENGAJIAN PENGURUSAN TEKNOLOGI DAN LOGISTIK
SCHOOL OF TECHNOLOGY MANAGEMENT AND LOGISTICS (STML)
Kolej Perniagaan
UUM College of Business
Universiti Utara Malaysia
06010 UUM SINTOK
KEDAH DARUL AMAN
MALAYSIA

Tel: 604-928 7001/7002
Faks (Fax): 604-928 7070
Laman Web (Web): www.stmlportal.uum.edu.my

KEDAH AMAN MAKMUR • BERSAMA MEMACU TRANSFORMASI

TO WHOM IT MAY CONCERN 25th May 2015

Dear Sir/Madam,

INVITATION TO VALIDATE CONTENT OF SURVEY QUESTIONNAIRE

With reference to the above title, a set of survey questionnaire for the PhD candidate is attached to receive your valuable comments and advices. The details of the survey questionnaire are as follows;

PhD candidate	:	**Nurazwa Ahmad**
Matric No.	:	**92222**
Proposal	:	**The Impact of Technological Capability on the Relationship of Manufacturing Practices and Manufacturing Performance in Malaysia.**
Survey Title	:	**A Survey on Manufacturing Practices, Technological Capability and Manufacturing performance.**

Your valuable experiences and knowledge will importantly contribute to the study. Therefore, it is very appreciated if you can provide critical insights and comments that could improve on this questionnaire thus enabling me to fulfill the content validity of the survey questionnaire.

Thank you for the participation and time contribution.

Best regards,

....

Nurazwa Ahmad
E-mail : s92222@student.uum.edu.my
Tel : 019-799 6885

Hereby, I am pleased to inform that I have fully reviewed and commented on the survey questionnaire submitted by the above candidate. I am of the opinion the survey questionnaire can be distributed to respondents for the data collection.

....
Name: GUSMAN NAWANIR
Date: 25/5/2015

Universiti Pengurusan Terkemuka
The Eminent Management University

Questionnaire

PUSAT PENGAJIAN PENGURUSAN TEKNOLOGI DAN LOGISTIK
SCHOOL OF TECHNOLOGY MANAGEMENT AND LOGISTICS (STML)
Kolej Perniagaan
UUM College of Business
Universiti Utara Malaysia
06010 UUM SINTOK
KEDAH DARUL AMAN
MALAYSIA

UUM Universiti Utara Malaysia

Tel: 604-928 7001/7002
Faks (Fax): 604-928 7070
Laman Web (Web): www.stmlportal.uum.edu.my

KEDAH AMAN MAKMUR • BERSAMA MEMACU TRANSFORMASI

TO WHOM IT MAY CONCERN

25th May 2015

Dear Sir/Madam,

INVITATION TO VALIDATE CONTENT OF SURVEY QUESTIONNAIRE

With reference to the above title, a set of survey questionnaire for the PhD candidate is attached to receive your valuable comments and advices. The details of the survey questionnaire are as follows;

PhD candidate	:	**Nurazwa Ahmad**
Matric No.	:	**92222**
Proposal	:	**The Impact of Technological Capability on the Relationship of Manufacturing Practices and Manufacturing Performance in Malaysia.**
Survey Title	:	**A Survey on Manufacturing Practices, Technological Capability and Manufacturing performance.**

Your valuable experiences and knowledge will importantly contribute to the study. Therefore, it is very appreciated if you can provide critical insights and comments that could improve on this questionnaire thus enabling me to fulfill the content validity of the survey questionnaire.

Thank you for the participation and time contribution.

Best regards,

....
Nurazwa Ahmad
E-mail : s92222@student.uum.edu.my
Tel : 019-799 6885

Hereby, I am pleased to inform that I have fully reviewed and commented on the survey questionnaire submitted by the above candidate. I am of the opinion the survey questionnaire can be distributed to respondents for the data collection.

....
Name: DR. SANTHIRASEGARAN A/L S R NADARAJAH
Senior Lecturer
School of Technology Management and Logistics
Universiti Utara Malaysia
Date: 25/5/2015

Universiti Pengurusan Terkemuka
The Eminent Management University

30 UUM

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....

Name: Mokhtar Noldin
Date: 25/05/15

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Thank you for the participation and time contribution.

Best regards,

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Nurazwa Ahmad
E-mail : s92222@student.uum.edu.my
Tel : 019-799 6885

Dr. Ahmad Yusni Bahaudin
Senior Lecturer
School of Technology Management and Logistics
College of Business
Universiti Utara Malaysia

Hereby, I am pleased to inform that I have fully reviewed and commented on the survey questionnaire submitted by the above candidate. I am of the opinion the survey questionnaire can be distributed to respondents for the data collection.

Name: AHMAD YUSNI BAHAUDIN
Date: 27/5/2015

Universiti Pengurusan Terkemuka
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TO WHOM IT MAY CONCERN

25th May 2015

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Matric No.	:	**92222**
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Thank you for the participation and time contribution.

Best regards,

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Nurazwa Ahmad
E-mail : s92222@student.uum.edu.my
Tel : 019-799 6885

ASSOC. PROF DR. AMLUS BIN IBRAHIM
PENSYARAH
School of Technology Management and Logistic
Universiti Utara Malaysia
Email: amlus@uum.edu.my

Hereby, I am pleased to inform that I have fully reviewed and commented on the survey questionnaire submitted by the above candidate. I am of the opinion the survey questionnaire can be distributed to respondents for the data collection.

....
Name: AMLUS BIN IBRAHIM
Date: 27 / 5 / 2015

Universiti Pengurusan Terkemuka
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TO WHOM IT MAY CONCERN 25th May 2015

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Nurazwa Ahmad
E-mail : s92222@student.uum.edu.my
Tel : 019-799 6885

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....

Name: MOHD AMLARY BIN JAMALUDIN
Date: 01/06/2015

Universiti Pengurusan Terkemuka
The Eminent Management University

Appendix 3: Table for Determining Sample Size

Table for Determining Sample Size from a Given Population

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	1000000	384

Note.—*N* is population size.
S is sample size.

Appendix 4: Cover Letter

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KEDAH AMAN MAKMUR ~ BERSAMA MEMACU TRANSFORMASI

TO WHOM IT MAY CONCERN 18 May 2015

Dear Respondents,

SURVEY ON MANUFACTURING COMPANY

This study is to investigate the impact of manufacturing practices and technological capability on company's manufacturing performance. Your contribution towards this survey will help us to understand the current level of Malaysia manufacturers' manufacturing performance and the importance and awareness of key practices and capability that can improve company performance level.

Your company is randomly selected to participate in this survey from Malaysian Industries: Federation of Malaysian Manufacturers (FMM) Directory 2014. Therefore, your feedback will represent other companies enlisted with FMM.

This questionnaire is preferably answered by representatives from the managerial level or other equivalent person who is well-versed in the area of manufacturing.

Your valuable knowledge and experience towards current industrial practices has significantly contributes to academic field of knowledge. Therefore, we are highly appreciated if you be able to contribute some of your valuable time to complete the survey questionnaire at your earliest convenience. Your response will be kept strictly confidential.

Thank you for the participation and time contribution. Once again, your support is valuable to this study and the industry. Please do not hesitate to contact us if you have any enquiries.

Best regards,

Nurazwa Ahmad (*Researcher*)
E-mail: nurazwaahmad@gmail.com
s92222@student.uum.edu.my
Tel: 019-7996885

Assoc. Prof. Dr. Siti Norezam Othman
E-mail: snorezam@gmail.com

ASSOC. PROF DR. SITI NOREZAM OTHMAN
Associate Professor
School of Technology Management and Logistics
College of Business
Universiti Utara Malaysia

Universiti Pengurusan Terkemuka
The Eminent Management University

Appendix 5: Certification of Study

OTHMAN YEOP ABDULLAH
GRADUATE SCHOOL OF BUSINESS
UNIVERSITI UTARA MALAYSIA
06010, UUM SINTOK
KEDAH DARUL AMAN
MALAYSIA

Tel :604-928 7118/7119/7130
Faks (fax) :604-928 7160
Laman Web :www.oyagsb.uum.edu.my

KEDAH AMAN MAKMUR.BERSAMA MEMACU TRANSFORMASI

UUM/OYAGSB/R-4
25/1/2015

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

CERTIFICATION OF STUDY

This is to certify that Nurazwa Ahmad is currently studying in Universiti Utara Malaysia and the following details apply :

Matric No.	:	92222
NRIC/ Passport No	:	851017065296
Programme	:	Doctor of Philosophy (Technology, Operations & Logistics Management)
College	:	College of Business
Admission Session	:	A082 DEC 2008/2009
Current Semester	:	A141 SEP 2014/2015
Current Status	:	Active
Programme Structure	:	Research
Mode of Study	:	Full Time
Duration of Study	:	4 - 10 semesters
Language of Study	:	English
Cumulative Grade Point Average	:	-
Exam Status	:	-
Proposal Defense	:	30/10/2014
VIVA	:	-

Thank you.

"SCHOLARSHIP, VIRTUE, SERVICE"

Yours faithfully

Rozita Binti Ramli
Assistant Registar
for Dean
Othman Yeop Abdullah Graduate School of Business

Universiti Pengurusan Terkemuka
The Eminent Management University

Appendix 6: Approval Letter for Data Collection

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

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Laman Web (Web): www.oyagsb.uum.edu.my

KEDAH AMAN MAKMUR • BERSAMA MEMACU TRANSFORMASI

UUM/OYAGSB/K-14
01 January 2015

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

LETTER FOR DATA COLLECTION AND RESEARCH WORK

This is to certify that **Nurazwa Ahmad (Matric no: 92222)** is a bonafied student of Doctor of Philosophy (PhD), Othman Yeop Abdullah Graduate School of Business, Universiti Utara Malaysia. she is conducting a research entitled ***"The Impact of Technological Capability on the Relationship of Manufacturing Practices and Manufacturing Performance in Malaysia."*** under the supervision of Prof. Madya Dr. Siti Norezam Bt Othman.

In this regard, I 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.

"SCHOLARSHIP, VIRTUE, SERVICE"

Yours faithfully

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

c.c - Supervisor
- Student's File (92222)

Universiti Pengurusan Terkemuka
The Eminent Management University

Appendix 7: Demographic Profile

D1own

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Malaysia owned	126	72.0	72.0	72.0
	Foreign owned	49	28.0	28.0	100.0
	Total	175	100.0	100.0	

D2sic

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Food products	56	32.0	32.0	32.0
	Chemicals and chemicals products	44	25.1	25.1	57.1
	Rubber and plastic products	38	21.7	21.7	78.9
	Computer, electronic and optical products	37	21.1	21.1	100.0
	Total	175	100.0	100.0	

D3age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 5 years	17	9.7	9.7	9.7
	Between 5 to 10 years	30	17.1	17.1	26.9
	More than 10 years	128	73.1	73.1	100.0
	Total	175	100.0	100.0	

D4employ

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 75 workers	82	46.9	46.9	46.9
	Between 75 to 200 workers	37	21.1	21.1	68.0
	More than 200 workers	56	32.0	32.0	100.0
	Total	175	100.0	100.0	

D5job

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Managing director or above	16	9.1	9.1	9.1
	Director	9	5.1	5.1	14.3
	General manager	11	6.3	6.3	20.6
	Plant manager	13	7.4	7.4	28.0
	Senior manager	15	8.6	8.6	36.6
	Department manager	37	21.1	21.1	57.7
	Senior Executive	74	42.3	42.3	100.0
	Total	175	100.0	100.0	

D6func

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Corporate executive or managing director	19	10.9	10.9	10.9
	Operation or production	119	68.0	68.0	78.9
	Planning and inventory	15	8.6	8.6	87.4
	Purchasing	2	1.1	1.1	88.6
	Quality control	9	5.1	5.1	93.7
	Supply chain management	11	6.3	6.3	100.0
	Total	175	100.0	100.0	

D7exp

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 5 years	48	27.4	27.4	27.4
	Between 5 to 10 years	64	36.6	36.6	64.0
	More than 10 years	63	36.0	36.0	100.0
	Total	175	100.0	100.0	

Appendix 8: Factor Analysis

Appendix 8.1: Factor Analysis for Independent Variable (Manufacturing Performance)

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	10.945	36.484	36.484	10.945	36.484	36.484	4.228	14.095	14.095
2	2.921	9.738	46.222	2.921	9.738	46.222	4.036	13.455	27.549
3	2.103	7.011	53.233	2.103	7.011	53.233	3.411	11.370	38.920
4	1.797	5.991	59.224	1.797	5.991	59.224	3.135	10.451	49.371
5	1.679	5.598	64.822	1.679	5.598	64.822	2.476	8.255	57.626
6	1.246	4.155	68.976	1.246	4.155	68.976	2.110	7.032	64.658
7	1.193	3.975	72.951	1.193	3.975	72.951	1.872	6.239	70.897
8	1.037	3.457	76.409	1.037	3.457	76.409	1.654	5.512	76.409
9	.674	2.247	78.656						
10	.640	2.132	80.788						
11	.606	2.021	82.809						
12	.524	1.748	84.557						
13	.487	1.625	86.182						
14	.474	1.581	87.764						
15	.439	1.465	89.228						
16	.392	1.307	90.535						
17	.357	1.189	91.724						
18	.324	1.079	92.803						
19	.299	.995	93.798						
20	.286	.953	94.751						
21	.251	.838	95.589						
22	.208	.695	96.284						
23	.203	.675	96.960						
24	.195	.649	97.609						
25	.173	.576	98.184						
26	.165	.551	98.735						
27	.128	.425	99.161						
28	.099	.331	99.491						
29	.089	.298	99.789						
30	.063	.211	100.000						

Extraction Method: Principal Component Analysis.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.859
Bartlett's Test of Sphericity	Approx. Chi-Square	3812.628
	df	435
	Sig.	.000

Rotated Component Matrix[a]

	Component							
	1	2	3	4	5	6	7	8
IT2	.876							
IT5	.872							
IT3	.852							
IT4	.802							
IT1	.689							
CR2		.826						
CR5		.815						
CR4		.796						
CR3		.735						
CR1		.709						
IS1			.869					
IS2			.811					
IS4			.805					
IS3			.797					
SSP3				.815				
SSP2				.758				
SSP4				.731				
SSP1				.728				
HRM4					.734			
HRM5					.665			
HRM6		.420			.645			
HRM3					.638			
IO2					.547			
TQM2						.768		
TQM3						.726		
TQM1						.638		
JIT2							.906	
JIT1							.832	
JIT8								.791
JIT9								.789

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 8 iterations.

Appendix 8.2: Factor Analysis for Moderating Variable (Technological Capability)

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.811
Bartlett's Test of Sphericity	Approx. Chi-Square	786.683
	df	28
	Sig.	.000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.028	50.352	50.352	4.028	50.352	50.352	3.064	38.298	38.298
2	1.665	20.814	71.166	1.665	20.814	71.166	2.629	32.867	71.166
3	.816	10.198	81.363						
4	.432	5.399	86.762						
5	.348	4.351	91.113						
6	.322	4.021	95.135						
7	.215	2.690	97.824						
8	.174	2.176	100.000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component	
	1	2
TC2	.912	
TC3	.909	
TC1	.795	
TC4	.715	
TC10		.843
TC8		.828
TC9		.799
TC7	.450	.671

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 3 iterations.

Appendix 8.3: Factor Analysis for Dependent Variable (Manufacturing Performance)

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.809
Bartlett's Test of Sphericity	Approx. Chi-Square	1267.106
	df	66
	Sig.	.000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.328	44.399	44.399	5.328	44.399	44.399	2.599	21.657	21.657
2	1.626	13.547	57.946	1.626	13.547	57.946	2.580	21.497	43.154
3	1.302	10.852	68.798	1.302	10.852	68.798	2.310	19.253	62.407
4	1.044	8.700	77.499	1.044	8.700	77.499	1.811	15.091	77.499
5	.778	6.482	83.981						
6	.513	4.274	88.255						
7	.341	2.841	91.096						
8	.311	2.589	93.685						
9	.248	2.070	95.755						
10	.222	1.848	97.603						
11	.161	1.345	98.948						
12	.126	1.052	100.000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component			
	1	2	3	4
PQ3	.894			
PQ1	.880			
PQ2	.872			
PF2		.838		
PF3		.750		
PF4		.745		
PF1		.666		.411
PC1			.841	
PC3			.834	
PD3			.767	
PD1				.878
PD2				.796

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 5 iterations.

Appendix 9: Reliability Analysis

Appendix 9.1: Reliability Analysis for Independent Variable (Information Technology)

Reliability Statistics

Cronbach's Alpha	N of Items
.924	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
IT1	18.39	10.309	.704	.924
IT2	18.59	9.083	.852	.896
IT3	18.56	9.351	.859	.894
IT4	18.55	9.881	.799	.907
IT5	18.69	9.906	.795	.908

Appendix 9.2: Reliability Analysis for Independent Variable (Customer Relationship)

Reliability Statistics

Cronbach's Alpha	N of Items
.923	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
CR1	20.55	7.766	.783	.910
CR2	20.63	7.327	.893	.888
CR3	20.66	7.204	.801	.907
CR4	20.62	7.571	.759	.914
CR5	20.65	7.550	.776	.911

Appendix 9.3: Reliability Analysis for Independent Variable (Information Sharing)

Reliability Statistics

Cronbach's Alpha	N of Items
.905	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
IS1	14.11	5.412	.780	.880
IS2	14.15	5.235	.811	.869
IS3	14.35	5.380	.752	.890
IS4	14.10	5.323	.805	.871

Appendix 9.4: Reliability Analysis for Independent Variable (Strategic Supplier Partnership)

Reliability Statistics

Cronbach's Alpha	N of Items
.896	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
SSP1	14.01	5.908	.789	.858
SSP2	13.98	5.373	.800	.856
SSP3	14.01	5.741	.815	.848
SSP4	13.95	6.630	.685	.895

Appendix 9.5: Reliability Analysis for Independent Variable (Human Resource Management)

Reliability Statistics

Cronbach's Alpha	N of Items
.780	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
HRM3	20.15	6.288	.558	.751
HRM4	19.73	7.442	.593	.728
HRM5	19.87	6.961	.574	.733
HRM6	19.45	8.088	.525	.751
IO2	19.59	7.910	.589	.735

Appendix 9.6: Reliability Analysis for Independent Variable (Quality Culture)

Reliability Statistics

Cronbach's Alpha	N of Items
.766	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
TQM1	10.42	1.808	.587	.708
TQM2	10.37	2.061	.675	.616
TQM3	10.45	2.065	.552	.737

Appendix 9.7: Reliability Analysis for Independent Variable (Production Layout)

Reliability Statistics

Cronbach's Alpha	N of Items
.839	2

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
JIT1	5.05	.635	.722	.
JIT2	4.94	.599	.722	.

Appendix 9.8: Reliability Analysis for Independent Variable (Production Set-up Times)

Reliability Statistics

Cronbach's Alpha	N of Items
.678	2

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
JIT8	4.86	.751	.514	.
JIT9	4.59	.864	.514	.

Appendix 9.9: Reliability Analysis for Moderating Variable (Technological Acquiring Capability)

Reliability Statistics

Cronbach's Alpha	N of Items
.876	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
TC1	12.95	10.561	.680	.862
TC2	12.81	9.993	.815	.809
TC3	12.95	9.504	.845	.795
TC4	12.67	11.278	.606	.889

Appendix 9.10: Reliability Analysis for Moderating Variable (Technological Upgrading Capability)

Reliability Statistics

Cronbach's Alpha	N of Items
.827	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
TC7	15.03	5.700	.610	.804
TC8	14.83	5.775	.729	.751
TC9	14.85	6.177	.618	.798
TC10	14.73	5.361	.672	.775

Appendix 9.11: Reliability Analysis for Dependent Variable (Quality Performance)

Reliability Statistics

Cronbach's Alpha	N of Items
.910	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
PQ1	10.46	1.710	.852	.844
PQ2	10.37	1.946	.832	.865
PQ3	10.43	1.844	.783	.902

Appendix 9.12: Reliability Analysis for Dependent Variable (Flexibility Performance)

Reliability Statistics

Cronbach's Alpha	N of Items
.821	4

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
PF1	13.88	6.210	.665	.768
PF2	14.11	5.929	.675	.761
PF3	14.03	5.826	.606	.795
PF4	14.17	5.852	.640	.777

Appendix 9.13: Reliability Analysis for Dependent Variable (Cost Performance)

Reliability Statistics

Cronbach's Alpha	N of Items
.837	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
PC1	9.02	3.373	.775	.695
PC3	9.04	3.314	.786	.683
PD3	8.81	4.361	.553	.903

Appendix 9.14: Reliability Analysis for Dependent Variable (Delivery Performance)

Reliability Statistics

Cronbach's Alpha	N of Items
.820	2

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
PD1	4.83	.817	.697	.
PD2	4.74	.962	.697	.

Appendix 10: Harman's Single Factor Test

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	15.551	33.088	33.088	15.551	33.088	33.088
2	3.513	7.475	40.563			
3	3.018	6.422	46.985			
4	2.437	5.186	52.171			
5	2.061	4.384	56.555			
6	1.723	3.666	60.221			
7	1.517	3.227	63.448			
8	1.375	2.925	66.373			
9	1.342	2.855	69.228			
10	1.250	2.660	71.888			
11	1.159	2.465	74.353			
12	1.104	2.348	76.701			
13	1.014	2.158	78.859			
14	.901	1.917	80.776			
15	.728	1.548	82.324			
16	.653	1.389	83.713			
17	.599	1.275	84.987			
18	.569	1.210	86.197			
19	.523	1.113	87.311			
20	.501	1.065	88.376			
21	.464	.988	89.363			
22	.430	.914	90.277			
23	.388	.825	91.103			
24	.354	.752	91.855			
25	.325	.692	92.547			
26	.299	.636	93.182			
27	.288	.614	93.796			
28	.280	.596	94.392			
29	.258	.548	94.940			
30	.251	.535	95.474			
31	.229	.487	95.961			
32	.214	.455	96.416			
33	.188	.399	96.815			
34	.174	.370	97.185			
35	.170	.362	97.547			

36	.154	.328	97.875			
37	.146	.312	98.186			
38	.133	.283	98.469			
39	.120	.255	98.725			
40	.107	.228	98.953			
41	.101	.216	99.168			
42	.096	.204	99.372			
43	.081	.172	99.544			
44	.065	.139	99.683			
45	.055	.118	99.801			
46	.051	.109	99.910			
47	.042	.090	100.000			

Extraction Method: Principal Component Analysis.

Appendix 11: Correlation Analysis

Correlations

		IT	CR	IS	SSP	HRM	QC	PL	STR	TAC	TUC	PQ	PF	PC	PD
IT	Pearson Correlation	1	.447**	.260**	.437**	.451**	.387**	.252**	.224**	.300**	.405**	.369**	.155*	.304**	.291**
	Sig. (2-tailed)		.000	.001	.000	.000	.000	.001	.003	.000	.000	.000	.043	.000	.000
	N	172	172	172	172	172	172	172	172	172	172	172	172	172	172
CR	Pearson Correlation	.447**	1	.484**	.551**	.449**	.436**	.318**	.369**	.407**	.518**	.663**	.399**	.366**	.357**
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	172	172	172	172	172	172	172	172	172	172	172	172	172	172
IS	Pearson Correlation	.260**	.484**	1	.531**	.164*	.312**	.276**	.251**	.322**	.347**	.355**	.310**	.242**	.160*
	Sig. (2-tailed)	.001	.000		.000	.031	.000	.000	.001	.000	.000	.000	.000	.001	.037
	N	172	172	172	172	172	172	172	172	172	172	172	172	172	172
SSP	Pearson Correlation	.437**	.551**	.531**	1	.457**	.447**	.279**	.304**	.321**	.488**	.446**	.299**	.278**	.290**
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	172	172	172	172	172	172	172	172	172	172	172	172	172	172
HRM	Pearson Correlation	.451**	.449**	.164*	.457**	1	.482**	.300**	.387**	.339**	.526**	.495**	.386**	.373**	.471**
	Sig. (2-tailed)	.000	.000	.031	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	172	172	172	172	172	172	172	172	172	172	172	172	172	172
QC	Pearson Correlation	.387**	.436**	.312**	.447**	.482**	1	.360**	.383**	.279**	.505**	.452**	.321**	.314**	.410**
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000
	N	172	172	172	172	172	172	172	172	172	172	172	172	172	172
PL	Pearson Correlation	.252**	.318**	.276**	.279**	.300**	.360**	1	.338**	.061	.333**	.274**	.192*	.141	.170*
	Sig. (2-tailed)	.001	.000	.000	.000	.000	.000		.000	.430	.000	.000	.012	.065	.026
	N	172	172	172	172	172	172	172	172	172	172	172	172	172	172
STR	Pearson Correlation	.224**	.369**	.251**	.304**	.387**	.383**	.338**	1	.252**	.486**	.329**	.364**	.304**	.315**
	Sig. (2-tailed)	.003	.000	.001	.000	.000	.000	.000		.001	.000	.000	.000	.000	.000
	N	172	172	172	172	172	172	172	172	172	172	172	172	172	172

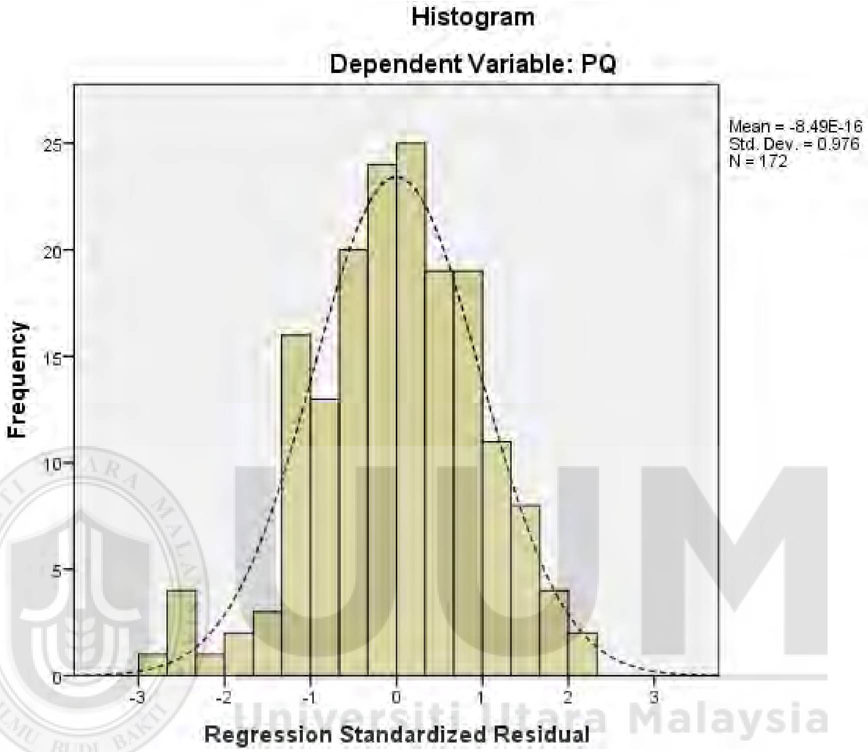
TAC	Pearson Correlation	.300**	.407**	.322**	.321**	.339**	.279**	.061	.252**	1	.401**	.334**	.499**	.464**	.317**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.430	.001		.000	.000	.000	.000	.000
	N	172	172	172	172	172	172	172	172	172	172	172	172	172	172
TUC	Pearson Correlation	.405**	.518**	.347**	.488**	.526**	.505**	.333**	.486**	.401**	1	.544**	.550**	.465**	.405**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000
	N	172	172	172	172	172	172	172	172	172	172	172	172	172	172
PQ	Pearson Correlation	.369**	.663**	.355**	.446**	.495**	.452**	.274**	.329**	.334**	.544**	1	.409**	.427**	.389**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000
	N	172	172	172	172	172	172	172	172	172	172	172	172	172	172
PF	Pearson Correlation	.155*	.399**	.310**	.299**	.386**	.321**	.192*	.364**	.499**	.550**	.409**	1	.577**	.413**
	Sig. (2-tailed)	.043	.000	.000	.000	.000	.000	.012	.000	.000	.000	.000		.000	.000
	N	172	172	172	172	172	172	172	172	172	172	172	172	172	172
PC	Pearson Correlation	.304**	.366**	.242**	.278**	.373**	.314**	.141	.304**	.464**	.465**	.427**	.577**	1	.479**
	Sig. (2-tailed)	.000	.000	.001	.000	.000	.000	.065	.000	.000	.000	.000	.000		.000
	N	172	172	172	172	172	172	172	172	172	172	172	172	172	172
PD	Pearson Correlation	.291**	.357**	.160*	.290**	.471**	.410**	.170*	.315**	.317**	.405**	.389**	.413**	.479**	1
	Sig. (2-tailed)	.000	.000	.037	.000	.000	.000	.026	.000	.000	.000	.000	.000	.000	
	N	172	172	172	172	172	172	172	172	172	172	172	172	172	172

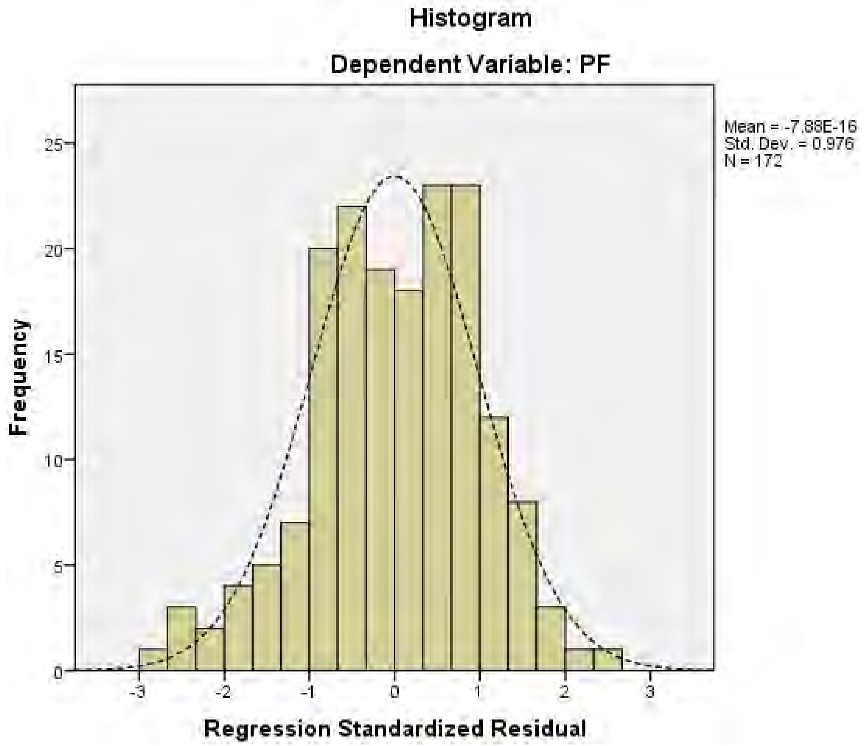
**. Correlation is significant at the 0.01 level (2-tailed).

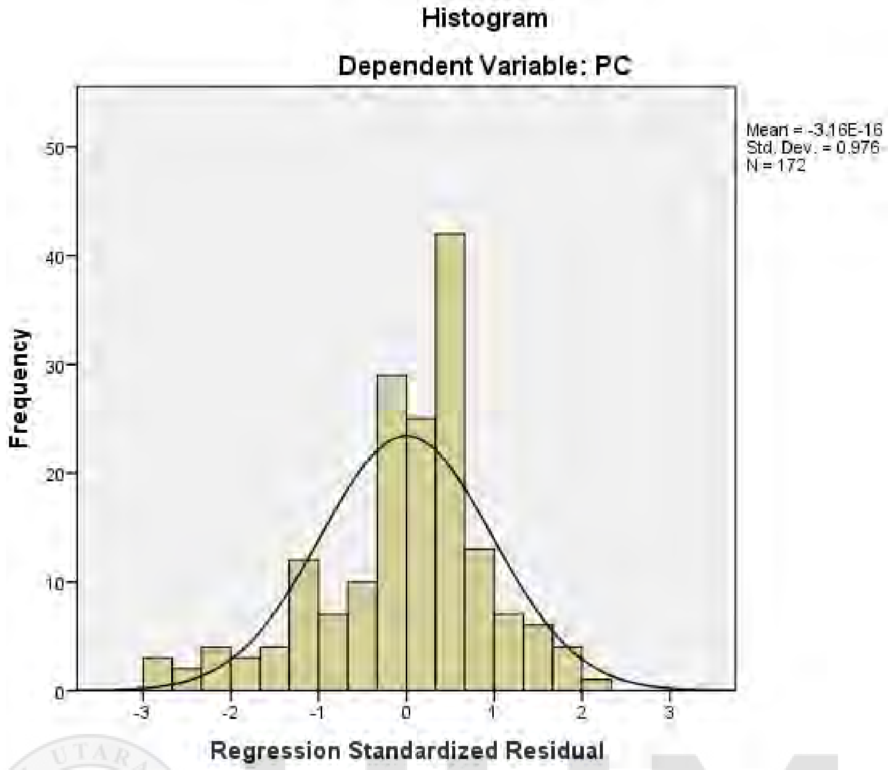
*. Correlation is significant at the 0.05 level (2-tailed).

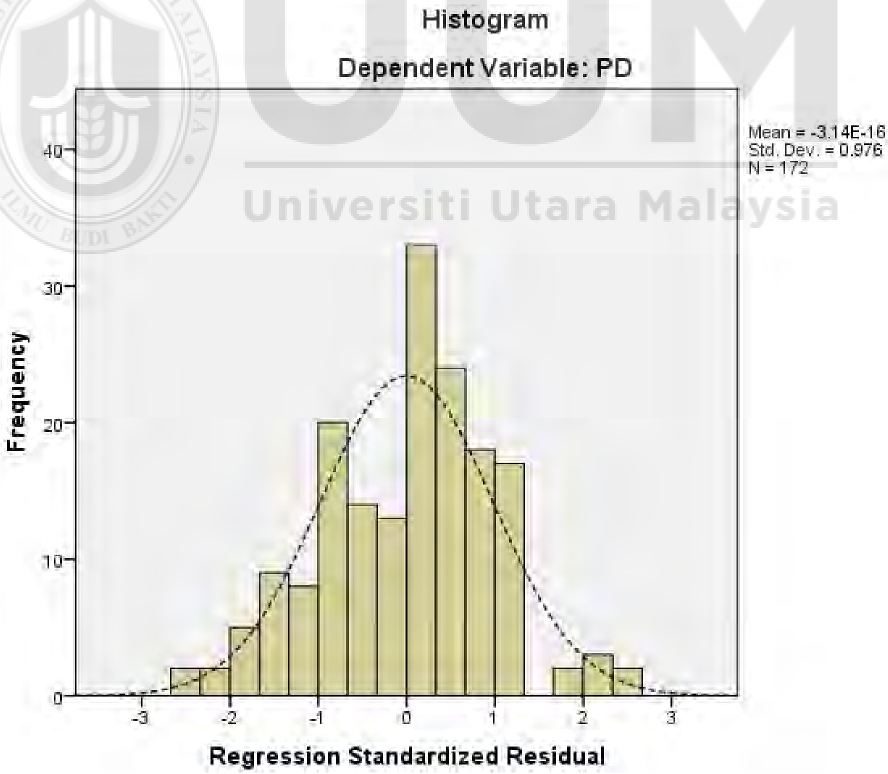
Appendix 12: Assumption of Normality, Linearity and Homoscedasticity

Appendix 12.1: Normality (Histogram)

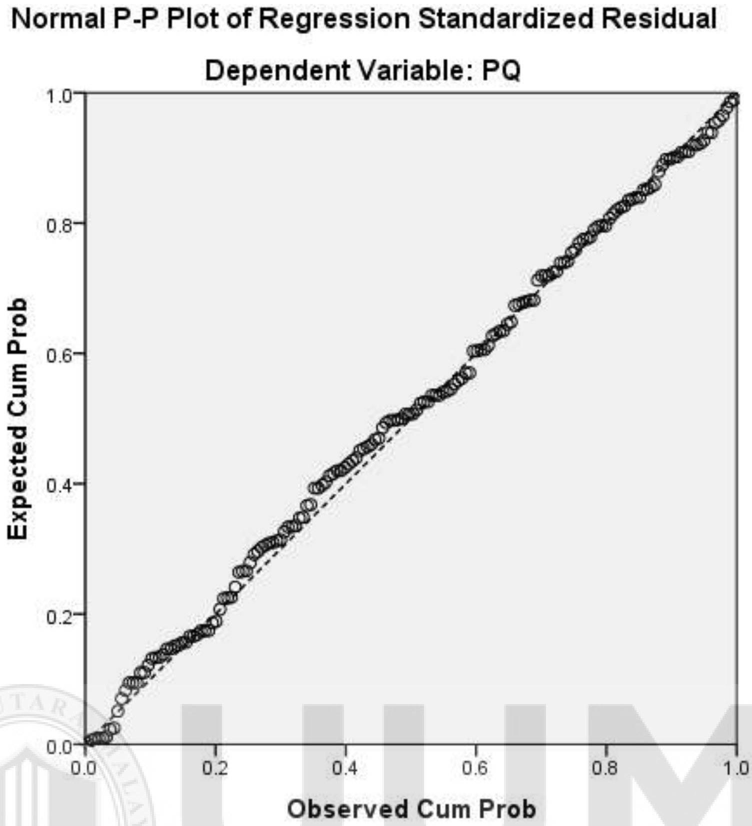


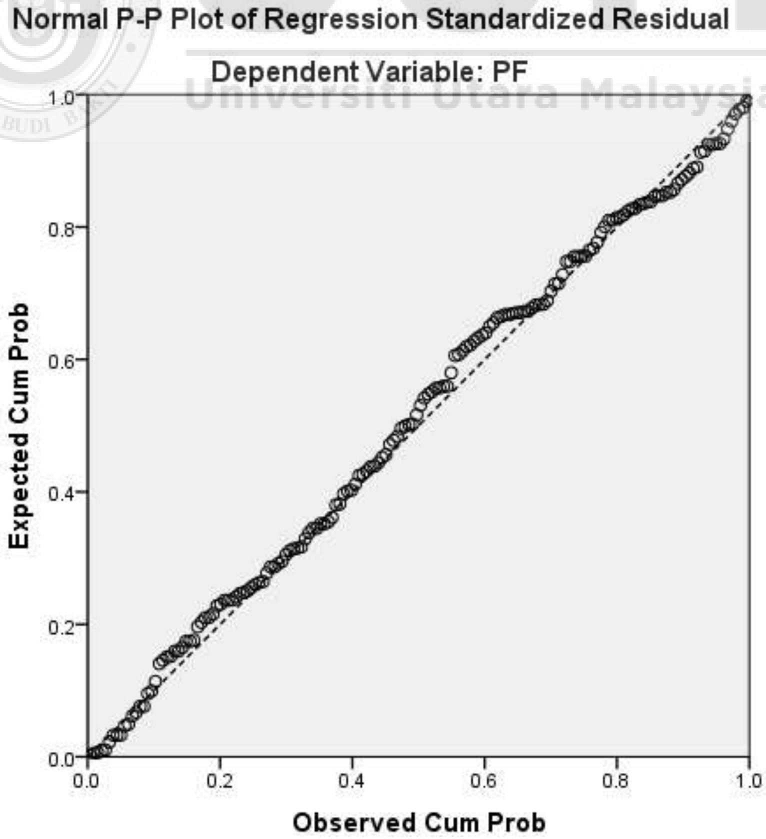


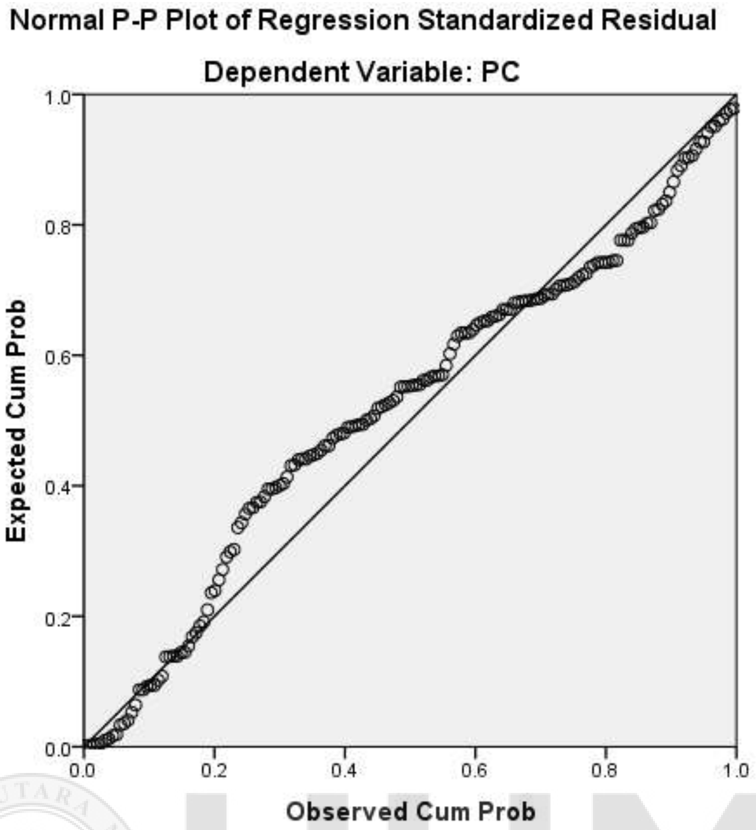

Histogram
Dependent Variable: PC
Mean = -3.16E-16
Std. Dev. = 0.976
N = 172
Frequency
Regression Standardized Residual

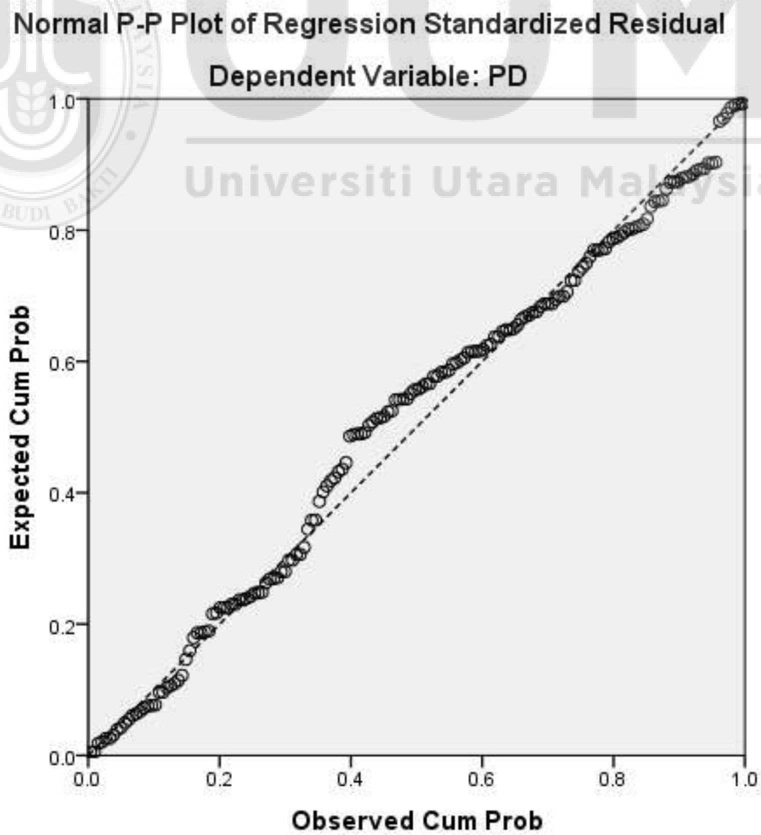

Histogram
Dependent Variable: PD
Mean = -3.14E-16
Std. Dev. = 0.976
N = 172
Frequency
Regression Standardized Residual

Appendix 12.2: Normality (P-P Plot)

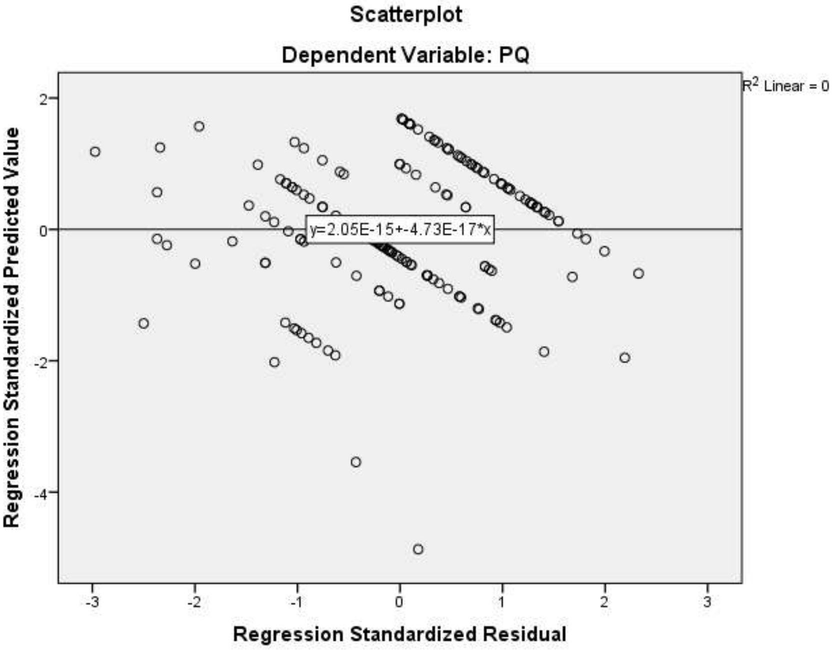


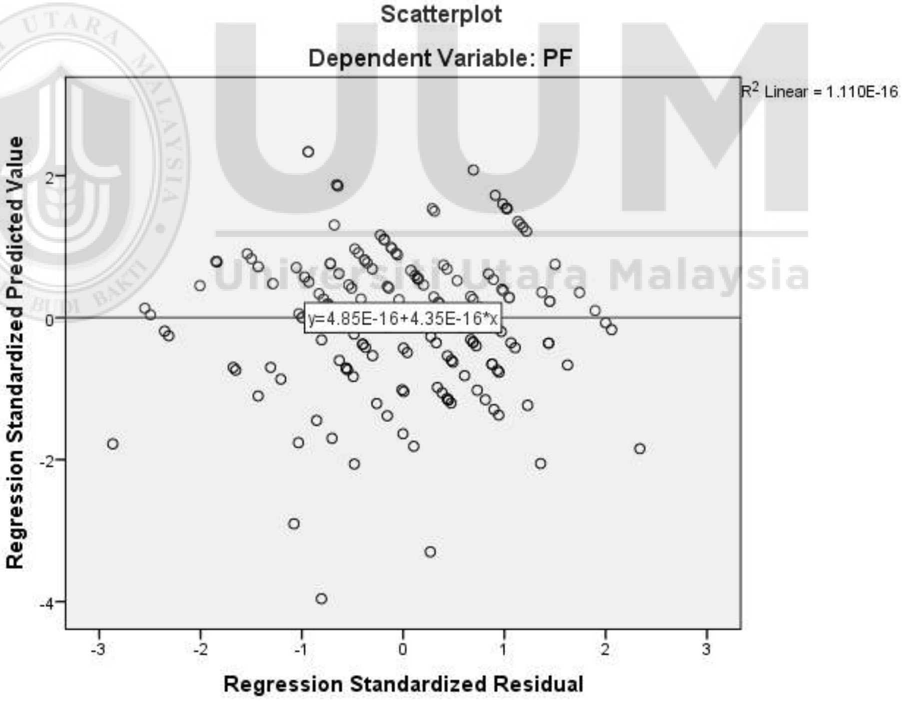


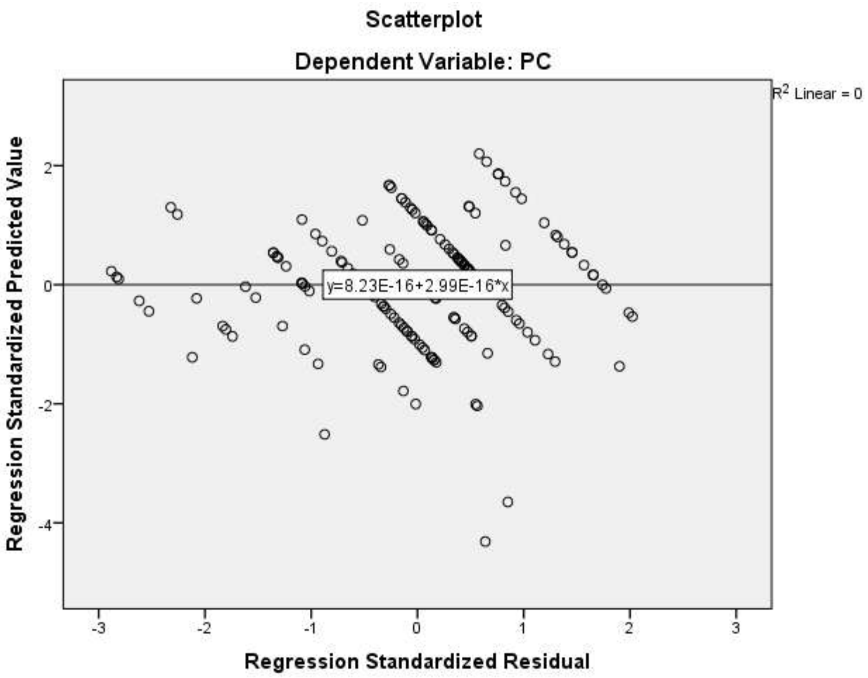

Normal P-P Plot of Regression Standardized Residual
Dependent Variable: PC
1.0
0.8
0.6
0.4
0.2
0.0
Expected Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0
Observed Cum Prob

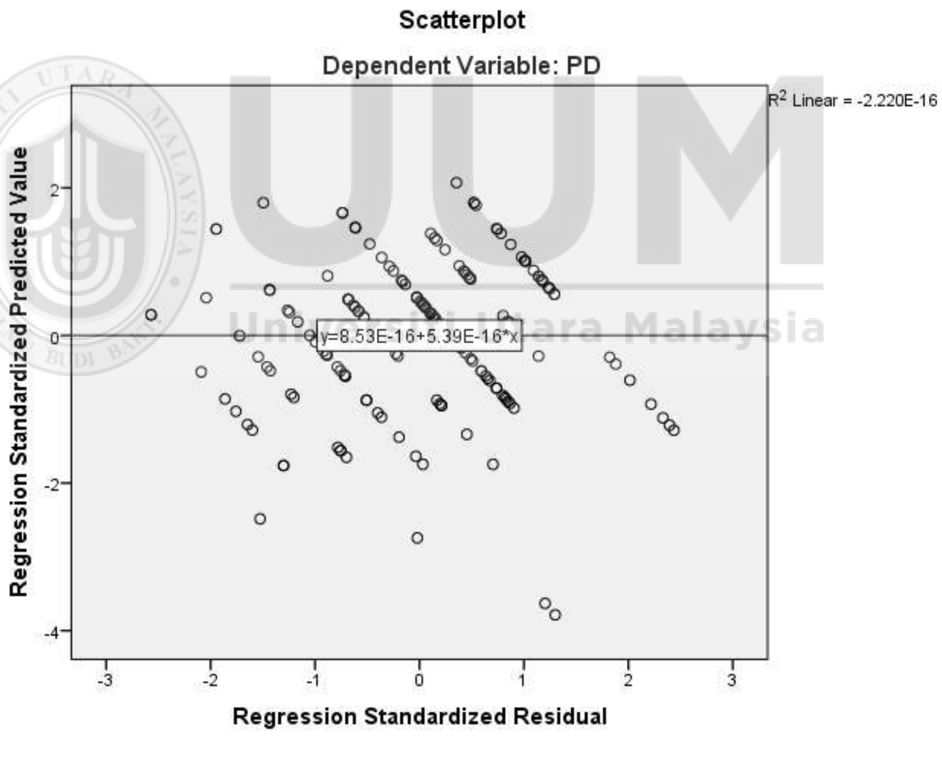

Normal P-P Plot of Regression Standardized Residual
Dependent Variable: PD
1.0
0.8
0.6
0.4
0.2
0.0
Expected Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0
Observed Cum Prob

Appendix 12.3: Linearity (Scatter Plot)

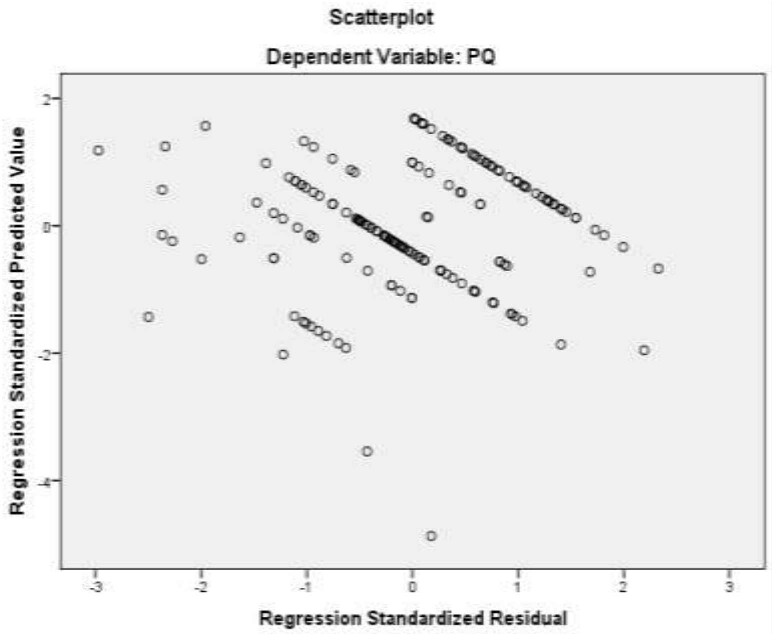


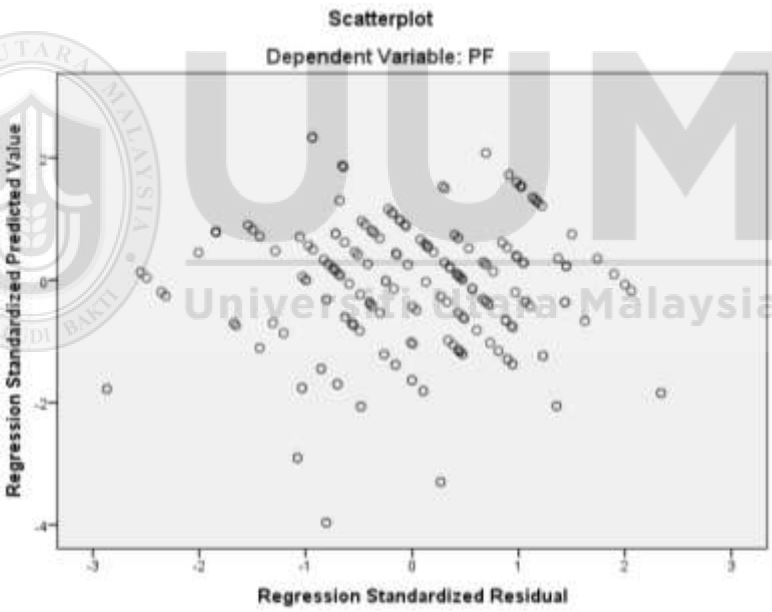


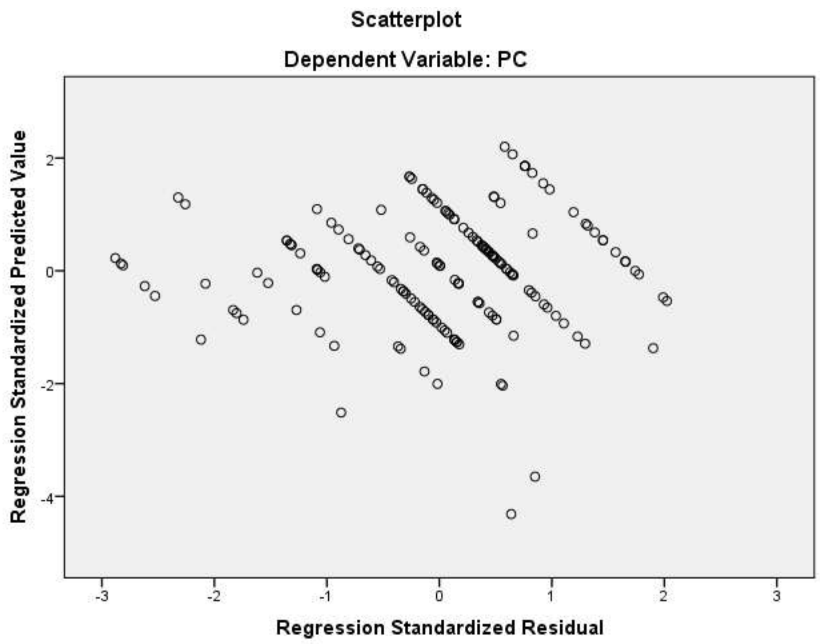

Scatterplot
Dependent Variable: PC
R² Linear = 0
y=8.23E-16+2.99E-16*x
Regression Standardized Predicted Value
Regression Standardized Residual

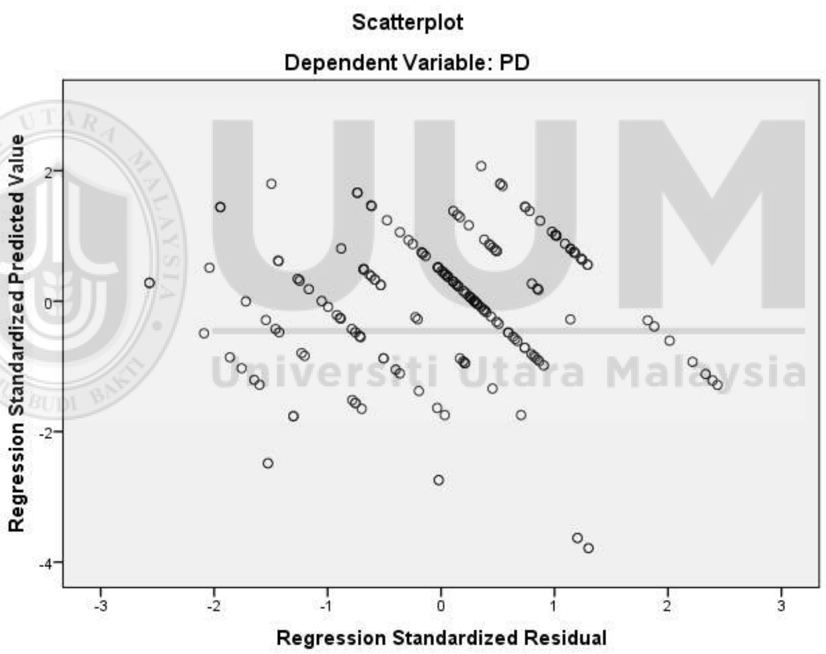

Scatterplot
Dependent Variable: PD
R² Linear = -2.220E-16
y=8.53E-16+5.39E-16*x
Regression Standardized Predicted Value
Regression Standardized Residual

Appendix 12.4: Homoscedasticity (Scatter Plot)






Scatterplot
Dependent Variable: PC
Regression Standardized Predicted Value
Regression Standardized Residual
2
0
-2
-4
-3
-2
-1
0
1
2
3


Scatterplot
Dependent Variable: PD
Regression Standardized Predicted Value
Regression Standardized Residual
2
0
-2
-4
-3
-2
-1
0
1
2
3

Appendix 13: Hierarchical Regression Analysis

Appendix 13.1: Hierarchical Regression Analysis for Technological Acquiring Capability, Manufacturing Practices Dimensions and Quality Performance

Model Summary[d]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.709[a]	.502	.478	.47865	.502	20.552	8	163	.000	
2	.709[b]	.502	.475	.48000	.000	.087	1	162	.769	
3	.732[c]	.536	.484	.47565	.033	1.372	8	154	.213	1.979

a. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP

b. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TAC

c. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TAC, PLxTAC, ISxTAC, STRxTAC, ITxTAC, SSPxTAC, HRMxTAC, CRxTAC, QCxTAC

d. Dependent Variable: PQ

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	37.669	8	4.709	20.552	.000[b]
	Residual	37.344	163	.229		
	Total	75.013	171			
2	Regression	37.689	9	4.188	18.176	.000[c]
	Residual	37.324	162	.230		
	Total	75.013	171			
3	Regression	40.172	17	2.363	10.445	.000[d]
	Residual	34.841	154	.226		
	Total	75.013	171			

a. Dependent Variable: PQ

b. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP

c. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TAC

d. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TAC, PLxTAC, ISxTAC, STRxTAC, ITxTAC, SSPxTAC, HRMxTAC, CRxTAC, QCxTAC

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.869	.384		2.260	.025		
	IT	-.006	.055	-.007	-.100	.920	.685	1.459
	CR	.486	.073	.497	6.618	.000	.543	1.843
	IS	.036	.062	.041	.579	.563	.623	1.604
	SSP	.002	.064	.003	.036	.971	.517	1.936
	HRM	.205	.073	.205	2.825	.005	.582	1.718
	QC	.123	.069	.123	1.769	.079	.630	1.588
	PL	-.002	.056	-.003	-.042	.966	.789	1.267
	STR	.009	.054	.010	.163	.871	.743	1.345
2	(Constant)	.873	.386		2.263	.025		
	IT	-.007	.055	-.008	-.125	.901	.680	1.470
	CR	.482	.075	.493	6.450	.000	.526	1.900
	IS	.033	.063	.037	.520	.604	.606	1.651
	SSP	.002	.065	.003	.038	.970	.517	1.936
	HRM	.202	.074	.201	2.737	.007	.568	1.760
	QC	.122	.070	.122	1.750	.082	.629	1.590
	PL	.001	.057	.001	.010	.992	.765	1.307
	STR	.007	.054	.009	.137	.891	.738	1.355
	TAC	.011	.039	.019	.294	.769	.748	1.337
3	(Constant)	-.256	1.510		-.170	.866		
	IT	.169	.248	.205	.681	.497	.033	29.985
	CR	.914	.315	.935	2.900	.004	.029	34.448
	IS	.109	.255	.124	.426	.671	.036	27.866
	SSP	-.452	.291	-.539	-1.553	.122	.025	39.909
	HRM	-.190	.312	-.189	-.608	.544	.031	32.161
	QC	.031	.316	.031	.098	.922	.030	33.248
	PL	-.075	.199	-.082	-.374	.709	.062	16.070
	STR	.587	.228	.697	2.575	.011	.041	24.279
	TAC	.294	.382	.488	.770	.442	.008	133.309
	ITxTAC	-.036	.056	-.366	-.636	.526	.009	109.937
	CRxTAC	-.103	.071	-1.122	-1.440	.152	.005	201.380
	ISxTAC	-.025	.062	-.257	-.402	.688	.007	135.396
	SSPxTAC	.114	.068	1.214	1.687	.094	.006	171.763
	HRMxTAC	.089	.071	.928	1.259	.210	.006	180.091
	QCxTAC	.013	.076	.142	.175	.861	.005	217.573
	PLxTAC	.023	.049	.220	.466	.642	.013	74.101
	STRxTAC	-.137	.052	-1.421	-2.624	.010	.010	97.223

a. Dependent Variable: PQ

Appendix 13.2: Hierarchical Regression Analysis for Technological Upgrading Capability, Manufacturing Practices Dimensions and Quality Performance

Model Summary[d]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.709[a]	.502	.478	.47865	.502	20.552	8	163	.000	
2	.722[b]	.521	.495	.47086	.019	6.435	1	162	.012	
3	.740[c]	.547	.497	.46950	.026	1.118	8	154	.354	2.092

a. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP

b. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TUC

c. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TUC, ISxTUC, PLxTUC, STRxTUC, ITxTUC, HRMxTUC, SSPxTUC, QCxTUC, CRxTUC

d. Dependent Variable: PQ

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	37.669	8	4.709	20.552	.000[b]
	Residual	37.344	163	.229		
	Total	75.013	171			
2	Regression	39.095	9	4.344	19.593	.000[c]
	Residual	35.917	162	.222		
	Total	75.013	171			
3	Regression	41.066	17	2.416	10.959	.000[d]
	Residual	33.947	154	.220		
	Total	75.013	171			

a. Dependent Variable: PQ

b. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP

c. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TUC

d. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TUC, ISxTUC, PLxTUC, STRxTUC, ITxTUC, HRMxTUC, SSPxTUC, QCxTUC, CRxTUC

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.869	.384		2.260	.025		
	IT	-.006	.055	-.007	-.100	.920	.685	1.459
	CR	.486	.073	.497	6.618	.000	.543	1.843
	IS	.036	.062	.041	.579	.563	.623	1.604
	SSP	.002	.064	.003	.036	.971	.517	1.936
	HRM	.205	.073	.205	2.825	.005	.582	1.718
	QC	.123	.069	.123	1.769	.079	.630	1.588
	PL	-.002	.056	-.003	-.042	.966	.789	1.267
	STR	.009	.054	.010	.163	.871	.743	1.345
2	(Constant)	.924	.379		2.438	.016		
	IT	-.016	.054	-.020	-.298	.766	.681	1.468
	CR	.457	.073	.467	6.249	.000	.529	1.889
	IS	.027	.061	.031	.450	.654	.621	1.609
	SSP	-.015	.064	-.018	-.242	.809	.510	1.959
	HRM	.167	.073	.167	2.292	.023	.558	1.793
	QC	.093	.069	.093	1.345	.180	.612	1.634
	PL	-.008	.055	-.009	-.143	.886	.788	1.269
	STR	-.027	.055	-.032	-.487	.627	.695	1.439
	TUC	.162	.064	.191	2.537	.012	.520	1.922
3	(Constant)	-.059	1.953		-.030	.976		
	IT	.540	.419	.656	1.289	.199	.011	88.033
	CR	.059	.501	.060	.118	.906	.011	89.150
	IS	.382	.409	.434	.935	.351	.014	73.333
	SSP	-.555	.462	-.662	-1.202	.231	.010	103.106
	HRM	.944	.466	.941	2.025	.045	.014	73.502
	QC	-.317	.470	-.318	-.674	.501	.013	75.680
	PL	-.479	.359	-.529	-1.334	.184	.019	53.523
	STR	.441	.343	.523	1.284	.201	.018	56.428
	TUC	.325	.425	.383	.764	.446	.012	85.681
	ITxTUC	-.112	.081	-1.053	-1.372	.172	.005	200.461
	CRxTUC	.086	.102	.813	.850	.397	.003	311.485
	ISxTUC	-.079	.082	-.719	-.959	.339	.005	191.214
	SSPxTUC	.106	.092	1.043	1.149	.252	.004	280.474
	HRMxTUC	-.149	.090	-1.375	-1.657	.100	.004	234.248
	QCxTUC	.083	.099	.771	.841	.402	.003	286.262
	PLxTUC	.093	.072	.830	1.278	.203	.007	143.575
	STRxTUC	-.089	.069	-.859	-1.290	.199	.007	150.860

a. Dependent Variable: PQ

Appendix 13.3: Hierarchical Regression Analysis for Technological Acquiring Capability, Manufacturing Practices Dimensions and Flexibility Performance

Model Summary[d]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.528[a]	.279	.243	.67770	.279	7.867	8	163	.000	
2	.611[b]	.374	.339	.63331	.095	24.651	1	162	.000	
3	.662[c]	.438	.376	.61531	.064	2.202	8	154	.030	1.794

a. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP

b. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TAC

c. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TAC, PLxTAC, ISxTAC, STRxTAC, ITxTAC, SSPxTAC, HRMxTAC, CRxTAC, QCxTAC

d. Dependent Variable: PF

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	28.905	8	3.613	7.867	.000[b]
	Residual	74.862	163	.459		
	Total	103.767	171			
2	Regression	38.792	9	4.310	10.747	.000[c]
	Residual	64.975	162	.401		
	Total	103.767	171			
3	Regression	45.463	17	2.674	7.064	.000[d]
	Residual	58.305	154	.379		
	Total	103.767	171			

a. Dependent Variable: PF

b. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP

c. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TAC

d. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TAC, PLxTAC, ISxTAC, STRxTAC, ITxTAC, SSPxTAC, HRMxTAC, CRxTAC, QCxTAC

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.886	.544		1.628	.106		
	IT	-.132	.078	-.136	-1.698	.091	.685	1.459
	CR	.227	.104	.197	2.182	.031	.543	1.843
	IS	.174	.087	.168	1.996	.048	.623	1.604
	SSP	-.031	.091	-.031	-.339	.735	.517	1.936
	HRM	.299	.103	.254	2.909	.004	.582	1.718
	QC	.086	.098	.073	.871	.385	.630	1.588
	PL	-.037	.080	-.035	-.466	.642	.789	1.267
	STR	.173	.076	.175	2.262	.025	.743	1.345
2	(Constant)	.978	.509		1.922	.056		
	IT	-.164	.073	-.169	-2.240	.026	.680	1.470
	CR	.142	.099	.124	1.442	.151	.526	1.900
	IS	.105	.083	.101	1.268	.207	.606	1.651
	SSP	-.027	.085	-.028	-.322	.748	.517	1.936
	HRM	.224	.097	.190	2.307	.022	.568	1.760
	QC	.067	.092	.057	.728	.468	.629	1.590
	PL	.029	.076	.027	.385	.700	.765	1.307
	STR	.143	.072	.144	1.994	.048	.738	1.355
	TAC	.253	.051	.357	4.965	.000	.748	1.337
3	(Constant)	-5.114	1.953		-2.619	.010		
	IT	-.708	.321	-.731	-2.209	.029	.033	29.985
	CR	-.373	.408	-.324	-.914	.362	.029	34.448
	IS	-.271	.330	-.261	-.819	.414	.036	27.866
	SSP	.734	.376	.744	1.950	.053	.025	39.909
	HRM	.814	.404	.690	2.016	.046	.031	32.161
	QC	.840	.408	.717	2.059	.041	.030	33.248
	PL	.390	.258	.366	1.512	.133	.062	16.070
	STR	.264	.295	.267	.896	.372	.041	24.279
	TAC	1.784	.494	2.520	3.613	.000	.008	133.309
	ITxTAC	.129	.072	1.128	1.780	.077	.009	109.937
	CRxTAC	.095	.092	.889	1.037	.301	.005	201.380
	ISxTAC	.101	.080	.886	1.261	.209	.007	135.396
	SSPxTAC	-.157	.087	-1.425	-1.800	.074	.006	171.763
	HRMxTAC	-.140	.091	-1.245	-1.536	.127	.006	180.091
	QCxTAC	-.204	.098	-1.859	-2.086	.039	.005	217.573
	PLxTAC	-.093	.063	-.773	-1.487	.139	.013	74.101
	STRxTAC	-.018	.068	-.163	-.273	.785	.010	97.223

a. Dependent Variable: PF

Appendix 13.4: Hierarchical Regression Analysis for Technological Upgrading Capability, Manufacturing Practices Dimensions and Flexibility Performance

Model Summary[d]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.528[a]	.279	.243	.67770	.279	7.867	8	163	.000	
2	.607[b]	.368	.333	.63607	.090	23.035	1	162	.000	
3	.623[c]	.388	.321	.64192	.020	.633	8	154	.749	1.954

a. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP

b. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TUC

c. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TUC, ISxTUC, PLxTUC, STRxTUC, ITxTUC, HRMxTUC, SSPxTUC, QCxTUC, CRxTUC

d. Dependent Variable: PF

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	28.905	8	3.613	7.867	.000[b]
	Residual	74.862	163	.459		
	Total	103.767	171			
2	Regression	38.225	9	4.247	10.498	.000[c]
	Residual	65.543	162	.405		
	Total	103.767	171			
3	Regression	40.310	17	2.371	5.755	.000[d]
	Residual	63.457	154	.412		
	Total	103.767	171			

a. Dependent Variable: PF

b. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP

c. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TUC

d. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TUC, ISxTUC, PLxTUC, STRxTUC, ITxTUC, HRMxTUC, SSPxTUC, QCxTUC, CRxTUC

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.886	.544		1.628	.106		
	IT	-.132	.078	-.136	-1.698	.091	.685	1.459
	CR	.227	.104	.197	2.182	.031	.543	1.843
	IS	.174	.087	.168	1.996	.048	.623	1.604
	SSP	-.031	.091	-.031	-.339	.735	.517	1.936
	HRM	.299	.103	.254	2.909	.004	.582	1.718
	QC	.086	.098	.073	.871	.385	.630	1.588
	PL	-.037	.080	-.035	-.466	.642	.789	1.267
	STR	.173	.076	.175	2.262	.025	.743	1.345
2	(Constant)	1.026	.512		2.006	.047		
	IT	-.160	.073	-.165	-2.176	.031	.681	1.468
	CR	.153	.099	.133	1.547	.124	.529	1.889
	IS	.153	.082	.147	1.861	.065	.621	1.609
	SSP	-.076	.086	-.077	-.885	.377	.510	1.959
	HRM	.202	.099	.172	2.052	.042	.558	1.793
	QC	.010	.094	.009	.107	.915	.612	1.634
	PL	-.051	.075	-.048	-.686	.494	.788	1.269
	STR	.082	.074	.083	1.106	.271	.695	1.439
	TUC	.414	.086	.415	4.799	.000	.520	1.922
3	(Constant)	.699	2.670		.262	.794		
	IT	-.361	.573	-.373	-.630	.529	.011	88.033
	CR	-.372	.685	-.323	-.543	.588	.011	89.150
	IS	.511	.559	.493	.914	.362	.014	73.333
	SSP	-.593	.631	-.601	-.940	.349	.010	103.106
	HRM	.546	.637	.463	.857	.393	.014	73.502
	QC	.443	.643	.378	.690	.491	.013	75.680
	PL	.051	.491	.048	.104	.917	.019	53.523
	STR	.170	.469	.171	.361	.718	.018	56.428
	TUC	.487	.581	.489	.838	.404	.012	85.681
	ITxTUC	.043	.111	.342	.383	.702	.005	200.461
	CRxTUC	.108	.139	.863	.776	.439	.003	311.485
	ISxTUC	-.073	.113	-.568	-.652	.515	.005	191.214
	SSPxTUC	.118	.126	.995	.943	.347	.004	280.474
	HRMxTUC	-.069	.123	-.541	-.561	.576	.004	234.248
	QCxTUC	-.101	.135	-.797	-.748	.456	.003	286.262
	PLxTUC	-.026	.099	-.198	-.262	.794	.007	143.575
	STRxTUC	-.016	.094	-.132	-.171	.865	.007	150.860

a. Dependent Variable: PF

Appendix 13.5: Hierarchical Regression Analysis for Technological Acquiring Capability, Manufacturing Practices Dimensions and Cost Performance

Model Summary[d]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.475[a]	.226	.188	.88832	.226	5.941	8	163	.000	
2	.548[b]	.301	.262	.84688	.075	17.341	1	162	.000	
3	.592[c]	.351	.279	.83695	.050	1.484	8	154	.167	2.203

a. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP

b. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TAC

c. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TAC, PLxTAC, ISxTAC, STRxTAC, ITxTAC, SSPxTAC, HRMxTAC, CRxTAC, QCxTAC

d. Dependent Variable: PC

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	37.503	8	4.688	5.941	.000[b]
	Residual	128.625	163	.789		
	Total	166.128	171			
2	Regression	49.940	9	5.549	7.737	.000[c]
	Residual	116.188	162	.717		
	Total	166.128	171			
3	Regression	58.254	17	3.427	4.892	.000[d]
	Residual	107.874	154	.700		
	Total	166.128	171			

a. Dependent Variable: PC

b. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP

c. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TAC

d. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TAC, PLxTAC, ISxTAC, STRxTAC, ITxTAC, SSPxTAC, HRMxTAC, CRxTAC, QCxTAC

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.078	.713		.110	.913		
	IT	.124	.102	.101	1.211	.228	.685	1.459
	CR	.219	.136	.151	1.611	.109	.543	1.843
	IS	.129	.114	.099	1.129	.261	.623	1.604
	SSP	-.059	.120	-.048	-.497	.620	.517	1.936
	HRM	.296	.135	.198	2.196	.030	.582	1.718
	QC	.122	.129	.082	.945	.346	.630	1.588
	PL	-.108	.105	-.080	-1.033	.303	.789	1.267
	STR	.168	.100	.134	1.678	.095	.743	1.345
2	(Constant)	.182	.681		.267	.790		
	IT	.088	.098	.072	.905	.367	.680	1.470
	CR	.125	.132	.086	.945	.346	.526	1.900
	IS	.051	.111	.039	.465	.643	.606	1.651
	SSP	-.056	.114	-.045	-.487	.627	.517	1.936
	HRM	.212	.130	.142	1.631	.105	.568	1.760
	QC	.101	.123	.068	.819	.414	.629	1.590
	PL	-.034	.101	-.025	-.332	.741	.765	1.307
	STR	.135	.096	.107	1.403	.162	.738	1.355
	TAC	.283	.068	.316	4.164	.000	.748	1.337
3	(Constant)	.507	2.657		.191	.849		
	IT	-.553	.436	-.451	-1.268	.207	.033	29.985
	CR	.443	.555	.304	.798	.426	.029	34.448
	IS	-.514	.449	-.392	-1.145	.254	.036	27.866
	SSP	.422	.512	.338	.825	.411	.025	39.909
	HRM	-.001	.549	-.001	-.001	.999	.031	32.161
	QC	.987	.555	.665	1.777	.078	.030	33.248
	PL	-.383	.351	-.284	-1.092	.277	.062	16.070
	STR	.007	.401	.005	.017	.986	.041	24.279
	TAC	.276	.672	.308	.410	.682	.008	133.309
	ITxTAC	.161	.098	1.112	1.633	.105	.009	109.937
	CRxTAC	-.094	.125	-.694	-.753	.452	.005	201.380
	ISxTAC	.144	.109	1.002	1.326	.187	.007	135.396
	SSPxTAC	-.097	.119	-.696	-.818	.414	.006	171.763
	HRMxTAC	.037	.124	.259	.298	.766	.006	180.091
	QCxTAC	-.227	.133	-1.629	-1.700	.091	.005	217.573
	PLxTAC	.091	.086	.596	1.065	.288	.013	74.101
	STRxTAC	.026	.092	.181	.282	.778	.010	97.223

a. Dependent Variable: PC

Appendix 13.6: Hierarchical Regression Analysis for Technological Upgrading Capability, Manufacturing Practices Dimensions and Cost Performance

Model Summary[d]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.475[a]	.226	.188	.88832	.226	5.941	8	163	.000	
2	.519[b]	.270	.229	.86544	.044	9.731	1	162	.002	
3	.588[c]	.346	.273	.84016	.076	2.237	8	154	.028	2.216

a. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP

b. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TUC

c. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TUC, ISxTUC, PLxTUC, STRxTUC, ITxTUC, HRMxTUC, SSPxTUC, QCxTUC, CRxTUC

d. Dependent Variable: PC

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	37.503	8	4.688	5.941	.000[b]
	Residual	128.625	163	.789		
	Total	166.128	171			
2	Regression	44.791	9	4.977	6.645	.000[c]
	Residual	121.337	162	.749		
	Total	166.128	171			
3	Regression	57.425	17	3.378	4.785	.000[d]
	Residual	108.703	154	.706		
	Total	166.128	171			

a. Dependent Variable: PC

b. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP

c. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TUC

d. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TUC, ISxTUC, PLxTUC, STRxTUC, ITxTUC, HRMxTUC, SSPxTUC, QCxTUC, CRxTUC

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	.078	.713		.110	.913		
	IT	.124	.102	.101	1.211	.228	.685	1.459
	CR	.219	.136	.151	1.611	.109	.543	1.843
	IS	.129	.114	.099	1.129	.261	.623	1.604
	SSP	-.059	.120	-.048	-.497	.620	.517	1.936
	HRM	.296	.135	.198	2.196	.030	.582	1.718
	QC	.122	.129	.082	.945	.346	.630	1.588
	PL	-.108	.105	-.080	-1.033	.303	.789	1.267
	STR	.168	.100	.134	1.678	.095	.743	1.345
2	(Constant)	.202	.696		.291	.772		
	IT	.100	.100	.081	.998	.320	.681	1.468
	CR	.154	.134	.106	1.146	.253	.529	1.889
	IS	.110	.112	.084	.986	.325	.621	1.609
	SSP	-.100	.117	-.080	-.849	.397	.510	1.959
	HRM	.210	.134	.141	1.568	.119	.558	1.793
	QC	.055	.127	.037	.431	.667	.612	1.634
	PL	-.121	.102	-.089	-1.183	.239	.788	1.269
	STR	.088	.101	.070	.869	.386	.695	1.439
	TUC	.366	.117	.290	3.119	.002	.520	1.922
3	(Constant)	1.105	3.494		.316	.752		
	IT	-1.112	.750	-.907	-1.483	.140	.011	88.033
	CR	.787	.896	.541	.879	.381	.011	89.150
	IS	-.987	.732	-.753	-1.348	.180	.014	73.333
	SSP	-.573	.826	-.459	-.694	.489	.010	103.106
	HRM	.001	.834	.000	.001	.999	.014	73.502
	QC	1.899	.841	1.281	2.259	.025	.013	75.680
	PL	.379	.643	.281	.590	.556	.019	53.523
	STR	-.326	.614	-.260	-.531	.596	.018	56.428
	TUC	.250	.761	.198	.329	.743	.012	85.681
	ITxTUC	.263	.146	1.664	1.803	.073	.005	200.461
	CRxTUC	-.135	.182	-.853	-.742	.459	.003	311.485
	ISxTUC	.230	.147	1.406	1.560	.121	.005	191.214
	SSPxTUC	.126	.164	.836	.766	.445	.004	280.474
	HRMxTUC	.038	.161	.238	.239	.811	.004	234.248
	QCxTUC	-.415	.177	-2.585	-2.344	.020	.003	286.262
	PLxTUC	-.112	.130	-.674	-.863	.389	.007	143.575
	STRxTUC	.083	.123	.538	.672	.503	.007	150.860

a. Dependent Variable: PC

Appendix 13.7: Hierarchical Regression Analysis for Technological Acquiring Capability, Manufacturing Practices Dimensions and Delivery Performance

Model Summary[d]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.537[a]	.288	.253	.74361	.288	8.238	8	163	.000	
2	.547[b]	.299	.260	.74004	.011	2.573	1	162	.111	
3	.599[c]	.359	.288	.72582	.060	1.802	8	154	.081	2.084

a. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP

b. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TAC

c. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TAC, PLxTAC, ISxTAC, STRxTAC, ITxTAC, SSPxTAC, HRMxTAC, CRxTAC, QCxTAC

d. Dependent Variable: PD

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	36.443	8	4.555	8.238	.000[b]
	Residual	90.131	163	.553		
	Total	126.574	171			
2	Regression	37.853	9	4.206	7.680	.000[c]
	Residual	88.722	162	.548		
	Total	126.574	171			
3	Regression	45.445	17	2.673	5.074	.000[d]
	Residual	81.129	154	.527		
	Total	126.574	171			

a. Dependent Variable: PD

b. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP

c. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TAC

d. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TAC, PLxTAC, ISxTAC, STRxTAC, ITxTAC, SSPxTAC, HRMxTAC, CRxTAC, QCxTAC

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	.602	.597		1.008	.315		
	IT	.032	.085	.030	.380	.705	.685	1.459
	CR	.160	.114	.126	1.407	.161	.543	1.843
	IS	-.020	.096	-.017	-.206	.837	.623	1.604
	SSP	-.023	.100	-.022	-.234	.815	.517	1.936
	HRM	.387	.113	.297	3.429	.001	.582	1.718
	QC	.256	.108	.198	2.378	.019	.630	1.588
	PL	-.072	.088	-.062	-.828	.409	.789	1.267
	STR	.112	.084	.102	1.335	.184	.743	1.345
2	(Constant)	.637	.595		1.071	.286		
	IT	.021	.085	.019	.241	.810	.680	1.470
	CR	.128	.115	.101	1.115	.267	.526	1.900
	IS	-.046	.097	-.040	-.474	.636	.606	1.651
	SSP	-.022	.100	-.020	-.222	.825	.517	1.936
	HRM	.359	.114	.275	3.155	.002	.568	1.760
	QC	.249	.107	.193	2.322	.022	.629	1.590
	PL	-.047	.088	-.040	-.535	.593	.765	1.307
	STR	.101	.084	.092	1.202	.231	.738	1.355
	TAC	.095	.059	.122	1.604	.111	.748	1.337
3	(Constant)	-.930	2.304		-.404	.687		
	IT	-.388	.378	-.362	-1.025	.307	.033	29.985
	CR	-.914	.481	-.719	-1.900	.059	.029	34.448
	IS	-.645	.390	-.564	-1.655	.100	.036	27.866
	SSP	.934	.444	.858	2.105	.037	.025	39.909
	HRM	1.037	.476	.796	2.176	.031	.031	32.161
	QC	1.173	.482	.906	2.436	.016	.030	33.248
	PL	-.016	.304	-.014	-.054	.957	.062	16.070
	STR	-.182	.348	-.166	-.523	.602	.041	24.279
	TAC	.468	.583	.598	.803	.423	.008	133.309
	ITxTAC	.100	.085	.792	1.171	.243	.009	109.937
	CRxTAC	.227	.109	1.913	2.090	.038	.005	201.380
	ISxTAC	.161	.094	1.285	1.711	.089	.007	135.396
	SSPxTAC	-.217	.103	-1.778	-2.103	.037	.006	171.763
	HRMxTAC	-.160	.108	-1.284	-1.483	.140	.006	180.091
	QCxTAC	-.225	.116	-1.856	-1.950	.053	.005	217.573
	PLxTAC	-.016	.074	-.117	-.211	.833	.013	74.101
	STRxTAC	.071	.080	.569	.895	.372	.010	97.223

a. Dependent Variable: PD

Appendix 13.8: Hierarchical Regression Analysis for Technological Upgrading Capability, Manufacturing Practices Dimensions and Delivery Performance

Model Summary[d]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.537[a]	.288	.253	.74361	.288	8.238	8	163	.000	
2	.542[b]	.294	.255	.74255	.006	1.462	1	162	.228	
3	.601[c]	.361	.291	.72466	.067	2.012	8	154	.048	2.067

a. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP

b. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TUC

c. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TUC, ISxTUC, PLxTUC, STRxTUC, ITxTUC, HRMxTUC, SSPxTUC, QCxTUC, CRxTUC

d. Dependent Variable: PD

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	36.443	8	4.555	8.238	.000[b]
	Residual	90.131	163	.553		
	Total	126.574	171			
2	Regression	37.250	9	4.139	7.506	.000[c]
	Residual	89.324	162	.551		
	Total	126.574	171			
3	Regression	45.704	17	2.688	5.120	.000[d]
	Residual	80.870	154	.525		
	Total	126.574	171			

a. Dependent Variable: PD

b. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP

c. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TUC

d. Predictors: (Constant), STR, IT, IS, PL, QC, HRM, CR, SSP, TUC, ISxTUC, PLxTUC, STRxTUC, ITxTUC, HRMxTUC, SSPxTUC, QCxTUC, CRxTUC

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.602	.597		1.008	.315		
	IT	.032	.085	.030	.380	.705	.685	1.459
	CR	.160	.114	.126	1.407	.161	.543	1.843
	IS	-.020	.096	-.017	-.206	.837	.623	1.604
	SSP	-.023	.100	-.022	-.234	.815	.517	1.936
	HRM	.387	.113	.297	3.429	.001	.582	1.718
	QC	.256	.108	.198	2.378	.019	.630	1.588
	PL	-.072	.088	-.062	-.828	.409	.789	1.267
	STR	.112	.084	.102	1.335	.184	.743	1.345
2	(Constant)	.643	.597		1.077	.283		
	IT	.024	.086	.023	.285	.776	.681	1.468
	CR	.139	.115	.109	1.203	.231	.529	1.889
	IS	-.026	.096	-.023	-.272	.786	.621	1.609
	SSP	-.037	.101	-.034	-.366	.715	.510	1.959
	HRM	.358	.115	.275	3.114	.002	.558	1.793
	QC	.234	.109	.181	2.144	.034	.612	1.634
	PL	-.077	.087	-.065	-.876	.382	.788	1.269
	STR	.085	.087	.078	.984	.326	.695	1.439
	TUC	.122	.101	.111	1.209	.228	.520	1.922
3	(Constant)	2.586	3.014		.858	.392		
	IT	1.064	.647	.994	1.645	.102	.011	88.033
	CR	-1.344	.773	-1.057	-1.739	.084	.011	89.150
	IS	-.430	.631	-.376	-.681	.497	.014	73.333
	SSP	-.111	.712	-.102	-.155	.877	.010	103.106
	HRM	-.368	.719	-.283	-.512	.609	.014	73.502
	QC	2.044	.725	1.579	2.817	.005	.013	75.680
	PL	-1.082	.554	-.920	-1.952	.053	.019	53.523
	STR	.607	.530	.554	1.146	.254	.018	56.428
	TUC	-.324	.656	-.294	-.494	.622	.012	85.681
	ITxTUC	-.203	.126	-1.476	-1.618	.108	.005	200.461
	CRxTUC	.320	.157	2.322	2.042	.043	.003	311.485
	ISxTUC	.084	.127	.592	.664	.507	.005	191.214
	SSPxTUC	.012	.142	.090	.084	.934	.004	280.474
	HRMxTUC	.146	.139	1.037	1.052	.295	.004	234.248
	QCxTUC	-.377	.153	-2.693	-2.471	.015	.003	286.262
	PLxTUC	.199	.112	1.374	1.781	.077	.007	143.575
	STRxTUC	-.106	.106	-.787	-.995	.321	.007	150.860

a. Dependent Variable: PD

Appendix 14: Publications Derived from the Thesis

Appendix 14.1

2014 International Symposium on Technology Management and Emerging Technologies (ISTMET 2014), May 27 - 29, 2014, Bandung, Indonesia

A Review of Technological Capability and Performance Relationship in Manufacturing Companies

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Abstract—**Manufacturing plays a very important function in the economy of most countries in nowadays age. Because of the dynamic character of manufacturing itself, its market and environmental situations, manufacturing firms are facing tremendous significance challenges. Developing countries are striving to compete in the global intense market, including Malaysia, and for that reason, this key industry needs to maintain and boost local capabilities for the economic strengthen and stability. As the technological capability (TC) has a strong involvement in the production and operation sectors which are the cornerstones of each manufacturing company, it should be improved and monitored periodically. The nature of a long term commitment of the technological capability creation and accumulation requires a huge considerable effort from a company to realize the effects of TC have on performance measures in every aspect while gaining competitive advantages and sustaining commercial success in the local and international market within their operational periods. Based from a resource-based view, it is in congruence that capabilities will promote firms' competitive advantage by improving the performance. The major intention of this paper is to have an overview on how TC actually relates towards performance measures in manufacturing companies.**

Keywords- ***Technological capability; firm performance; manufacturing companies***

I. Introduction

Substantial bodies of literatures on technological capability predominantly investigated on various roles of the capability, to some point they show the importance in development and acquisition of technological capability for industrial growth. Malaysia is still behind to catch-up to the higher level of technology. It is proposed that the government should stimulate an upgrading in technological capacity by deploying learning policies for better spillovers among local firms [1]. The contribution of manufacturing sector through the purchasing of technology is widely recognized as a method to upgrade local technologies. For instance, the case of automobile manufacturing, Malaysia can adopt the technology from the merger of automobile frontiers of Nissan-Renault from Japan and France to raise competitiveness in local firms hence upgrading the local TCs [2]. Basically, technology in organization consists of the hardware which includes machinery and equipments, and the software which is the procedure and habitual related to organization's word and knowledge embodied to the hardware [3]. There are mainly three areas in which technological change has primarily occurred in; information technology, materials technology, and manufacturing process technology [4]. A basic concept in the development of TC in an industrial organization involves the technological learning process, and TC is needed to generate and manage technical change [5] (see Figure 1).

This paper is prepared as follows. First, the operationalization of TC is reviewed. Following, will be the description on the types of TC. Next, draw attention to how TC is related to the manufacturing companies. Then, a reporting of previous literatures on the TC and performance relationship is done. As a final point, the paper ends with a conclusion and some recommendation for future studies.

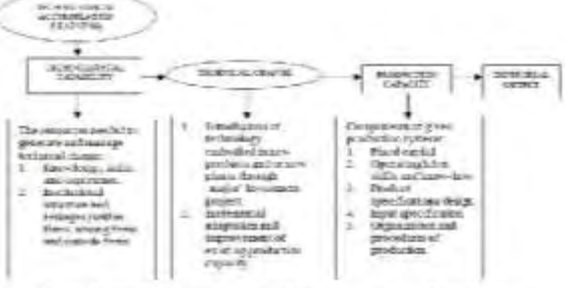

Figure 1. Technological accumulation: basic concepts and terms

II. What is Exactly the Technological Capability?

TC is an expression used to encompass the system of activities, physical systems, skills and knowledge bases, managerial systems of learning and incentive, and values that generate an extraordinary benefit for a company. Normally, a firm is capable of operating, maintaining, adapting, and assimilating the transferred technology. However, the issue arises is, to what extent the firm TC level can create a competitive environment on the firm which might outperform

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Appendix 14.2

Proceedings International Conference of Technology Management, Business and Entrepreneurship 2012 (ICTMBE2012),
Renaissance Hotel, Melaka, Malaysia 18-19 Dec 2012

A REVIEW OF TECHNOLOGICAL CAPABILITY IN MALAYSIAN MANUFACTURING SECTOR

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ABSTRACT

Today, manufacturing industry plays a crucial role of the economy in most countries. Due to the dynamic nature of manufacturing, its market and environmental situations, manufacturing firms are facing a serious and great importance challenges. Malaysia is striving to compete in the global market and therefore have to maintain and boost local industries for economic strengthen. The economic expert of the country had advised local companies to strengthen and upgrade their technological capabilities in order to achieve better economic performance. As the technological capability involved in the production and operation which are the cornerstones of every manufacturing company, therefore it should then be improved and monitored periodically. Substantial bodies of literatures on technological capability predominantly have investigated on various roles of the capability, to some point it shows the importance of technological capability acquisition for industrial development. However, the creation of technological capability is not a short term commitment. It takes effort on every aspect to realize its effects on the performance of organizations while gaining competitive advantages and sustaining commercial success in the local and global market along their operational period. Based from the resource-based view theory, the main idea of this paper is to review on how technological capability gives an impact towards manufacturing performance of Malaysian manufacturers. Finally, this paper will identify the measurements of manufacturing performance which are important to be scrutinized in manufacturing plants hence to improve their operational and production performance therefore achieved competitive advantages.

Keywords: Technological capabilities; performance; manufacturing sector

Introduction to Malaysian manufacturing sector

The manufacturing sector has become the most dynamic sector in an industrial economy compared to other sector of construction, mining and quarry, and utilities (Idris, Wahid, Nor, Mohamed, & Kechot, 2004). It plays a crucial role in the economy in most countries. This sector is considered as the leading catalyst to the world economy and it successfully contributed to the economic growth mostly in the third world countries. In the earlier trend, the manufacturing grows faster in exports other than other sectors. Before that, the manufacturing growth was sluggish in early 1961 until 1970, and become stronger when foreign firms started to expand local