

# THE THEORETICAL GAPS ON THE IT PRODUCTIVITY PARADOX: A CONCEPTUAL PAPER

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## Abstract

Basically the theoretical gaps are concentrated on the issue that focusing solely on the financial measurements to measure the firms' performance. It has been found that IT investment will bring not only financial benefits, but also nonfinancial benefits to the firms. The objective of this study is to investigate the relationship between information technology (IT) investment and the Malaysian Electrical and Engineering (E&E) manufacturing firms' performance. In addition, this paper also aims to establish the problem statement in the IT productivity paradox area that will serve as a basis for future research with regards to this issue within the E&E manufacturing performance in Malaysia.

**Keywords:** *productivity paradox, IT investment, nonfinancial benefits, firm performance*

## 1.0 INTRODUCTION

The relationship on the effects of IT investments to firms' performance has drawn intense research interest from academics and scholars alike. Initial studies have discovered that the 'productivity paradox' on the relationship between IT investment and productivity has happened over a decade ago. However, later studies produced convincing (albeit varied) positive and negative results (Barua, Kriebel & Mukhopadhyay, 1995; Brynjolfsson, 1996; Brynjolfsson & Hitt, 1996; Hitt & Brynjolfsson 1996; Bharadwaj, Bharadwaj & Kosynski, 1999). The varied nature of mixed results could be explained on the varied selection of IT investment measurement which normally rested on the dollars and cents spent on IT (Bharadwaj, Bharadwaj & Kosynski, 1999) and the different methods used to measure performance itself (Hitt & Brynjolsson, 1996).

The focus of previous researchers had been mainly on the measures of IT spending and firms' performance (Markus & Soh, 1993; Strassmann, 1985). Many scholars studied the direct relationship between IT expenditures and performance measurements in financial ratios whereas some examined intermediate variables which subsequently affect performance (Ragowsky, Neumann & Ahituv, 1994). According to Mahmood and Mann (2005), previous researches on this issue can nominally be classified into three categories; the first one was primarily non empirical and deals with anecdotal case studies. The second one

was primarily empirical and defined the unit of analysis as the industry. Finally the third one was also empirical and used firm-level data to investigate the possible relations. All of these findings were inconclusive of the values of investment in IT and the benefits reaped from such investments. The business benefits of IT were a highly important but controversial issue that had drawn intense research endeavours in the past two decades (Winston & Benjamin, 2006). The studies of potential returns in IT investments had been researched by various scholars (Brynjolfsson & Hitt, 1996; Bharadwaj, Bharadwaj, & Konsynski, 1999; Dewan & Kraemer, 2000; Im, Dow, & Grover, 2001). However, research attempted to demonstrate the value of investment in IT had not provided a clear indication of how IT spending provides a pay-off (Walter, Sheri, & Robert, 2007).

Various studies have proposed differing evidence in showing whether there were benefits in IT investment (Brynjolfsson, 1993). Some used financial indicators and found the positive relationship (Bharadwaj et al., 1999; Brynjolfsson, Hitt & Yang, 2002). Research studied showed that IT investment improved firms' performance (Brynjolfsson & Hitt, 1996). Some other examples of studies showing positive relationship between IT investment and firms' performance Alpar & Kim ,1990; Mahmood & Mann ,1993; Barua et al ,1995; Brynjolfsson & Hitt ,1996; Mitra & Chaya, 1996; Rai, Patnayakuni & Patnayakuni, 1997; Tam ,1998; Sircar, Turnbow & Bordoloi, 2000). On a more recent note, one study found on average, a positive correlation exists between increased IT investments and productivity levels when studying a large number of firms (Thouin, Hoffman, & Ford, 2008).

All these findings seemed to support the notion that there are benefits that can be accrued from IT investment and this fact is well established (Mitra, 2005). There are many ways where firms can get benefits from IT investment: by managing organizational knowledge, enhancing decision making, and increasing the effectiveness and efficiency of firms' processes (Garud & Kumaraswamy, 2005). The findings from the study by Thouin, Hoffman and Ford (2008) indicated that IT budgetary expenditures were found to significantly affect firm-level financial performance. Another study by Jae, Jun and Sangho (2009) who attempted to investigate the effects of IT investment on firm financial performance in China showed that IT investment has a positive impact on firms' performance in China. Although earlier studies were sceptical about the contributions of IT on productivity, many recent studies had found strong correlations between IT and productivity (Kyhyang & Seung, 2010).

In contrast, there were scholars who questioned the benefits of IT investment to firm performance (Carr, 2003; Kohli & Devaraj, 2003). According to Hayes (2004), findings by Standish Group showed that only 28% of IT projects were successful in 2004, as compared to 34% in 2003. Thus it was a challenging process for a firm to gain a business value on its IT investment (Jeffery & Leliveld, 2004). Although the benefits from IT investment has long been argued and debated, there is no clear consensus reached (Gang, Hongjiao , Linyan & Amrik, 2009). Their finding showed that IT had no direct impact on the dependent variable in contrast to clear positive result (Thouin et al., 2008).

According to Sircar et al. (2000), conflicting results were found when some researchers tried to study the relationship of IT investment on firm performance; and this had made it difficult to draw conclusive findings about their studies. There were those who managed to obtain positive relationship between the IT investment and performance but there were also researchers who claimed that there was no correlation between IT investment and profitability (Brynjolffson & Hitts, 1996). In between these two findings, there were also scholars who found mixed results thus making their findings inconclusive (Cron & Sobol, 1983). In view of conflicting findings on this issue, it is noted that the understanding of how IT affects productivity either at the level of the firm or for the economy as a whole is extremely limited (Mariela & Concepción, 2009). Thus, this justifies the further need for this research to be carried out to gain better understanding of IT investment to performance in different organizational settings.

Some previous studies on the issues of the productivity paradox that is on the relationships between IT investment and firm performance are as shown in the Table 1 below. As an overview, among the studies

which showed significant and positive relationship were done by researchers such as Mahmood & Mann (1993), Brynjolfsson & Hitt (1996), Sircar et al. (2000), Lee & Bose (2002) and Thouin et al (2008). In addition to this, there were several studies which have used size as the controlling variable which indicates that size of the firms needs to be controlled in order to study the nature of relationship that exists between IT investment and firms' performance (Mitra & Chaya, 1996; and Yongmei, Hongjian, & Junhua, 2008).

**Table 1 Previous studies on 'Productivity Paradox'**

<b>Authors</b>	<b>Scope</b>
Mahmood and Mann (1993)	This study applied the System Resource Approach theory (Yuchtman & Seashore, 1967). The measures used return on investment, return on sales, growth in revenue, sales by total assets, sales by employee and market to book value. The findings indicated that when analyzed using canonical correlation, IT investment was significantly related to performance.
Mitra and Chaya (1996)	This study determined that IT investments were related to firm performance in the form of lower average total costs, lower average production costs and higher average overhead costs. Another finding from this study was that larger firms tended to spend more on IT as compared to smaller companies which indicated that size needs to be controlled for when studying on the relationship.
Sircar <i>et al.</i> (2000)	This study also determined a significant relationship existed when IT investment was measured as a set of IT investment measures, and analyzed using canonical correlation.
Bharadwaj (2000)	This study used the Resource Based View where the firm's performance was linked to resources which were unique, rare and difficult to imitate.
Chan (2000)	The author reviewed comprehensively the articles on the issue. He proposed the usage of multiple measures and different level of analysis to understand the issue better.
Lee and Bose (2002)	This study explored on the usage of aggregate measures and the inclusion of intervening variables. This research was made to understand the linkage between IT and a firm's economic performance using aggregated measures of accounting-based and market-based performance while considering intervening variables such as firm size, capital intensity, research and development intensity and advertising intensity. It was found that IT has a significant effect on aggregated composite measures of accounting-based and market-based performance.
Fang and Lin (2006).	This study provided a regression model to measure the performance of ERP systems and found that financial perspectives have good relationship with non-financial perspectives.
Yongmei et al.(2008)	The researchers included the factor IT capability as an indirect variable linking IT investment to firm performance while firm size was treated as a control variable.
Thouin et al (2008).	This study examined the effects of 3 different firm-level IT characteristics on financial performance. The three characteristics are the effects of IT budget, IT outsourcing, and the relative number of IT personnel on firm-level financial performance are analyzed. The results were mostly significant except for an IT personnel was insignificant.
Mariela et al (2009).	Authors investigated the impact of investments in information technologies (ITs) on the productivity of Spanish firms. They used a Cobb–Douglas function to measure the contribution of IT capital to labour productivity. Findings showed some improvement in labour productivity in the considered period, but this improvement was not significantly derived from IT investment.
Lee, Chunhui and Siew (2010)	This study hypothesized that IT business value is influenced by firm specific context. Findings showed that U.S. manufacturing industries specializing in durable goods industry firms realized higher IT business value in improved labor and administrative productivity. In conclusion, the findings support the theoretical claim that IT spending does matter strategically in the right setting.
Marthandan and Tang (2010)	The authors tried to examine IT evaluation issues and challenges and they identified 8 issues/challenges that were faced by IS researchers, specialists and business managers.

Another point to note is that the expenditures incurred for IT investment is enormous that leads to serious managerial concerns over the business value of IT (Lee et al., 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.

## 2.0 RESEARCH ISSUES

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 the increase in IT investment and manufacturing performance. The benefits of IT investment can bring to improve firms' performance has managed to stimulate interests among scholars and practitioners alike. Many empirical researches have been conducted with conflicting results (Sircar et al. 2000; Barua et al. 1995; Brynjolfsson, 1996; Brynjolfsson & Hitt, 1996; Hitt & Brynjolfsson, 1996; Bharadwaj, et al 1999) on the outcome of their IT investments to firms' 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) showed that there will be an increase in corporate IT investment by a further 2.5% from its figure of 2.5% 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 is 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, there were concerns about the productivity and profitability of IT investment.

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. The conceptual explanations of the term productivity paradox are as follows. The term productivity is basically the amount of output produced per unit of input. Even though it is simple to define, it is difficult to be measured. 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).

Likewise, 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). 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, et al., 1995; Brynjolfsson, 1996; Brynjolfsson & Hitt, 1996; Hitt & Brynjolfsson, 1996; Bharadwaj, et al., 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 has 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 et al., 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 has 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 relationship during the late 1990's and later periods (Brynjolfsson & Hitt, 1995, 1996; Dewan & Min, 1997; Stratopoulos & Dehning, 2000; Garud & Kumaraswamy, 2005; Thouin, et al., 2008; 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, et al., 2008).

Chan (2000) posited that it was quite elusive for empirical evidence to support unambiguously the notion that investments in IT have led to improvements in firms' 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 found little overall correlation between IT spending and increased business performance. A study by Mckeen and Smith (1993) said that IT was indirectly linked with firms' performance. It had been recognized that the link between IT investment and firms' 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 question 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 highlight the gaps and to look 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 proven the findings from these studies were mixed, either positive effects to the firm performance or vice versa. There is no conclusive finding 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 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 the results are conditional on the characteristics of the US business environment'. There is a need to fill the gap by carrying out the study in the Malaysia's E&E settings. It need to be 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 led to serious managerial concerns over the business value of IT (Lee , et al., 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.

### 3.0 CONCLUSION

This study concludes that there are extra benefits from the IT investment to a firm. These benefits are basically in terms of financial indicators and additional nonfinancial indicators that need to be counted so as to better assess the full impacts if IT investment to the performance of the E&E manufacturing firms in Malaysia. And these diverse benefits of IT investment benefits will form the basis for problem statement in carrying out future research in this area.

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