

2007

Different Perspectives on IT Business Value: An Integrative Approach

Simon K. Poon

University of Sydney, s.poon@usyd.edu.au

Mario Eugster

University of Sydney, marioeugster@yahoo.com.au

Joseph G. Davis

University of Sydney, jdavis@it.usyd.edu.au

Byounggu Choi

University of Sydney, choi@it.usyd.edu.au

Follow this and additional works at: <http://aisel.aisnet.org/acis2007>

Recommended Citation

Poon, Simon K.; Eugster, Mario; Davis, Joseph G.; and Choi, Byounggu, "Different Perspectives on IT Business Value: An Integrative Approach" (2007). *ACIS 2007 Proceedings*. 104.

<http://aisel.aisnet.org/acis2007/104>

This material is brought to you by the Australasian (ACIS) at AIS Electronic Library (AISeL). It has been accepted for inclusion in ACIS 2007 Proceedings by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact elibrary@aisnet.org.

Different Perspectives on IT Business Value: An Integrative Approach

Simon K. Poon, Mario Eugster, Joseph G. Davis, Byounggu Choi
School of Information Technologies
University of Sydney
Sydney, Australia

Email: s.poon@usyd.edu.au, marioeugster@yahoo.com.au, {jdavis, choi}@it.usyd.edu.au

Abstract

Despite growing evidence of a positive impact of Information Technology (IT) investments on firm performance, the variations in the results across organisations are still significant. This research takes a fresh approach by addressing complementarity impacts of organisational practices on three different dimensions of IT business value (ITBV). The goal is to identify important organisational practices and empirically test the synergistic relationships among them and their impacts on different dimensions of IT business value. We implemented an integrative approach to analyse the complex interactions among multiple organisational practices. First, we categorised ITBV into four dimensions based on different management objectives: strategic, informational, transactional and organisational transformation. Second, organisational configuration for each ITBV dimension is identified using regression trees. Third, a formal complementarity test was performed on each configuration pattern. Our findings indicate that the set of organisational practices affecting each dimension of ITBV is different. Hence, IT complementary factors that affect particular dimensions of ITBV do not necessarily have the same effect on other dimensions.

Keywords

Information Technology Business Value, Complementarity Theory, Configuration Theory, Regression Tree.

1. Introduction

Realising business value from Information Technology (IT) investments has been an important research topic for over two decades. Since the original formulation of the IT productivity paradox¹, several researchers have attempted to understand the complex relationship between IT and organisational productivity. By the early 1990's, firm-level evidence of productivity benefits from IT began to emerge (Brynjolfsson and Hitt 1996). Furthermore, Brynjolfsson and Yang (1996) provided several possible explanations for the productivity paradox such as measurement errors, time lags, redistribution benefits, and mismanagement.

Recent research has broadened its focus to comprehensively investigate IT investment benefits. For example, Mirani and Lederer (1998) found that IT has a strong impact on general business performance and Kraemer and Dedrick (2001) reported evidence that IT investments led to much higher financial returns than non-IT investments. These studies argued that there had actually been an underinvestment in IT. Although many research studies have shown that the return of IT is real, there is still a substantial variation in the value achieved from IT investments across organisations (Stiroh 2004).

Bresnahan et al. (2002) found that investments in IT and many work practices were correlated with each other. They argued that these practices were part of a complementary system which has a strong impact on the organisational performance. Brynjolfsson and Hitt (1998) also reported that each dollar spent on IT capital would require \$9 of unmeasured intangible investment. They referred to this form of investment as *IT complementarities*.

Although many studies have attempted to understand how organisational investment complement IT to achieve better business value (Tallon et al. 2000; Melville et al. 2004), there are remaining challenges in analysing the synergistic effects of organisational factors (Athey and Stern 1998). First, compared to other investments, organisational factors are much harder to observe and some important factors are often omitted in the analysis. Second, relationships can be extremely complex because many organisational practices are often adopted in clusters. Third, certain organisational factors affect business value but may not necessarily have reverse effects when they are reduced or removed (Poon et al. 2005).

¹Nobel Prize winner Robert Solow (1987) stated that: "you can see the computer age everywhere but in the productivity statistics".

It has been argued that the current organisational theories are not sufficient to show the full complexity of the variables involved (Sinha and Van de Ven 2005). Siggelkow (2001) argued that it is not only important to understand a certain configuration of practices, but also the way they interrelate. A proper understanding of complementary practices and correctly implementing them synergistically will have a greater impact on business value realisation. Many theories such as contingency, configuration or complementarity theories have been employed to describe the synergistic effort of organisational practices with IT investments.

While complementarity theory has been used to explain the reinforcing relationships between IT and organisational practices (Brynjolfsson and Hitt 2000; Aral and Weill 2006), there is a paucity of empirically testable evidence. This is partly due to lack of empirical models to characterise the complex interactions of organisational factors. We argue that there is a need to develop an integrative approach to synthesise important organisational practices and empirically test the synergistic relationship of these factors on the strength of IT business value. The recognition of such relationships would allow an organisation to effectively manage and use them to realise greater value from IT. The objective of this research study is to provide a better understanding of organisational practices which will enable organisations to benefit from their IT investments.

The remainder of this paper is organised as follows: Section 2 gives a brief literature review on IT business value research. The methodology used for the analysis is described in section 3. Section 4 is a brief description of the data set and summary statistics. In section 5, the data analysis and results are presented. Section 6 concludes this paper and outlines avenues for further research.

2. Literature Review

This section will outline some related key findings from the IT business value literature to form the basis of this study. In order to better understand how IT relates to organisational practices in achieving organisational performance, we draw from organisational perspectives using contingency, configuration and complementarity theories to explain the complex relationships between IT and organisational factors and their business value impacts.

2.1. Organisational Dimensions of IT Business Value

Realising business value from IT investments has been an important research area for more than two decades. Initially, IT business value research attempted to explore the relationship between IT investment and firm-level productivity. Subsequently, consistent empirical evidence of productivity benefits gained through IT has emerged (Brynjolfsson and Hitt 1996; Kohli and Devaraj 2003). However, the recent focus is on how IT enables organisations to achieve better business value (Aral and Weill 2006). Also, organisational practices have been found to have a major impact on achieving high benefits of IT investments. Tallon et al. (2000) found that organisational practices accounted for over 50% of the variance of organisational performance.

Research literature has suggested a number of organisational practices as key factors in achieving high business value. Weill and Ross (2004) focused on business unit involvement and strong management commitment as important aspects. Aral and Weill (2006), on the other hand, identified IT skills, IT management competence, IT communication and digital transaction intensity as key organisational variables. Tallon et al. (2000) emphasised the importance for executives to become less indifferent towards IT and see IT as a key component in achieving business benefits. Recent studies have shown that organisations which are aware of Information Technology capabilities (IT savvy) and regard IT as key in achieving business goals and competitive advantage achieve a much higher return on their investments (e.g. Weill and Aral 2005 and Gregor et al. 2004).

The alignment of IT with business goals is another key factor often cited to explain the observed variation in IT business value. Henderson and Venkatraman (1989) found that IT had evolved from simple “back-office” operations to a “strategic” role and IT had to be aligned to gain business value. Based on interviews with business and IT executives, Tallon et al. (2000) found that organisations with higher strategy alignment achieve higher business value and confirmed that executives who valued IT (being IT-aware) achieve higher levels of strategic alignment of IT and business. Luftman (1996) argued that IT needs to be aligned to the organisational structure and competitive environment, to maximise economic performance. Weill and Aral (2006) found that to better synchronize IT and business strategy, IT portfolio management had to be very supportive in enabling fact-based decisions. Kraemer and Dedrick (2001) argued that organisational practices like IT alignment, employee involvement, total quality management and re-engineering were likely to enhance business values.

To identify important management practices, Nohria et al. (2003) researched 160 companies and categorised the important management practices into four primary and two secondary factors. The top four primary practices include a clearly focused strategy, flawless operational execution, performance-oriented culture and a fast, flexible, flat organisation. Gregor et al. (2004) drew from this research and derived factors like IT-savvy, formal contracting, gaining unanticipated benefits, ICT integration and improving organisation-wide ICT skills as key organisational practices for achieving higher IT business value.

2.2. Research into the Complex Relationship between Information Technology and Organisational Practices

In order to conceptualise how IT relates to organisational practices, the literature on IT business value is organised into three broad theoretical perspectives, namely, contingency, configuration and complementarity theories, also referred to as C-Theories by Van de Ven (2005). They provide useful ways to frame the problem of capturing and analysing the interrelationships between IT and organisational practices.

2.2.1. The Contingency Perspective

The contingency theory sees fit from a moderation perspective (Venkatraman 1989) and has often been used to support the understanding of organisational structure and variables like technology, strategy or environment. An organisation should focus on internal and external domain and adjust their organisational structure to match both systems best by understanding the interrelationships within and among subsystems (Kast and Rosenzweig 1972). Like all fit theories, the contingency theory assumes that a better "fit" among certain contingency variables like organisational structure, technology, strategy etc. lead to better organisational performance.

In ITBV research, much effort has been devoted to study IT contingency variables and their effect on organisational performance. Driven by the success of the contingency theory perspective in organisational design, many early studies showed benefits of practices like user involvement in leading to higher organisational performance (Tait and Vessey 1988). The benefits of the contingency approach can also be seen in addressing impacts of alignment between organisational factors. For example, several research studies in the area of IT and business strategy have relied on the contingency theory to describe benefits of strategic alignment (Sabherwal et al. 2001; Oh and Pinsonneault 2007). Using the alignment concept, Tallon et al. (2000) found that an appropriate level of alignment between Information Technology and an organisation's business strategy can increase significantly the received IT business value. Subsequently, Melville et al. (2004) showed by using an integrative framework that contingencies in form of IT, organisational resources and business processes lead to improved organisational performance.

2.2.2. The Configuration Perspective

Configuration theory builds on contingency theory by taking a holistic view of organizational practices and their relationships (Ketchen et al. 1993; Pettigrew 2000). The basic assumption of this theory is that meaning creation is the result of the dynamic interplay among individual parts and the whole of any social entity such as an organization. Social entity as a whole cannot be understood in isolation. There have been several approaches to analyse frequently recurring clusters of attributes or *gestalts* (Venkatraman 1989), whereas the configuration perspective is probably the most developed form. Meyer et al. (1993) stated that configurations consist of multiple organisational "factors" or "variables" that usually occur together and assume that they are strongly linked to each other. Rather than trying to explain how order is designed into the parts of an organization, configurational theorists try to explain how order emerges from the complex interactions of those parts as a whole.

Sugumaran and Arogyaswamy (2004) argued that configurations built on contingency theory can be used to assess performance issues. In ITBV research, configuration theory allows the grouping of multiple variables into clusters and propose successful configurational "patterns" in order to achieve high business value. Research addressing specific configurations has been performed at the IS project-level (Chivukula 2003). Gregor et al. (2004) used regression trees to identify configurations of key practices which seemed to produce higher business value. Their study listed different configurations relating to a high perceived IT business value. They concluded that organisations with certain configurations achieved significantly higher returns on their IT investments.

2.2.3. The Complementarity Perspective

Complementarity theory takes both a holistic view of organizational practices and focuses on the interdependence of fit in bundles of practices. Unlike the contingency theory, complementarity theory assumes that separate variables cannot be individually fine-tuned to achieve better performance (Huang et al. 2004). Furthermore, complementarity theory focuses on uniqueness rather than the general archetypes that are common in research using configuration theory (Whittington et al. 1999). The effects of complementarity on performance have been explored empirically (Ichniowski et al. 1997) and can be used to provide more operational insights into the nature of change involved (Barua et al. 1995, Huang et al. 2004). For example, Milgrom and Roberts insisted that "changing only a few of the system elements at a time to their optimal values may not come at all close to achieving all the benefits that are available through a fully coordinated move, and may even have negative payoffs" (Milgrom and Roberts, 1995, p. 191)

In ITBV research, Brynjolfsson and Yang (2000) see "organisational complements [...] as a major driver of the contribution of information technology" whereas Bresnahan et al. (2002) argued from an organisational perspective that "the new work practices are more likely to detect complementarity between IT and skilled

work". Melville et al. (2004) concluded that "IT business value is generated by the deployment of IT and complementary organisational resources". Aral and Weill (2006) used complementarity analysis to test the reinforcing relationship between organisational IT capabilities (IT competencies and practices) and IT investments (allocated investment categories). They found that these complementary effects strengthen and broaden the impacts of IT on a firm's performance which can explain 2% - 12% of the business value variation among organisations.

2.3. Summary of Literature and Evaluation of the State of Research

The original paradox about Information Technology's contribution has been resolved and there is widespread consensus that IT contributes to positively to organisational performance. But the benefits a firm gains from its IT investments have been shown to vary widely due to the impact of organisational factors. Recent research has therefore shifted to identify key practices that influence business value outcome. In the recent past, different approaches have been employed in analysing the complex relationship between organisational practices and IT. The aim of this study is to understand the structure behind those practices which are key in achieving a high ITBV by extracting the most important factors and investigating the complementarities among them.

3. Methodology

In this study, a three-stage approach is used to better understand what actually enhances realisation of IT business value. The first stage defines the dependent variables; benefits of IT investments are divided into categories based on different management objectives proposed by previous IT business value research. By drawing from the configurational perspective, the second stage uses regression trees to identify the configuration of key practices. The goal of using regression trees is to produce a holistic view of the impact of the different factors influencing IT business value. By analysing and categorising practices according to their importance, regression trees reduce the set of impacting organisational variables successfully based on their level of inputs. In the third stage, the extracted key practices in achieving high IT business value are analysed using supermodular functions. Such an analysis provides clear insights into the significance of complementarity between selected key practices and points out whether the simultaneous implementation of practices is significantly beneficial.

3.1. Stage 1: Different Dimensions of Business Value Impacts

A major issue in IT business value research was always on how to best capture the provided benefits of IT. As stated by Brynjolfsson and Yang (2000) when attempting to resolve the productivity paradox, measurements of inputs and outputs are often not captured by conventional approaches of performance management.

To better capture their investments, Weill (1992) proposed to categorise business value by management objectives (1) transactional, (2) informational, and (3) strategic. These dimensions of Information System benefits or IT investment categories have been used since that time in various other research studies (such as Mirani and Lederer 1998; Aral and Weill 2006).

3.2 Stage 2: Identify Configurations using Regression Trees

Regression trees provide a useful approach to analyse a large number of organisational practices simultaneously. This technique allows us to classify huge datasets and support building sets of configurations among organisational practices. This data mining technique can help us to discover configurations. This technique does not require any a priori knowledge about the structure and allow grouping of certain variables according to their importance and linking them to the IT business value.

Regression trees differ from decision trees in predicting continuous (ordered) values, rather than class labels (Han and Kamber 2001). Although this technique provides an easily understandable tree structure with simple if-then conditions, the difficulties in performing regression tree analysis are similar to decision trees.

3.3 Stage 3: Testing Complementarity

While the configurations discovered in stage 2 do not provide statistical measures on degree of interrelatedness among the variables, drawing from lattice network and supermodularity, we perform complementarity analysis in this stage. By using a set of testable restrictions on regression, we are able to categorise different types of complementarity structures with statistical significance.

4. Data Description

The data used for analysis was originally collected for a study of key management strategies that help achieve business value from ICT (Gregor et al. 2004) sponsored by the Australian Department of Communication,

Information Technology and Arts in 2004. The data set is based on a questionnaire and responses from 1050 Australian organisations from different industries. It provides information about organisational practices firms used in the previous 18 months as well as the benefits they gained from their IT investments.²

4.1. Data set and constructs

This data set provided a good foundation for IT business value research in Australia, as the questionnaires were developed to capture different forms of IT benefits. Since the firm-level questionnaire has been developed based on recent research with a focus on organisational transformation and IT investments, it provides useful data for this research study. The first set of questions categorises the strength of IT business value impacts into different dimensions. Table 1 shows the dimensions of strategic, informational, transactional and organisational transformation business value with a brief description of each one. Table 2 lists the eleven organisational practices. The goal of our analysis is to investigate synergistic impacts within this bundle of organisational practices on the strength of the four dimensions of IT business value.

Table 1: Dependent variables: Dimensions of IT business value

Construct name	Description	Basis
Strategic IT Business Value	Strategic benefits relating to IT investments such as aligning business strategy with operational aims, customer and supplier relationship management, innovations or creating competitive advantage through IT.	6 questions
Informational IT Business Value	Informational benefits relating to fast, easy and timely access to accurate information such as decision making tools and interfaces for information exchange.	5 questions
Transactional IT Business Value	Transactional benefits relating to reducing operating and communication costs, business efficiency and productivity increases, savings in supply chain management etc.	6 questions

Table 2: Independent variables: Organisational practices

Construct name	Description
Project Management	The frequency of using formal project management methodology.
Business Case	The frequency of developing formal business cases for ICT investments.
Post Implementation	The frequency of performing post implementation reviews of IT investments.
Change Management	The frequency of employing external change management specialists.
ICT Opportunism	The frequency of recognising and achieving significant additional benefits which were initially unanticipated.
ICT Skill Level	The frequency of achieving valuable increases in ICT skill level within the organisation.
Business Strategy Planning	The frequency of engaging in formal business strategic planning.
ICT Strategic Planning	The frequency of engaging in ICT strategic planning.
Industry Leadership	The frequency of seeking to be an industry leader in adopting new ICT.
Formal Contracting	The frequency of establishing formal contractual arrangements for ICT investments.
ICT Integration	The frequency of integrating new ICT into existing business processes across key functional areas.

4.2. Descriptive Statistics

After removing records with incomplete data in the business value estimating questions, a dataset containing responses from 705 organisations could be used for further analysis.³ The three dimensions of business value benefits in table 1 were collected on a scale of 1-10. The values can be interpreted as "1" representing never achieving business value and "10" indicating always achieving business value from a particular IT investment.

Table 3: Average and weighted impact on 4 dimensions of business values from IT

	Mean (Std. Deviation)
Strength of Strategic dimension of IT Business Value	6.678 (1.860)
Strength of Informational dimension of IT Business Value	7.620 (1.643)
Strength of Transactional dimension of IT Business Value	6.163 (1.879)

Table 4: Summary statistics of organisational practices

Construct name	Mean(Std. Deviation)	Construct name	Mean(Std. Deviation)
Project Management	3.130 (1.499)	Business Strategy Planning	3.490 (1.248)
Business Case	3.150 (1.487)	ICT Strategic Planning	3.130 (1.336)
Post Implementation	3.220 (1.409)	Industry Leadership	2.860 (1.439)
Change Management	2.140 (1.288)	Formal Contracting	2.950 (1.431)
ICT Opportunism	3.340 (1.105)	ICT Integration	3.640 (1.139)
ICT Skill Level	3.470 (1.085)		

The practices are summarised statistically in table 4. These practices were rated by management executives based on how often their organisation performs certain practices, ranging from 1 (*never*) to 5 (*always*). The values in-between can be interpreted as follows: 2 as *rarely*, 3 as *sometimes* and 4 as *often*. We also performed a

²For further details about data survey development, collection and sampling see Gregor et al. (2004).

³This figure is identical with the number of records used for the analysis in Gregor et al. (2004), we followed a similar data preparation procedure.

correlation matrix for all the practices and found that they are highly correlated to each other (except ICT Integration and Change Management). These results indicate that each organisational factor is potentially complementary to other organisational factors.

5. Analysis and Findings

5.1 Analysing different dimensions of IT Business Value impacts

To assess the business value of an organisation, managers were asked to determine the benefits derived from their IT implementations in three dimensions: strategic, informational and transactional. To validate the model, a confirmatory factor analysis (CFA) was performed. It allowed us to statistically test for specific hypotheses about the factor structure for a set of variables (Long 1993). Table 5 shows some key results from both analyses.

Table 5: Key results of CFA model

Metric index	3-factor model
Degrees of Freedom	206
Goodness of Fit Index (GFI)	0.88
Comparative Fit Index (CFI)	0.98
Non-Normed Fit Index (NNFI)	0.98
Root Mean Square Error of Approximation (RMSEA)	0.078
Standardized RMR	0.045

According to Thompson (2000), assessing results and the goodness of fit of confirmatory factor analysis has to be done carefully since no single index covers all aspects. Certain indices proved thereby to be preferred for certain assessments. A good overview of classification models and adequate indices for different purposes is provided in Sun (2005). For the validation of the model with the underlying business value factors, the construct validity evaluation model is most appropriate. It provides well-established cut-off criteria and recommends focusing on the RMSEA, NNFI, SRMR, CFI and GFI values. The model (shown in table 5) has a good overall fit. The RMSEA index shows that the average error approximation is reasonable.

5.2 Stage 2: Analysing Configurations Organisational Practices using Regression Trees

A regression tree classification has been used to identify key practices leading to IT business value. In the analysis of IT business value, the regression tree was first built to a "fully-grown" tree as proposed in Breiman et al. (1998) and by using post-pruning, sub-trees have been removed until a best level of fit has been achieved. The best level is defined by the minimal cost complexity tree algorithm, which defines the cost complexity as a function of the number of leaves and the error rate.

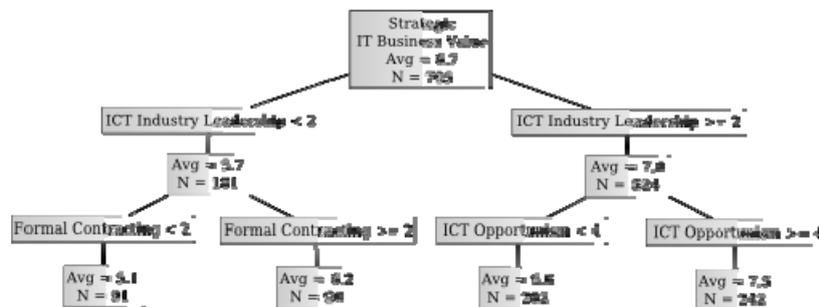


Figure 1: Regression tree showing strategic dimension of IT business value

The regression tree in figure 1 shows the main factors in achieving low and high strategic business value. The tree can be interpreted as follows: The overall average strategic value achieved is 6.7 out of 10 based on 705 data records. The most important organisational practice was found to be ICT Industry Leadership. The biggest business value split is found between organisations that are never seeking to become industry leader in adopting new ICT and others (≥ 2). Firms never seeking to become ICT industry leader are gaining an average strategic business value of 5.7/10. On the other hand, firms that are rarely or more focused on becoming industry leader in adopting new ICT (≥ 2) and often looking for unanticipated benefits of investments (≥ 4) have an average strategic business value of 7.5/10. We applied the same strategies to the other 2 dimensions of ITBV. Figure 2 and 3 show key practices leading to low and high informational dimension of ITBV, Transactional dimension of ITBV.

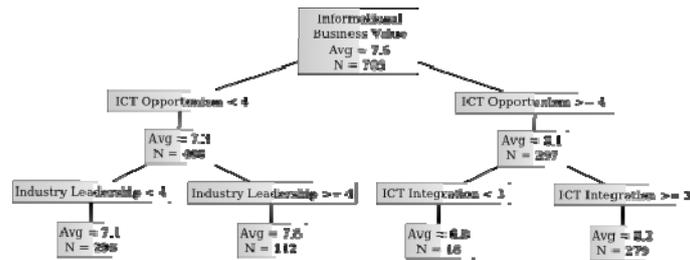


Figure 2: Regression tree showing Informational dimension of IT business value

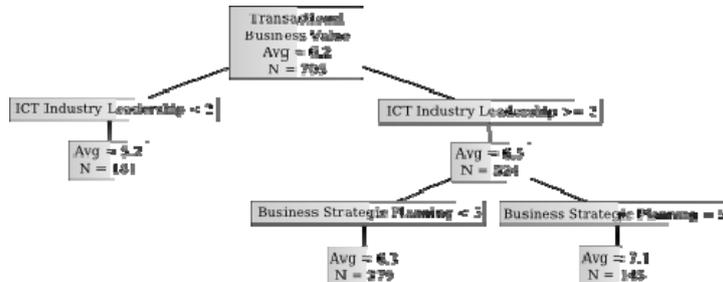


Figure 3: Regression tree showing transformational dimension of IT business value

To test for complementarities between ICT Industry Leadership and ICT Opportunism (the two practices on the right hand side of the tree) on strategic dimension of IT business value, the hypotheses (H1a – H1c) are proposed. To test for complementarities for remaining dimensions of IT business value, we propose the hypotheses (H2a - H2c and H3a – H3c):

- Hypothesis H1a: ICT Industry Leadership (≥ 2) and ICT Opportunism (≥ 4) are complementary in achieving strategic business value.
- Hypothesis H1b: ICT Industry Leadership (≥ 2) has direct impact in achieving strategic business value.
- Hypothesis H1c: ICT Opportunism (≥ 4) has direct impact in achieving strategic business value.
- Hypothesis H2a: ICT Opportunism (≥ 4) and ICT Integration (≥ 3) are complementary in achieving informational business value.
- Hypothesis H2b: ICT Opportunism (≥ 4) has direct impact in achieving informational business value.
- Hypothesis H2c: ICT Integration (≥ 3) has direct impact in achieving informational business value.
- Hypothesis H3a: ICT Industry Leadership (≥ 2) and Strategic Business Planning ($= 5$) are complementary in achieving transactional business value.
- Hypothesis H3b: ICT Industry Leadership (≥ 2) has direct impact in achieving transactional business value.
- Hypothesis H3c: Strategic Business Planning ($= 5$) has direct impact in achieving transactional business value.

5.3. Stage 3: Complementarity Analysis

The three regression trees found in stage 2 have proposed three different configurations of key practices. The configuration for each business value dimension seems to be somewhat different. In this stage, we test for complementarities of each configuration as proposed in the hypotheses. We only found that three out of four configurations provided statistically insignificant complementarity. Due to the space limitation, the result for the analysis of complementarity towards informational dimension of ITBV is presented. Table 6 shows the complementarity analysis for key practices leading to high informational business value.

Table 6: Complementarity analysis for Informational Dimension of IT Business Value

Selected Key Management Practices		Informational BV	
High Opportunism (≥ 4) and High ICT Integration (≥ 3) - (γ_{11})		8.19 (0.09)	
High Opportunism (≥ 4) and Low ICT Integration (< 3) - (γ_{10})		6.87 (0.38)	
Low Opportunism (< 4) and High ICT Integration (≥ 3) - (γ_{01})		7.43 (0.09)	
Low Opportunism (< 4) and Low ICT Integration (< 3) - (γ_{00})		6.83 (0.18)	
Statistical Tests		Test Value	F-Statistic
Test for complementarity ($\gamma_{11} + \gamma_{00} \geq \gamma_{10} + \gamma_{01}$)		0.71**	F(1,669) = 2.60
2*Criticality	$\gamma_{10} \geq \gamma_{00}$ and $\gamma_{11} \geq \gamma_{01}$	0.04 & 0.75***	F(1,669) = 0.01 & 33.49
	$\gamma_{01} \geq \gamma_{00}$ and $\gamma_{11} \geq \gamma_{10}$	0.61*** & 1.31***	F(1,669) = 9.28 & 11.37
Result	Complementarity. Significant direct impact only from ICT Integration, but no significant direct impact from Opportunism.		

First, $\gamma_{11} + \gamma_{00} \geq \gamma_{10} + \gamma_{01}$ has been tested in order to provide evidence of complementary relationship between ICT Opportunism and ICT Integration at a 0.05 level of significance. Hence, hypothesis H2a is supported. The tests for criticality shows that by just looking for opportunism, almost no benefits can be achieved and only hypothesis H2c is supported on a significance level of 0.01.

6. Discussions and Conclusion

This study has uncovered the complementarity of organisational practices which could lead to higher IT business value. Our results not only show that some organisational practices have only a significant positive impact on IT business value when applied in conjunction with other practices, they also indicate that the set of organisational practices affecting each dimension of business value are different. It appears that some organisational factors have different intensity of effects on different dimensions of IT business values impacts. We conclude that IT complementary factors that affect particular dimensions of business value do not necessarily have the same effect on other dimensions. This complementary analysis has provided us empirical evidence of the complex relationship structures among organisational practices.

The recognition of different configuration structures of organisational practices allows an organisation to effectively manage and use such relationships to increase their return on IT investments. To support the understanding of the effects and impacts of organisational practices and IT, this study has drawn from various organisational perspectives using contingency, configuration and complementarity theories. These theories have provided the basis of our different approaches in explaining organisational practices' impact on IT business value. Our results show not only the benefits of recognizing such synergistic relationships, but also the importance of recognising different configurations of practices. Studying practices based on configurational approaches has been found to be inadequate to tease out the interrelatedness among the practices. This research can be considered as one of the first studies in better understanding the manifold, complex, and interrelated structure of IT and organisational practices. This study made two major contributions to current research on IT business value. First, it showed that using only a configurational perspective in order to understand the complex relationship between IT and organisational practices is inadequate to understand interrelatedness between organisational practices. Second, this study provides a foundation for further research on reinforcing impacts of organisational practices and IT investments.

We aim to extend this research by using complexity theory to explain the interactions among organisational components and their non-linear dynamics. By borrowing methodologies from other fields, this perspective might contribute to IT business value research by providing analytical tools not previously available in measuring and evaluating complex relationships between organisational practices and IT.

References

- Aral, S., & Weill, P. 2006, 'IT assets, organizational capabilities and firm performance: Do resource allocations and organizational differences explain performance variation? ', *CISR working paper No. 360*, MIT
- Athey, S. & Stern, S. 1998, An empirical framework for testing theories about complementarity in organizational design, Technical report, NBER Working Paper 6600.
- Barua, A., Kriebel, C.H. & Mukhopadhyay, T. "Information Technologies and Business Value: An Analytic and Empirical Investigation," *Information Systems Research* (6:1), 1995, pp. 3-23

- Breiman, L., Friedman, J.H., & Olshen, R.A. Stone, C.J. 1998, *Classification and Regression Trees*, Florida: Chapman and Hall.
- Bresnahan, T., Brynjolfsson, E., & Hitt, L.M. 2002, 'Information technology, workplace organisation, and the demand for skilled labor: Firm-level evidence', *The Quarterly Journal of Economics*, vol. 117, no. 1, pp. 339–376.
- Brynjolfsson, E., & Hitt, L.M. 1996, 'Paradox lost? Firm-level evidence on the returns to information systems spending', *Management Science*, vol. 42, no. 4, pp.541–558.
- Brynjolfsson, E., & Hitt, L.M. 1998, 'Beyond the productivity paradox', *Communications of the ACM*, vol. 41, no. 8, pp. 49–55.
- Brynjolfsson, E., & Hitt, L.M. 2000, 'Beyond computation: Information technology, organizational transformation and business performance', *Journal of Economic Perspectives*, vol. 14, no. 4., pp. 23–48.
- Brynjolfsson, E., & Yang, S. 2000, 'Information technology and productivity: A review of the literature', *Advances in Computers*, vol. 43, pp. 179–214.
- Chivukula, R. 2003, Business value of information technology: An applied framework to assess the business value of IT and maximize the impact of IT strategy, Master's thesis, Massachusetts Institute of Technology.
- Gregor, S., Fernandez, W., Holtham, D., Martin, M., & Stern, S., Vitale, M. Pratt, G. 2004, 'Achieving value from ICT: key management strategies', *Department of Communications, Information Technology and the Arts, ICT Research Study, Canberra* .
- Gregor, S., Martin, M., Fernandez, W., Stern, S. & Vitale, M. 2007, 'Identifying the key strategies in the realization of the value from information technology', *Department of Communications, Information Technology and the Arts, ICT Research Study, Canberra, Australia*.
- Han, J., & Kamber, M. 2001, *Data mining: concepts and techniques*, San Francisco: Morgan Kaufmann Publishers.
- Huang, X., Sinha, K.K. & Dong, Y. 2004, "Complementarities Between In-Store and Supply Chain Technologies in Retail Operations: An Empirical Analysis," *University of Minnesota, Working Paper*.
- Henderson, J., & Venkatraman, N. 1993, 'Strategic alignment: Leveraging information technology for transforming organizations', *IBM Systems Journal*, vol. 1, no. 32, pp. 4–17.
- Ichniowski, C., Shaw, K. & Prennushi, G. "The Effects of Human Resource Management Practices on Productivity," *American Economic Review* (87), 1997, pp. 291-313.
- Kast, F.E., & Rosenzweig, J.E. 1972, 'General systems theory: Applications for organization and management', *The Academy of Management Journal*, vol. 15, no. 4, pp. 447–465.
- Ketchen, D., Thomas, J. & Snow, C. "Organizational Configurations and Performance: A Comparison of Theoretical Perspectives," *Academy of Management Journal* (36:6), 1993, pp. 1278-1313.
- Kohli, R., & Devaraj, S. 2003, 'Measuring information technology payoff: A meta-analysis of structural variables in firm-level empirical research', *Information Systems Research*, vol. 14, no. 2, pp. 127–145.
- Kraemer, K.. & Dedrick, J. 2001, 'The productivity paradox: Is it resolved? Is there a new one? What does it all mean for managers?', *CRITO working Paper*, University of California, Irvine.
- Long, S.J. 1983, *Confirmatory Factor Analysis*, Quantitative Applications in the Social Sciences, Sage Publications, Inc.
- Luftman, J.N. 1996, *Competing in the Information Age. Applying the Strategic Alignment Model.*, Oxford University Press, chapter 3, pp. 43–73.
- Melville, N., Kraemer, K. & Gurbaxani, V. 2004, 'Review: Information technology and organizational performance: an integrative model of it business value', *MIS Quarterly*, vol. 28, no. 2, pp. 283–322.
- Meyer, A., & Tsui, A., Hinings, C.R. 1993, 'Configurational approaches to organizational analysis', *Academy of Management Journal*, vol. 36, no. 6, pp. 1175-1195.
- Milgrom, P., & Roberts, J. 1990, 'The economics of modern manufacturing: Technology, strategy, and organization', *The American Economic Review*, vol. 80, no. 3, pp. 511–528.

- Milgrom P. & Roberts, J. 1995, "Complementarities of Fit: Strategy, Structure, and Organizational Change," *Journal of Accounting and Economics* (19), pp. 179-208.
- Mirani, R. & Lederer, A.L. 1998, 'An instrument for assessing the organizational benefits of IS projects', *Decision Sciences*, vol. 29, no. 4, pp. 803-839.
- Nohria, N., Joyce, W. & Roberson, B. 2003, 'What really works', *Harvard Business Review*, vol. 81, no. 7, pp. 42-55.
- Oh, W. & Pinsonneault, A. 2007, 'On the assessment of the strategic value of information technologies: conceptual and analytical approaches', *MIS Quarterly*, vol. 31, no. 2, pp. 239-265.
- Pettigrew, A., Whittington, R., Melin, L., Sanchez-Runde, C., van den Bosch, F., Ruigrok, W. & Numagami, T., eds. 2003, *Innovative Forms of Organizing: International Perspectives*, Sage Publications Ltd.
- Poon, S.K., Davis, J.G. & Choi, B. 2005, 'Understanding IT complementarities using augmented endogenous growth framework', *Proceedings of the 26th International Conference on Information Systems (ICIS2005), Las Vegas*.
- Sabherwal, R., Hirschheim, R., & Goles, T. 2001, 'The dynamics of alignment: Insights from a punctuated equilibrium model', *Organization Science*, vol. 12, no. 2, pp. 179-197.
- Siggelkow, N. 2001, 'Change in the presence of fit: The rise, the fall, and the renaissance of Liz Claiborne', *Academy of Management Journal*, vol. 44, no. 4, pp. 838-857.
- Sinha, K.K., & Van de Ven, A. 2005, 'Designing work within and between organizations', *Organization Science*, vol. 16, no. 4, pp. 398-408.
- Solow, R. 1987, 'We'd better watch out', *New York Times Book Review* p.36.
- Stiroh, K.J. 2004, 'Reassessing the impact of IT in the production function: A meta-analysis and sensitivity tests', Federal Reserve Bank of New York. Draft version.
- Sugumaran, V., & Arogyaswamy, B. 2004, 'Measuring IT performance: Contingency variables and value modes', *Journal of Computer Information Systems*, vol. 44, no. 2, pp. 79-86.
- Sun, J. 2005, 'Assessing goodness of fit in confirmatory factor analysis', *Measurement and Evaluation in Counselling and Development*, vol. 37, no. 4, pp. 240-256.
- Tait, P., & Vessey, I. 1988, 'The effect of user involvement on system success: A contingency approach', *MIS Quarterly*, vol. 12, no. 1, pp. 91-110.
- Tallon, P. & Kraemer, K. 2007, 'Fact or fiction? The reality behind executives' perceptions of IT business value', *Journal of Management Information Systems*, forthcoming.
- Tallon, P.P., Kraemer, K.L. & Gurbaxani, V. 2000, 'Executives' perceptions of the business value of information technology: A process-oriented approach', *Journal of Management Information Systems*, vol. 16, no. 4, pp. 145-173.
- Thompson, B. 2000, Ten Commandments of Structural Equation Modeling, *Reading and Understanding More Multivariate Statistics*, Washington, DC: American Psychological Association (APA), pp. 261-285.
- Van de Ven, A.H. 2005, 'Organisational design perspective', Ph.D. Seminar in Macro-Organization Behavior, online, viewed on 22/05/2007, <http://webpages.csom.umn.edu/smo/avandeven/MGT8302/MGT8302>.
- Venkatraman, N. 1989, 'The concept of fit in strategy research: Toward verbal and statistical correspondence', *Academy of Management Review*, vol. 14, no. 3, pp. 423-444.
- Weill, P. 1992, 'The relationship between investment in information technology and firm performance: A study of the valve manufacturing sector', *Information Systems Research*, vol. 3, no. 4, pp. 307-333.
- Weill, P., Aral, S. 2005, 'IT savvy pays off: How top performers match IT portfolios and organizational practices', *CISR working paper 353*, MIT.
- Weill, P., Aral, S. 2006, 'Generating premium returns on your IT investments', *MIT Sloan Management Review*, vol. 47, no.2, pp. 39-52.
- Weill, P., Olson, M. H. 1989, 'An assessment of the contingency theory of management information systems', *Journal of Management Information Systems*, vol. 6, no. 1, pp. 59-85.
- Weill, P., Ross, J. 2004, *IT Governance: How Top Performers Manage IT Decision Rights for Superior Results*, Harvard Business School Press.

Whittington, R., Pettigrew, A., Peck, S., Fenton, E. & Conyon, M. 1999, "Change and Complementarities in the New Competitive Landscape: A European Panel Study, 1992-1996," *Organization Science* (10:5), pp. 583-600.

Copyright

Simon K. Poon, Mario Eugster, Joseph G. Davis and Byounggu Choi © 2007. The authors assign to ACIS and educational and non-profit institutions a non-exclusive licence to use this document for personal use and in courses of instruction provided that the article is used in full and this copyright statement is reproduced. The authors also grant a non-exclusive licence to ACIS to publish this document in full in the Conference Proceedings. Those documents may be published on the World Wide Web, CD-ROM, in printed form, and on mirror sites on the World Wide Web. Any other usage is prohibited without the express permission of the authors.