

**INFORMATION TECHNOLOGY INVESTMENT AND MANUFACTURING
FIRM PERFORMANCE: THE MODERATING EFFECT OF
DECENTRALIZED DECISION MAKING**

by

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**Thesis submitted in fulfillment of the requirements
for the degree of
Doctor of Philosophy**

Januari 2015

ACKNOWLEDGEMENTS

First of all, I would like to express my sincerest appreciation and thankfulness to my supervisors, Dato Professor Yuserrie Zainuddin and Dato Professor Daing Nasir Ibrahim. I feel highly indebted to them for becoming my supervisors, staying with me throughout the duration of my study and for guiding me to complete the study. My gratitude and greatest appreciation go to my examining committee members, Profesor Dr Norshuhada Shiratuddin, Dr Marini Nurbanum Mohamad and Dr Lau Hooi Ping (Dr Adeline) and who provided me with valuable comments to further correct and enhance my thesis.

My appreciation and thankfulness also go to my employer, MARA University of Technology, for sponsoring me to do my PhD study. My gratitude is also extended to all my friends who have helped me directly or indirectly to do and finish my PhD thesis. I am also indebted to my respondents from E&E manufacturing firms throughout Malaysia for supplying me with the data that I can analyze and provide the output. Also my appreciation to USM staff especially those at Management school for their cooperation that made my study at Management School USM a memorable one.

Last but not least, I would like to express my sincerest appreciation and gratitude to my wife Norazizon Mohamad Nor, who helped me in so many ways throughout my study. To my adorable sons and daughters, Muhammad, Maryam, Ahmad Adnan and Khadijah, your love and concerns are the driving forces that help to motivate me throughout the study.

I dedicate this dissertation of mine to all mentioned above. Thank you.

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LIST OF ABBREVIATIONS

| | |
|------|---|
| ABC | Activity Based Costing |
| ATM | Automated Teller Machine |
| BSC | Balanced Scorecard |
| CIM | Computer Integrated Manufacturing |
| CFO | Chief Financial Officer |
| CIO | Chief Information Officer |
| ERP | Enterprise Resource Planning |
| E&E | Electrical & Electronic |
| FMM | Federation of Malaysian Manufacturers |
| FMS | Flexible Manufacturing System |
| GDP | Gross Domestic Product |
| IT | Information Technology |
| IV | Independent variable |
| DV | Dependent Variable |
| ITAA | Information Technology Association of America |
| IMP3 | Third Industrial Master Plan |
| ITAA | Information Technology Association of America |
| MBI | Malaysian Benchmarking Index |
| MIDA | Malaysian Industrial Development Authority |
| MIT | Massachusetts Institute of Technology |
| MPC | Malaysian Productivity Corporation |
| NEM | New Economic Model |
| NPC | National Productivity Corporation |

| | |
|-------|---|
| PIKOM | Persatuan Industri Komputer dan Multimedia Malaysia |
| PMS | Performance Measurement System |
| ROI | Return on Investment |
| SME | Small Medium Enterprise |
| TFT | Total Factor Productivity |
| RO | Research Objective |
| RQ | Research Question |
| SRT | System Resource Theory |
| US | United States |

**PELABURAN DALAM TEKNOLOGI MAKLUMAT DAN PRESTASI
FIRMA PEMBUATAN: KAJIAN KESAN PEMODERAT MEMBUAT
KEPUTUSAN TERPENCAR**

ABSTRAK

Tesis ini membentangkan kajian empirikal berkaitan dengan pengukuran prestasi pelbagai dimensi di dalam syarikat-syarikat pembuatan barangan elektrik dan elektronik di Malaysia. Fokus kepada pelaburan teknologi maklumat sebagai pembolehubah yang akan mempengaruhi prestasi syarikat dibuat kerana jumlah perbelanjaannya yang sentiasa meningkat dari setahun ke setahun berikutnya. Tambahan kepada itu, isu ‘paradok produktiviti’ di dalam bidang teknologi maklumat yang telah dibahaskan beberapa tahun sebelum ini ialah antara sebab utama mengapa kajian ini dibuat.

Selain itu, kajian ini juga membentangkan kajian berkaitan dengan penggunaan pengukuran prestasi pelbagai dimensi di dalam sektor perkilangan elektrik dan elektronik di Malaysia. Untuk lebih tepat lagi, ia mengkaji hubungan di antara perbelanjaan di dalam bidang Teknologi Maklumat dengan pengukuran prestasi pelbagai dimensi yang diukur menggunakan kaedah ‘Balanced Scorecard’ di dalam syarikat pembuatan barangan elektrik dan elektronik oleh sesebuah syarikat berkenaan. Perbelanjaan di dalam bidang Teknologi Maklumat ini dikategorikan kepada empat dimensi berbeza iaitu perbelanjaan infrastruktur, transaksi, strategi dan informasi.

Objektif kajian ini ialah untuk melihat sejauh mana tahap pengukuran prestasi pelbagai dimensi syarikat diamalkan oleh syarikat perkilangan elektrik dan elektronik di Malaysia dan juga tambahan kepada itu, objektif seterusnya ialah untuk mengukur kadar hubungan dan kesan oleh pelaburan teknologi maklumat kepada prestasi

syarikat perkilangan elektrik dan elektronik. Matlamat kajian ini dikira dicapai bilamana kadar penggunaan pengukuran prestasi pelbagai dimensi dapat ditentukan dan juga kesan pelaburan teknologi maklumat kepada prestasi syarikat perkilangan elektrik dan elektronik dapat dikenalpasti. Tambahan kepada itu, tesis ini juga mengkaji kesan moderasi desentralisasi pengurusan di dalam membuat keputusan kepada hubungan di antara perbelanjaan teknologi maklumat dan pengukuran prestasi pelbagai dimensi.

Data dikumpul dari 74 syarikat pembuatan barangan elektrik dan elektronik di Malaysia yang mana keputusannya menunjukkan bahawa penekanan kepada dimensi berbeza di dalam perbelanjaan teknologi maklumat akan memberi kesan berlainan kepada pengukuran prestasi pelbagai dimensi syarikat, dan kesan moderasi desentralisasi pengurusan di dalam membuat keputusan hanya signifikan bila diukur pada pengukuran prestasi dimensi Pelanggan sahaja. Kaedah analisis data ialah menggunakan kaedah regresi berganda untuk mengkaji hubungan diantara pembolehubah, kaedah analisa deskriptif untuk melihat analisa dari segi jumlah minimum, maksimum dan purata.

Tambahan kepada itu, kesan pemoderat membuat keputusan terpecar juga dianalisa dan diketahui menggunakan kaedah Analisis Regresi Berganda Berhierarchy. Pembolehubah kawalan dalam bentuk saiz yang dikira melalui bilangan pekerja juga dimasukkan ke dalam kajian ini untuk memastikan samada saiz sesebuah syarikat memberi kesan ataupun tidak kepada kesan kajian hubungan diantara perbelanjaan teknologi maklumat dengan prestasi syarikat.

**INFORMATION TECHNOLOGY INVESTMENT AND MANUFACTURING
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ABSTRACT

This research was carried out mainly to find out the results on the relationship between IT investment and multidimensional performance measurement in the electrical and electronic manufacturing setting in Malaysia. The focus on IT investment as the independent variable was made because of the huge amount allocated for it annually and the amount keeps on increasing over the years. Further to that, the issue of ‘productivity paradox’ which has been an ongoing debate for quite number of years was another pulling factor of why this research was carried out.

In addition to that, this research presented the study on the use of multiple measures of performance in the electrical and electronic (E&E) manufacturing firms in Malaysia. To be more specific, it examines how IT Investment which was categorized into four types according to its IT investment objective, namely infrastructure, transactional, strategic and informational affects a firm’s multidimensional performance measurement system represented by the balanced scorecard approach.

The objectives for this research are to establish on the multidimensional performance measurement practices within the E&E manufacturers in Malaysia and also to gauge on the extent of relationship between IT investment and manufacturing firm performance. The aims and objectives of this research were accomplished when the data was obtained for intensity of IT investment, extent of multiple performance measures in use are known and the effects of IT investment to multidimensional manufacturing performance were established. This research also studied on the

moderating effects of Decentralized Decision Making on the relationship between IT investment and firm performance.

Data was collected from 74 electrical and electronic manufacturing firms in Malaysia. The results suggest that greater emphasis on multiple measures for performance evaluation is associated with different types of IT investments categorizations; and the moderating effect of decentralized decision making was only associated with customer perspective only. The data analysis was done by using hierarchical multiple regression analysis so as to study on the relationships between independent and dependent variables, and by using descriptive statistics to analyze on the amounts that are maximum, minimum and average.

In addition to that, the moderating effects of decentralized decision making were analyzed and known by using the hierarchical regression analysis. The control variable in the form of size by way of employee numbers was also considered within this study so as to determine whether size would bring effects or not to the relationships between IT investment and firm performance.

CHAPTER 1

INTRODUCTION

1.0 Introduction

Malaysia economy managed to register a positive Gross Domestic Product (GDP) of 4.6 percent in 2008 (MIDA, 2008). The Malaysia government, although aware of the challenges facing the world economy at large and Malaysia economy in particular, is optimistic that Malaysia can weather these economic challenges (MIDA, 2008). The Malaysian economy grew to 7.2% in 2010, compared to a contraction of 1.7% it had in 2009 and Bank Negara Malaysia has projected a growth of 5-6% in 2011 when based on current estimates (MIDA, 2011).

Productivity in the manufacturing sector was varied when in 2010, it recorded a significant 9.4% growth in 2010, however it could ease to 5.3% in 2011 when considering the softening of the global market which will have an impact on external demand for Malaysia's manufactured export (Productivity Report, 2010/2011).

As stated above, productivity growth in the manufacturing sector which grew to 9.4% in 2010, was caused by a significant improvement in external demand. Despite all these increase in productivity growth for the manufacturing sector in 2010, the sector's productivity level of RM54,392 in 2010 remained below pre-crisis levels of RM55,349 (2007) and RM56,449 (2008) (Productivity Report, 2010/2011).

The leading export contributor came from the Electrical & Electronic (E&E) sector, contributing export valued at RM227.8 billion or 41.2% of total export and it

also became the largest contributor to added value, accounting for 41.1% of total manufacturing added value in 2009 (Productivity Report, 2009). There were increases in the amount in 2010, whereby the gross output of the industry amounted to RM166.2 billion (US\$55.8 billion), exports totaled to RM249.8 billion (US\$83.8 billion) and created jobs to 336,408 people (MIDA, 2011).

1.1 Background to the Study

Despite all these achievements, the manufacturing sector's output actually declined by 9.3% in 2009 and this was impacted by deterioration in the export of E&E products cluster which contracted by 22.8% whereby this sub-sector represented about 41.2% of the manufactured exports (Productivity Report, 2009).

The productivity statistics according to industries as produced by Malaysian Productivity Corporation (MPC) showed that E&E sector productivity position was at the second bottom of the list as shown in Table 1.1 below. The second lowest productivity growth for E&E industry is a practical gap that justifies further study to address this problem. This productivity problem in the E&E sector is one of the issues that will be looked at in this study.

Table 1.1
Productivity growth of manufacturing sub sectors and industries, 2010.

| Industries | Productivity Growth |
|--|----------------------------|
| Other transport equipment | 23.57 |
| Motor vehicles, Trailers and semi-trailers | 21.76 |
| Basic Metals | 15.51 |
| Medical, Precision and Optical instruments | 14.75 |
| Rubber and Plastic Products | 14.59 |
| Machinery and Equipment | 13.64 |
| Chemicals and Chemical Products | 13.01 |

| Table 1.1(continued) | |
|---|-------|
| Foods, Products and Beverages | 12.74 |
| Manufacturing | 9.42 |
| Paper and Paper Products | 9.11 |
| Refined Petroleum Products | 9.0 |
| Electrical and Electronics Products | 6.4 |
| Publishing, Printing and Recorded Media | 5.81 |

Source: *Computed from Annual Survey of Manufacturing Industries, Department of Statistics, Malaysia. Productivity Report 2010/2011 (www.mpc.gov.my)*

Apart from this, according to Persatuan Industri Komputer dan Multimedia Malaysia (PIKOM), IT related expenditure in Malaysia is estimated at RM32.3 billion in 2005 and is expected to increase to RM34 billion and RM37 billion in 2006 and 2007 respectively. In year 2009, Malaysian IT spending was recorded at US\$4.2 billion in 2009, US\$4.6 billion in year 2010, and was estimated to expand to US\$5.0bn in 2011 (Malaysia Information Technology Report Q3 2011, 2011) and in addition to this, it was projected that there was 7% growth in Malaysia IT spending in 2010, driven by a pick-up in business spending on hardware and applications. According to the PIKOM, it was stated that IT related expenditure accounts for more than 10% of national GDP in Malaysia (Malaysia Information Technology Report Q2 2010, 2010). Further to this, SME Corp Malaysia and Multimedia Development Corp chief executive officer Datuk Mohd Badlisham Ghazali had expected that IT investment will reach RM2 billion this year from the IT sector (Business Times, 2012). And to be exact, the IT expenditure is said to reach RM61.9 billion this year (Utusan Malaysia, 2013).

Although these statistics indicated the rising prominence of IT spending in Malaysia, nonetheless the exact extent of the amount of IT investment in the Malaysian E&E sector was one of the key issues which was investigated in this study. The importance of studying on the intensity of IT investment within E&E

sector was because it is a very much technology driven and the increasing investment in IT was very much anticipated in the industry.

This study seeks to explore the relationship between manufacturing firm performance and IT investment to see the extent of relationship that IT investment can bring to improve manufacturing firm performance.

1.2 Practical Manufacturing Gap

Despite all these seemingly good indications of manufacturing performance in general, and E&E sector in particular, there were also some practical problems with regard to manufacturing performance in Malaysia which will be explained in the practical gaps below. There are several symptoms which were indicative of practical problems in Malaysian manufacturing firm performance. The indicators are discussed in the section below.

1.2.1 Financial Indicators

1.2.1.1 Increases in Manufacturing Costs

Rising costs in manufacturing operations has been cited as one of the main reasons of why during the period between 2002 to August 2003, forty manufacturing companies had closed down. From that amount, nine companies had relocated to China (8 companies) and Indonesia (1 company). From the number of companies which had closed down, there were 15 companies owned fully by foreign investors. The investors concerned were from Japan (5), Taiwan (5), United States (2), Singapore (1), Australia (1) and Switzerland (1) (Dewan Rakyat, 2003).

As for during the period between January 2002 to April 2004, there were about 11 foreign companies which had closed down and relocated their businesses to these countries; China (8), Thailand (2), Indonesia (1). These companies were owned by foreign investors from Taiwan (5), Japan (2), Canada (1), United States (1), Australia (1) and Singapore (1). The industries involved were electrical components and electrical products (5), plastics (3), foodstuff and consumer needs (2), and furniture (1) (Dewan Negara, 2004). Some of the main reasons cited for the closing down of operations were because of increase in production costs, low demand and market problems, financial problems and termination of supply contracts to multinational corporations (MNC). These steps were taken to reduce operational costs and at the same time to increase the competitiveness in the global market.

During the period between January to June 2004, a company owned by a foreign entity and a local company closed down their operations and relocated abroad resulting in 210 workers being laid off (Dewan Negara, 2004). Another twelve foreign companies between 2000 to 2005 had relocated their manufacturing operations to China, especially industries involved in manufacturing electrical components and electrical products (9). These companies were from Taiwan (4), Japan (2), Canada (1), United states (1) and Singapore (1). (Dewan Rakyat, 2005). Again the main reasons for the closing down and relocation of these foreign companies were for the purpose of operational rationalization and to achieve cost effectiveness as well as to increase business competitiveness in the global market (Dewan Rakyat, 2005).

In 2006, 39 factories were closed down. Another 20 factories had also ceased operation in 2007. In addition, another 38 factories were closed down in 2008

(Dewan Negara, 2009). The closures of factories and laying off workers were also eminent in 2009 (Dewan Negara, 2009). Between year 2008 and up to february 2009, exactly 50 companies had closed down their operation in Malaysia which led to the 15562 workers were retrenched (Dewan Negara, 2009). Among the reasons cited for the closure of factories were because of financial problems and increases in manufacturing costs.

These financial problems and increase in manufacturing costs are the issues and gaps that needs to be looked into by the firms, in which the present study acknowledged and tried to address it.

1.2.1.2 Lowest Added Value Growth

The Added Value Growth for the E&E sector has registered the lowest percentage as compared to other manufacturing sectors in Malaysia. Added Value measures the wealth generated by collective efforts of both the employees and the capital providers (Productivity Report, 2010/2011). The reason for this statistic to be included in the present study because it shows the lack of wealth generated by the E&E manufacturers, which translated into weak financial perspective for the firms. This issue and gap of lowest percentage of added value growth need to be looked at by the firms and this study acknowledged and considered it as financial problems that need to be solved. The summaries of the percentages of added value growth for the sectors in the manufacturing industry are listed in the table below;

Table 1.2
Added value growth of the manufacturing subsectors, 2010

| Manufacturing subsectors | Percent |
|--|----------------|
| Other Transport Equipment | 27.40 |
| Motor Vehicles, Trailers and Semi-Trailers | 25.38 |
| Medical, Precision and Optical Instruments | 20.70 |
| Machinery and Equipment | 18.88 |
| Rubber and Plastic Products | 15.48 |
| Refined Petroleum Products | 13.96 |
| Basic Metals | 12.29 |
| Chemical and Chemical Products | 12.24 |
| Food Products and Beverages | 11.12 |
| Paper and Paper Products | 8.0 |
| Publishing, Printing of Recorded Media | 7.28 |
| E&E Products | 7.1 |

Adapted from Productivity Report 2010/2011.

1.2.2 Internal Business Process Perspective

1.2.2.1 Lack of Sophisticated Technologies and Inefficient System

Total factor Productivity (TFT) measures the efficiency of the utilization of both capital and human resources and higher TFP growth shows efficient utilization and management of resources, materials and inputs used for the production of goods and services (Productivity Report, 2010/2011).

Sub-sectors which showed lower Total Factor Productivity (TFP) growth include wood & wood products (0.7%), nonmetallic mineral products (0.7%), electrical & electronic products (0.5%), fabricated metal (0.3%), and textiles & apparel (0.2%) (Productivity Report, 2010/2011). This low TFP of 0.5% for the E&E sectors indicates productivity problems and this forms the practical gap that need to be looked at in this study.

1.2.3 Innovation and Learning Indicator

1.2.3.1 Lack of Progress in Innovation

As explained by Abdul Rahim Saad (2005), Malaysia manufacturing industry suffered from both structural and technological weaknesses (Hobday, 1995; Hamzah Kassim & Ismail Salleh, 2001). Lacking of innovation development was apparent due to the relocation exercises made by manufacturers to other low cost countries which resulted in some firms supplying to these manufacturers were losing businesses and hence, innovativeness (Abdul Rahim Saad, 2005).

One key conclusion of previous World Bank Report (2009) that examined the Malaysia's investment climate noticed there was constraints that could significantly reduce the productivity of firms operating in Malaysia. One example cited was the reduced innovative capacities in the firms due to hiring workers without the appropriate skills and this was because of the skills shortage problems in the market (Productivity Report, 2010/2011).

This lack of innovation is considered as one of the practical gaps that needs to be addressed by the firms and has been acknowledged in this study. Innovation is a must for business success and considered as the key drivers for economic growth and development. Under the New Economic Model (NEM), innovation is considered the core in propelling the nation to become a high income economy (Productivity Report, 2010/2011).

By being more innovative, firms are able to create more new products that can be sold to the market. Thus this could increase further the firm's revenue from selling new and improved innovated products to the market.

1.2.4 Customer Indicator

1.2.4.1 Customer Performance

Malaysia Benchmarking Index (MBI) had indicated that the customer performance in the E&E sector had fallen when compared with other selected industries. The poor showing was due to the higher complaints per customer (%) and complaints per order (%). This is illustrated in Table 1.3 below.

Table 1.3
MBI for manufacturing companies in selected industries

| Performance | KPI | Fabricated Metals | E&E | Petrochemicals | Transport Equipment |
|-------------|-----------------------------|-------------------|------|----------------|---------------------|
| Customer | Complaints per customer (%) | 0.1 | 1.2 | 0.33 | 0.36 |
| | Complaints per order (%) | 0.25 | 5.43 | 0.28 | 1.04 |

Adapted from: *MPC Report (2008)*

And this weakness in customer indicator forms the basis for the inclusion of customer perspective as one of the gaps that needs to be addressed by the firms.

1.3 Theoretical Gaps

There are three main theoretical gaps which are to be covered in this study.

1.3.1 Manufacturing Performance

The inadequacies of relying exclusively on the financial indicators in manufacturing performance measurement are well documented and understood (Medori, Steeple,

Pye & Wood, 1995). According to Eccles and Pyburn (1992), the drawbacks of looking solely into financial indicators are well known by managers. Among the many limitations cited are the financial measures are at best too summarized to be useful and, at worst, they provide a very limited and often misleading picture of the performance of the organization (Tarr, 1995). It is widely recognized during the 1990's that the exclusive reliance on financial indicators are not appropriate anymore for the purpose of measuring performance in manufacturing (Geanuracos & Meiklejohn, 1993).

According to Banker, Potter and Srinivasan (2000), non-financial measurements show better indicators for future performance and they are important in evaluating and motivating managerial performance. In addition to this, studies by Maiga and Jacobs (2003) and Hoque and James (2000) showed that the usage of multiple performance measure which is inclusive of non-financial indicators will lead to better firms' performance. Because of this theoretical gap that explained clearly that the sole reliance on using financial measure is not appropriate and suitable anymore, and that the multiple usage of performance measures will lead to better firm performance, thus it is one of the objectives for this research is to look into the multiple performance measures usage in the E&E companies in Malaysia.

A further look at performance indicators for local E&E industry, most of the measures used are financial measures which are represented by productivity and profitability indicators (Productivity Report, 2010/2011). Some of the mostly cited productivity performance indicators as explained in the report were Capital Productivity, Labour Productivity, Labour Competitiveness, Capital Intensity, Process Efficiency and Added Value Content.

To further determine the gaps with regard to the performance measures used in the E&E sector, an interview was conducted with a manager, industry and research division specializing on E&E sector, at National Productivity Centre (NPC). The purpose of this interview was to gauge on the usage of performance indicators in the E&E manufacturers that is to know the usage of financial and non financial indicators in those firms. From the interview, it was revealed that financial indicators are mainly used as the indicators for company's performance, whereas the non-financial indicators are used mainly in the operations division. The non-financial measures as used in operation are cited to be defect rates and process efficiency. This showed the gaps the present practices of E&E manufacturers in the sense that the non-financial indicators were not fully practiced in the firms and this is one of the gaps that was covered in this study.

This study attempts to close the theoretical and practical gap on E & E performance measurement by suggesting a Balanced Scorecard (BSC) approach to measure performance. BSC is chosen since it is the most widely used multiple measures in manufacturing (Gomes, Mahmoud, & Joao, 2004). BSC is multidimensional in nature and has a comprehensive set of performance measure that contains both financial and non-financial indicators (Kaplan & Norton, 1996). The usage of BSC in the E&E manufacturing firms is one of the key issues investigated in this study.

This approach included both the financial and non-financial indicators under four perspectives, namely financial, internal business process, innovation & learning and customer perspectives. All of the perspectives are linked by cause and effect or means end relationship whereby improvement in non-financial perspective will in the end lead to improvement in financial performance. By concentrating on this

approach, it is hoped that E&E sector can help to minimize the practical gaps as explained previously.

The justifications for the application of BSC methods in the manufacturing firms are as listed below:

- i. It encompasses both financial and non-financial indicators
- ii. It incorporates strategy to link with vision and mission of the company.
- iii. BSC are used widely among all performance measurement system indicating wide acceptability of its usage among practitioners and scholars alike (Gomes, Yaasin & Lisboa, 2004).

1.3.2 Relationship between IT Investment and Firm Performance (Productivity Paradox)

As explained in the preceding section, IT expenditures have been on the rise in the manufacturing sector in Malaysia. This study intends to explore further and specify on the relationship between increase in IT investment and increase in manufacturing performance.

The benefits IT investment can bring to improve firm performance has managed to stimulate interests among scholars and practitioners alike. Many empirical researches have been conducted with conflicting results (Sircar, Turnbow & Bordoloi 2000, Barua, Kriebel & Mukhopadhyay 1995, Brynjolfsson 1996, Brynjolfsson & Hitt 1996, Hitt & Brynjolfsson 1996, Bharadwaj, Bharadwaj & Kosynski 1999) on the outcome of their IT investments to firm performance. Some registered positive relationships between the two variables and some do not. Despite these uncertainties in outcome, firms continue to invest enormous amount of money for IT investment.

An International Data Corporation Report (1995) projects that there will be an increase in corporate IT investment by a further 2.5% from its figure of 2.5% now to 5% of revenues by 2010. With this big amount of money being allocated for IT investment, it was imperative that businesses identify which forms of IT investments and IT management which are most effective (Seddon, Graeser & Wilcocks, 2002). In addition, according to Karyn and James (2010), the spending on IT related expenditures by businesses around the world was well over \$2 trillion per annum.

Although a huge amount of money spent on IT investment was well known, more than two thirds of *Fortune* 100 companies chief executive officers felt that the benefits gained from their IT investment were still vague (Rifkin, 1989; Shank & Govindarajan, 1996). As the amount of IT investment keeps on increasing, concerns have been raised by executives and government policymakers about the productivity and profitability of IT investment (Kim, Jun & Sancho, 2009).

A further look at the literature had stated that large sums were invested in IT, and seemed to be swallowed by a large black hole without rendering many returns (Brynjolfsson, 1993; Peppard & Rowland, 1995). Black hole as referred above was large IT investment by firms that vanished without getting monetary benefits as expected.

Many firms which had taken the bold steps of spending in IT investment without calculating the potential benefits accrued from it as they do not want to be left behind in information technology. Recent researchers like Jeffery and Leliveld (2004) also support the view that IT investments form a major portion in capital budgets in many organizations.

The evidence on the potential benefits of IT investments had continued to interest researchers and what baffles them is of how to turn IT investment into profit

making expenditures. Although many agreed to the benefits that can be generated from IT investment, there are also those whom thought otherwise. Schrage (1997) for example rejected the notion of IT investment as profitable by calling the conclusions the big lie of the information age (Schrage, 1997).

The conceptual explanation of the term productivity paradox are as follows. The term productivity is basically the amount of output produced per unit of input. While it is simple to define, but it is difficult to measure it for example, the measurement used for output will not just include the physical products produced from the production floor but rather the value created for consumers and in today's economy, value depends increasingly on product quality, timeliness, customization, convenience, variety, and other intangibles (Brynjolfsson & Hitt, 1993).

And the same goes for the difficulty in measuring the input because of the various natures of input data in the form of quantity and quality of capital equipment used, materials and other resources consumed (Brynjolfsson & Hitt, 1993). And with regards to the relationships between IT investment (factor input) and firm performance (factor output), many authors have studied on this premise using various measurement basis both for factor input and output and in the end producing mixed results that is positive and negative results (Barua, Kriebel & Mukhopadhyay 1995, Brynjolfsson 1996, Brynjolfsson & Hitt 1996, Hitt & Brynjolfsson 1996, Bharadwaj, Bharadwaj & Kosynski 1999).

Many firms assumed that by investing in IT, it would create economic returns to a firm but the inconsistencies in the results obtained had baffled the researchers even more on the potential productivity benefits of IT investment to firm performance. To be precisely defined, the productivity paradox is the perception that there is lack of increased in output due to the investment in IT (Sircar, Turnbow, &

Bordoloi, 2000). The study on Productivity Paradox falls into two categories, industry and company level. The first category concerns with the effects of IT investments on the aggregate economy wide scale and the second category concerns with the effects on firm performance.

The effects of IT investments on firms' performance had been delved by many researchers especially of whether IT could be a significant contributor to productivity growth (Kyhyang, Yuhn, & Seung, 2010). Although IT investments occupy a large component of a firm's budget, but measuring the payoff of IT investments have not produced conclusive findings on it and thus led to the term IT productivity paradox, which caused a debate in the information system (IS) field (Yongmei, Hongjian, & Junhua, 2008).

The second category concerns at firm level where according to Strassman (1997), there was no correlation between IT investment and profitability. The productivity paradox that exists at second level that stimulated research interests among researchers (e.g., Brynjolfsson & Hitt, 1993; Strassmann 1997; Weill, 1992) and which are of concern to this study. These previous studies as explained above found vague relation between IT investment and firm performance.

These previous findings were later contradicted by a more positive relationships during the late 1990's and later periods (Brynjolfsson & Hitt, 1995, 1996; Dewan & Min, 1997; Stratopoulos & Dehning, 2000; Garud & Kumaraswamy, 2005; Thouin, Hoffman, Ford, 2008; Kim, Xiang and Lee, 2009; Kyhyang et al., 2010). These conflicting findings implied that the linkage between IT investments and firm performance was much more complex than previously thought (Yongmei, Hongjian, & Junhua, 2008).

Chan (2000) posited that it was quite elusive for empirical evidence to support unambiguously the notion that investments in IT has led to improvements in firm performance. The ongoing and always increasing investment in IT has strengthened further the need to evaluate the productivity impacts of IT. In general, these studies find little overall correlation between IT spending and increased business performance. A study by Mckeen and Smith (1993) said that IT was indirectly linked with firm performance. It had been recognized that the link between IT investment and firm performance was indirect due to the effect of mediating and moderating variables (Chen & Zhu, 2004). According to Michael and Carla (2010), the difficulty in measuring the value of IT is considered as the most enduring questions at the intersection of accounting and information systems.

However, most of the empirical studies done on productivity paradox as mentioned in the explanations above were looking on the effects of IT investment on financial performance only, neglecting the benefits that IT investments can bring to non-financial performance (Brynjolfsson, 1993; Peppard & Rowland, 1995; Brynjolfsson & Hitt, 1995, 1996, 1998; Dewan & Min, 1997, Stratopoulos & Dehning, 2000; Irani & Love, 2000/2001; Marthandan & Tang, 2010).

This study attempts to close the gap by looking at the effects of IT investment in improving both financial and non-financial perspectives of manufacturing performance. The elements of performance chosen for use in this study was the Balanced Scorecard since it was the most often cited performance measurement system in manufacturing (Gomes, Mahmoud & Lisboa, 2004), and it comprised both financial and non-financial indicators.

Further to that, the justifications for studying on the issue of productivity paradox are as follows:

- i. Previous literatures as cited above had proved the findings from these studies were mixed, either positive effects to the firm performance or vice versa. There is no conclusive findings on the outcome from IT investment to firm performance, thus justifying it further for this research to be carried out to further investigate on this premise.
- ii. According to Melville, Kraemer and Gurbaxani, (2004), one of the most pressing theoretical gaps in the area of productivity paradox is the ‘emphasis on US firms’ and ‘lack of cross-country studies’, so its ‘results are conditional on the characteristics of the US business environment’. Thus this thesis attempted to fill the gap by carrying out the study in the Malaysia’s E&E settings. It was conducted empirically to study the effect of IT investments on manufacturing business performance in Malaysia, based on data from Malaysian E&E industrial firms.
- iii. Thirdly, IT investment is an enormous and significant spending by a firm (Bureau of Economic Analysis, 2007) thus justifying the need for this research to evaluate the benefits from this high IT expenditure and to see whether it’ll bring the expected benefits that can commensurate with the huge money invested. It was noted that the expenditures incurred for IT investment is enormous that lead to serious managerial concerns over the business value of IT (Lee , Chunhui & Siew , 2010). The rising trend in firms' IT investment on hardware and software increased from 5% in 1978 to 22% in 2005, approaching investments in land and structures (Bureau of Economic Analysis, 2007). This fact further justifies the need to better assess

the payoff from high IT investments so that the investment will bring the added benefits to the firm.

1.3.3 Decentralized Decision Making

As more and more firms were using IT in order to run their business transactions, the costs of acquiring IT had gradually beginning to lower down. IT manufacturers were able to take advantage of the rising demand and this had attracted other IT firms to come into this business thus forcing the IT costs to go down.

According to Malone (1997), the decrease in IT costs had changed the organizational decision making, resulting in decentralized control becoming more favorable in many situations. According to Malone (1997), as communication costs continue to fall, there comes a point where connected, decentralized decision makers were more effective as these decentralized decision makers can acquire and use information available at their fingertips to make autonomous decisions within their task authority.

According to Wilson et al. (1986), one of the decentralization effects was to allow access to better and wider information and to unaccustomed data and this would affect decision making in which in the end, will affect performance. This was true since in decentralized firms using IT applications, managers were exposed to vast and almost limitless information and based on this information, and they were better able to make effective decisions that can bring benefits to the firm. Further to this, decentralization will also lead to faster response to changing circumstances, increased motivation of managers, excellent training for future top level executives and finally better information leading to superior decisions and performance (Jiambalvo, 2001). On a shorter note, decentralization will lead to effective decision

making of middle managers within the IT environment which can effect on the causal relationship between IT investment and firm performance and thus this will certainly moderate on the relative strength of the causal relationship.

In addition to this, company-wide computer networks could facilitate access to different types of information located in diverse parts of the organization (Malone et al., 1987; Malone & Rockart, 1990). According to Huber (1990), middle managers would be able to make faster and more effective decisions using the availability of relevant information at decentralized decision nodes. On top of that, IT through its decentralized nodes can facilitate and disseminate global information of the firm to line workers that will improve their decision making capacities and also enhances management's monitoring capability (Kanamori & Motohashi, 2006). In all, it can be said that decentralized decision making will influence on the relationship between IT and firm performance by giving access to different types of information that forms effective decisions capacities to workers whom are involved in the causal relationship. And again this effective decentralized decision making capabilities is thought to moderate on the relationship between the IT investment and performance.

Furthermore, middle managers would be able to exchange information among themselves in different organizational subunits which in the end could further support more comprehensive analyses and lead to better decision outcomes (Andersen, 2005). This better decisions outcome by way of comprehensive analysis in the decentralized decision making will lead to effective decentralized decision making that can influence on the outcome the causal relationship between independent variable and the dependent variable.

With regard to the empirical study on the relationships between IT investment and firm performance, a study by Andersen (2005) considered relationships between computerized information systems, decentralized decision making, and performance. His study focused on the interaction between decentralized decision processes and information technology and the effects on organizational performance in different environmental settings.

The selection of decentralized decision making as the moderator was made based on the following reasons. Firstly, According to Andersen & Segars (2001), there was no clear evidence of causality on the relationship between IT and decentralization when they were measured simultaneously, implying that decentralization cannot work as an intervening variable or dependence variable on this relationship. Secondly, according to the findings by Andersen (2005), there was no direct relationship between decentralized decision making and firm's performance, thus suggesting and implying that decentralized decision making cannot become an independent variable. And based on these two premises, it is presumed that decentralization will work as a moderator on the relationship between IT, decentralization and firm performance and this is one of the theoretical gap to be covered in this study.

Thirdly as has been explained earlier, the linkage between IT investment and organizational performance had produced mixed positive and negative results, thus suggesting the need for the moderator to strengthen on the relationship. The mixed results produced by authors studying on this premise as cited in the earlier sections has provided stimulus for researchers to further study on this issue so that a conclusive finding can be reached in organizational settings. According to Baron and Kenny (1986), they posited that moderating variable are typically introduced

when there is unexpectedly or inconsistent relationship between a predictor and criterion variable.

In short, the justifications for the inclusion of decentralized decision making as the moderator can be summarized as below;

i. There were mixed results on the studies of IT productivity paradox as has been highlighted in the earlier explanations. Thus according to Baron & Kenny (1986), the moderating variable is typically introduced when there is inconsistent relationship between a predictor and criterion variable. Thus in this study, a moderating variable is introduced when there were inconsistencies in the findings by way of mixed results for the studies of IT productivity paradox.

ii. Secondly, there were no clear evidence of causality on the relationship between IT and decentralization (Andersen & Segars, 2001). Since there is no causality on the relationship, thus we can imply that decentralization cannot become an intervening or dependence variable in the relationship with IT since it will bring no effects or no causal relationships in the study of IT productivity paradox.

iii. Thirdly, it has been found out by Andersen (2005) that there was no direct relationship between decentralization and firm's performance. This implies that decentralization cannot become an independent variable in the study of IT productivity paradox.

Based on the three explanations above, it can be presumed that decentralization will work as a moderator on the study of IT productivity paradox.

Thus this study seeks to extend the theoretical gap by examining the moderating effects of decentralized decision making on the relationships between IT investment and manufacturing firm performance. This theoretical gap was one of the areas investigated in this study.

1.4 Problem Statement

As highlighted in the earlier sections, there were many practical gaps in the manufacturing performance such as rising costs, lack of innovation and below average statistics. These had indicated the needs to acknowledge the problems in the manufacturing firm performance and thus, the need to suggest revised and improvised methods to encounter the said symptoms and problems. Thus these manufacturing practical gaps are basically the indicators that manufacturing performance problems do exist in the E&E manufacturing industry and thus need to be addressed by looking at how performance can be further enhanced within this E&E industry.

In terms of theoretical gap, criticisms were made on traditional financial measurements and showed the importance in the introduction of non-financial indicators. The extensive usage of financial indicators and selected non-financial indicators such as in operations division in Malaysian E&E manufacturing firms (Lok Lee & Mazlina Shafie, 2007) indicated that a more comprehensive approach needed to be looked into so that firms would be better able to deal with practical gaps explained previously. Thus in this study, the problems of relying mostly on financial perspectives and less emphasis on non financial performance indicators need to be investigated in terms of usage of both financial and non financial indicators in the E&E industry, and to look at the advantages that firms can obtain if they were to use both financial and non financial indicators in order to increase their firm performance comprehensively.

Most empirical studies on the issue of productivity paradox consider IT as a single homogeneous asset (Bharadwaj, 2000), divide IT investment into labor and capital stock (Brynjolfsson and Hitt, 1996, Bharadwaj, 2000), and to investigate IT

investment to productivity (Mariela & Conception, 2009). Though most studies divide IT investment to reflect strategy and firm performance, but only few divide it into different asset class. This problem of homogeneously treating the IT spending into one category only needs to be discussed further because according to Woodward (1959), categorizing task technology into small batch proved to be more effective in determining firm effectiveness. To encounter this problem of homogeneously treating the IT investment and to further enhance the firm performance based on the different IT asset classes which will bring different benefits to the company (Weill & Aral, 2004), this study applies the categorizations of IT investment according to four asset class namely infrastructure, transactional, strategic and informational (Weill and Aral, 2006b). Within this study, the four categorizations of IT assets class were introduced where firms need to segregate their IT spending according to these four IT segregations.

Although this study looked similar to a series of studies by Weill (1992, 2003, 2004, 2005), but there are differences to it that sets this research apart from previous studies on this issue. The similarities and differences between this study and Weill's studies are elaborated as follows:

- i. The four dimensions of independent variables are similar to the studies by Weill(1992, 2004) which are infrastructure, transactional, strategic and informational. But all of the Weill's studies had been carried out in the United States (US) and as had been explained earlier, one of the theoretical gap in this issue is the lack of cross country studies, thus the data and findings from the previous studies were confined to the business traits in the western countries especially in the US. This study used the IT categorization by Weill in the Malaysian E&E manufacturing setting.

- ii. Secondly in Weill's works, he focused on measuring the benefits from the segregation of IT investments be it in financial and non-financial which is also the objective of this study. But this study differed from his study in the sense that this study conceptualized the performance in terms of Balanced Scorecard which Weill did not do. Balanced scorecard approach is a more comprehensive performance measurement where it was created to clarify and translate vision and strategy and to translate strategic objectives into a coherent set of performance measures (Kaplan & Norton, 1993).
- iii. Thirdly, this study used the System Resource Theory to become the background theory in explain the relatedness of each variables which Weill did not do. The concepts of effectiveness, efficiency, productivity, resource acquisition and multidimensional performance measurement were all related to this study, which Weill did not have.
- iv. Finally, this study employed a third variable which moderates on the relationship between IT investment and performance. The function of decentralized decision making in moderating on the relationship was explained and tested in this study which also Weill did not do.

Another point to note is that the expenditures incurred for IT investment is enormous that lead to serious managerial concerns over the business value of IT (Lee , Chunhui & Siew; 2010). The rising trend in Firms' IT investment on hardware and software increased from 5% in 1978 to 22% in 2005, approaching investments in land and structures (Bureau of Economic Analysis, 2007). This problem of high IT spending further justify the need for this research to look at the amount of IT investment in Malaysian setting since it is such a huge investment in