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Information Technology Resources and Business Performance: An Australian Context

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Abstract

Information Technology (IT) resources have been suggested to contribute to business performance in the literature, yet the contribution of different resources is not well-explained. This study investigates the relationship between information technology resources and companies' business performance with the presence of the information technology use intensity in industries. The relationship is studied not only at aggregate level but also at detail level which gives an answer to the question of which resource has the most effect on performance. The results of Australian company survey are used in this paper. It is found that IT human resource and IT infrastructure affect business performance while the effect of IT partnership is not significant. This study is expected to help companies' managements to have a clearer view of how to enhance the benefits of IT resources on companies' performance by understanding and focusing on the more important resources.

Keywords: IT resources, IT capability, business performance, organizational performance, IT human resources

1. Introduction

The business value of information technology has been debated for many years. "While some authors have attributed large productivity improvements and substantial consumer benefits to IT, others report that IT has not had any bottom line impact on business profitability" (Hitt and Brynjolfsson, 1996). Carr (2003) argued that IT is ubiquitous, increasingly inexpensive and accessible to all organisations, thus, it cannot provide differential advantage to any company because scarcity, not ubiquity, is the basis for a sustained competitive advantage. He compared IT to infrastructural technology, like railroads and telegraphs, which is far more valuable when shared than when used in isolation. Its benefits are accessible to all and cannot create competitive for any individual firm (Carr, 2003). However, Ross et al. (1996) argue that although firms buy the same software packages, hire similar contractors, outsource to the same major vendors, some of them generate significant business value from IT while others do not. The difference is in their ability to build and leverage unique IT management assets which can generate sustainable competitive advantage for a firm. Mata et al. (1995) show that IT itself cannot deliver any sustainable advantage, but the management of IT can.

Recently, some researchers have discussed that managing IT is a capability that can create uniqueness and provide organisations a competitive advantage (Bharadwaj, 2000; Santhanam

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and Hartono, 2003; Bhatt and Grover, 2005). In their research, Ravinchandran and Lertwongsatien (2005) found a positive effect of information systems resources on firm performance indirectly through the role of capabilities. It is argued that resource-based theory can provide the appropriate theoretical lens to examine how companies' internal factors can make the difference and be a source of competitive advantage (Barney, 1991; Mata et al., 1995; Ross et al., 1996). In the literature, IT resources have been suggested to contribute to business performance, yet the contribution of different resources is not well-explained. This research draws on resources-based theory to examine the effect of IT resources on business performance directly in Australian context. The relationship is studied not only at aggregate level but also at detail level which gives an answer to the question of which resource has the most effect on performance.

Apart from this introduction section, Section 2 provides literature review and conceptual framework for the study. Research methodology is given in Section 3. Section 4 provides data analysis which is followed by a discussion part in Section 5. After giving limitations of the study and suggesting further research in Section 6, a conclusion of the paper is given in Section 7.

2. Literature review and conceptual framework

2.1 IT resources and organizational performance

2.1.1 Organizational performance

Defining and measuring performance have been the interests of researchers for centuries. There is, however, a lack of agreement as to what constitutes performance in organisation performance literature. It can be seen in three perspectives: (a) the goal approach - assuming that organisations pursue identifiable goals, thus performance is assessed in terms of goal attainment; (b) the systems resource approach - stressing the relationship between the organisation and its environment. Performance in this perspective is measured in terms of the organisation's ability to secure scarce and valued resources; and (c) the process approach which defines performance in terms of the behaviour of organisation participants (Ford and Schellenberg, 1982). But generally, the concept of organisational performance is based on the idea that an organisation is the voluntary association of productive assets such as human, physical and capital resources, for the purpose of achieving a shared purpose. Because resource providers will only commit themselves to the organisation so long as they are satisfied with the value they receive in return, value creation, as defined by resource providers, is the essential overall performance criterion for any organisation (Alchian and Demsetz, 1972; Jensen and Meckling, 1976; Barney, 2002; Carton and Hofer, 2006).

Organisational performance is a multidimensional construct which permits value to be created on different dimensions (Steers, 1975; Cameron, 1986; Murphyet al., 1996). It is possible to conceive of multiple measures of the value created (Carton and Hofer, 2006). Companies may pursue different objectives and there is probably no single measure that fully captures firm performance (Venkatraman and Ramanujam, 1986; Voss and Voss, 2000). Interpretation of performance depends on the observer's perspective. Carton and Hofer (2006) argued that value is in the eye of the beholder. So, each group of organisational stakeholders will have a different view of organisational performance which depends on their purpose for associating with the organisation. Therefore, to select a perspective of performance that conforms to the phenomenon of interest, a researcher should select a perspective that coincides with the purpose of the research. There seems to be no consensus regarding the measures of organisational performance. Organisational performance studies have inconsistent results because of the different characteristics of the sample used, the variance in

measurements employed and the lack of consensus on the purpose of measuring performance. Performance has been conceptualised in different ways for different researchers. It can be measured objectively based on historical data (Bharadwaj, 2000; Sanders and Premus, 2005) or measured subjectively based on perception of respondents on organisational performance in relation to their expectations, goals or in comparison with performance of their company's competitors (Ravinchandran and Lertwongsatien, 2005). This might be due to the many varied views of what are expected outcomes of organisational activities and because performance has often been characterised by the purposes of the research being performed (Carton and Hofer, 2006).

In general, the overall organisational performance can be measured by financial performance, operational performance, and stakeholder performance (a measure of how well stakeholders are treated by an organisation) (Carton and Hofer, 2006; Venkatraman and Ramanujam, 1986). But it appears that most strategy studies have restricted their focus to the first two dimensions which represent business performance (Venkatraman and Ramanujam, 1986). This study uses organisational performance and business performance interchangeably.

2.1.2 IT resources

Resource-based view has been widely discussed in the literature. It views the organization as a collection of resources and capabilities. In examining the link between company resources and sustain competitive advantage, Barney (1991) had two general assumptions about companies. Firstly, resources are heterogeneously distributed across competing companies. Secondly, resources are imperfectly mobile. The differences in organizations' performance are driven primarily by their unique resources and capabilities. Resource-based perspective has been studied in IT since the mid-1990s with much of the IT research attempted to identify and define either a single IT resource or sets of IT resources (Wade and Hulland, 2004). This view has been studied in IT as IT resources and IT capabilities (Mata et al., 1995; Ross et al., 1996; Bharadwaj, 2000; Ravinchandran and Lertwongsatien, 2005). Concerning the contribution of IT resources to companies' sustain competitive advantage, it is found that managerial IT skills are the resource that lead to sustain competitive advantage (Mata et al., 1995). Capabilities represent a firm's capacity to deploy resources using organizational processes to affect a desired end. They are often developed in functional areas or by combining physical, human and technological resources at the corporate level (Amit and Schoemaker, 1993). IT capability was first defined by Ross et al. (1996) as "the ability to control IT-related costs, deliver systems when needed and effect business objectives through IT implementations". They argue that highly competent IT staff, a strong partnering relationship between business and IT management and a reusable technology base are the three key IT assets/resources that bring IT capabilities. In turn, IT capability will enhance an organization's competitiveness. With the focus on which IT capabilities are core to the business's future capacity to use IT successfully, not on whether IT is core or non-core in an organization, Feeny and Willcocks (1998) identify the nine core capabilities that an organization must maintain. They suggest that this core IT capability model should be seen as a blueprint for sustaining an organization's ability to exploit IT. Those core capabilities are: IS/IT leadership, Business system thinking, Relationship building, Architecture planning, Making technology work, Informed buying, Contract facilitation, Contract monitoring, and Vendor development.

Later, Bharadwaj (2000), extending the traditional notion of organizational capabilities to an organization's IT function, defined IT capability as the ability to mobilize and deploy IT-based resources in combination or copresence with other resources and capabilities. Those IT-based resources are IT infrastructure; IT human resources (comprising technical and managerial IT skills); intangible IT-enabled resources (such as knowledge assets, customer

orientation and synergy- the sharing of resources and capabilities across organizational divisions). Peppard and Ward (2004) mention three interrelated attributes of IT capabilities: a fusion of business knowledge with IT knowledge; a flexible and reusable IT platform; and an effective use process (itself with two aspects: using the technology and working with information).

From the literature reviews, there are three commonly discussed IT resources: IT infrastructure (Ross et al., 1996; Bharadwaj, 2000; Peppard and Ward, 2004; Bhatt and Grover, 2005; Ravinchandran and Lertwongsatien, 2005; Mithas et al., 2007), IT human resources (Mata et al., 1995; Ross et al., 1996; Bharadwaj, 2000; Peppard and Ward, 2004; Bhatt and Grover, 2005; Ravinchandran and Lertwongsatien, 2005) and IT partnership (Ross et al., 1996; Feeny and Willcocks, 1998; Peppard and Ward, 2004; Bhatt and Grover, 2005; Ravinchandran and Lertwongsatien, 2005). Those three main resources will be used for analyzing IT resources in this study.

2.1.3 IT resources and its relationship with organisational performance

There has been little empirical work in IT capability and IT resources. Using different ways of operationalising the IT resources and capability construct and different methods, researchers found a positive relationship between IT capability/resources and the firm's business performance. An initial and significant contribution by Bharadwaj (2000) analysed the relationship by using the rankings of IT leaders as its indicator of IT capability. It is found that firms with high IT capability tend to outperform a control sample of firms on a variety of profit and cost-based performance measures. Santhanam and Hartono (2003) also used the rankings of IT leaders as its indicator of IT capability but with different benchmark firms from Bharadwaj and found a positive relationship between IT capability and firm's performance. In particular Sanders and Premus (2005) used a survey of 245 large manufacturing companies and four scale items to measure IT capability relative to industry standards, key competitors, key customers and the level of information networks used with key suppliers. An alternative approach by Ravinchandran and Lertwongsatien (2005) used resource-based theory and data collected from 129 firms in United States to examine how information systems resources and capabilities affect firm performance. They proposed a model that interrelates IS resources, IT capabilities, IT support for core competencies, and firm performance. The results suggested that firm performance is explained by the extent to which IT is used to support firm's core competencies and that an organisation's ability to use IT to support its core competencies is dependent on IS functional capabilities, which, in turn depend on the nature of IS resources.

Recently, in research on the relationship between types of information technology capabilities and competitive advantage, Bhatt and Grover (2005) operationalised the IT capability construct with three dimensions: IT infrastructure, IT business experience and relationship infrastructure. By studying the primary data from over 200 CIOs of corporations, they found that each of these dimensions except IT infrastructure has a positive effect on the competitive advantage of the firm. IT capability is also shown to be positively related to organizational effectiveness in other research (Zhang et al., 2004).

Although some previous IT research has examine the contributions of IT resources and capabilities to company's performance, most of these research has not used detail measurement model for IT resources/capabilities constructs. There are two notable research Bhatt and Grover (2005) and Ravinchandran and Lertwongsatien (2005), using detail measurement model for IT resource/capability construct to analyse its effects on business performance and competitive advantage. The former research analyses the effect of three IT capabilities on company's competitive advantage directly while the latter analyses the association between IT resources (using the same three main resources/capabilities with

former study) and business performance indirectly. Three broad categories of resources identified in the IT literature were used in the Ravinchandran and Lertwongsatien (2005) model. They are IT human capital, IT infrastructure flexibility, and IT relationship quality. Of which, IT human capital includes two indicators (business and technical skills, and specificity - firm specific knowledge about the organisation like culture and business routines of IT personnel) which were researched in a narrower aspect of either one of the two indicators in previous studies. IT relationship quality includes relationships between internal and external partners with IT people which is also a broader coverage in comparison with previous studies. This study uses Ravinchandran and Lertwongsatien (2005) constructs for its model because those constructs are broader, measuring detail perspectives of IT resources than those used in Bhatt and Grover (2005) study.

This study is different from earlier studies in some aspects. Firstly, it analyses the association between IT resources and performance with broaden aspects of constructs (using the three broad categories of resources used in Ravinchandran and Lertwongsatien (2005) study) and analyses the association directly (not analyses the association indirectly as Ravinchandran and Lertwongsatien (2005) did). Secondly, it studies the association at a detail level (at each IT resource level), not only at aggregate level (at IT resources in general level). Thus, the result provides a clear idea on which IT resource contributes the most to business performance which helps companies focus on the more important resources. Different culture and research context might have different effect on an association between variables and the research model. This study was conducted in the context of Australian business which is the third difference from previous studies in the field.

2.2 Conceptual framework and research questions

Drawing from the viewpoint of the resources-based theory that company resources are the main driver of company performance, in addition with the supportive literature of previous IT research as mentioned in previous part, we propose a conceptual framework that interrelates IT resources and business performance with the presence of the intensity of IT use in industries. Of which three main categories of IT resources are: IT human resource, IT infrastructure and IT partnership which affect business performance directly. Operating performance (profitability, productivity and financial performance) and market-based performance (success in entering new market and bring new products and services to the market of the company) are considered in measuring business performance in this study.

The extent of IT use across industries could reflect the variation of the potential payoff from using IT between industries. This study uses across-industry survey data; thus the effect of intensity of IT use in the industry is considered in the research model. The intensity of IT use not only affects companies' business performance but also has inter-relationships with IT resources itself. The intensity of IT use among company's competitors and customers in the industry might put a pressure on the company to invest more in IT resources or to have more IT used in the company. In turn, a good performance company with good IT human resources, effective IT infrastructure and having a good relationship with partners can be considered as an encouraging source for other companies in the industry to reassess their IT resources and to follow; thus the intensity of IT use in the industry might be increased. The research model is presented in Figure 1. This section will develop the relationships between constructs in the research model and clarify research hypotheses.

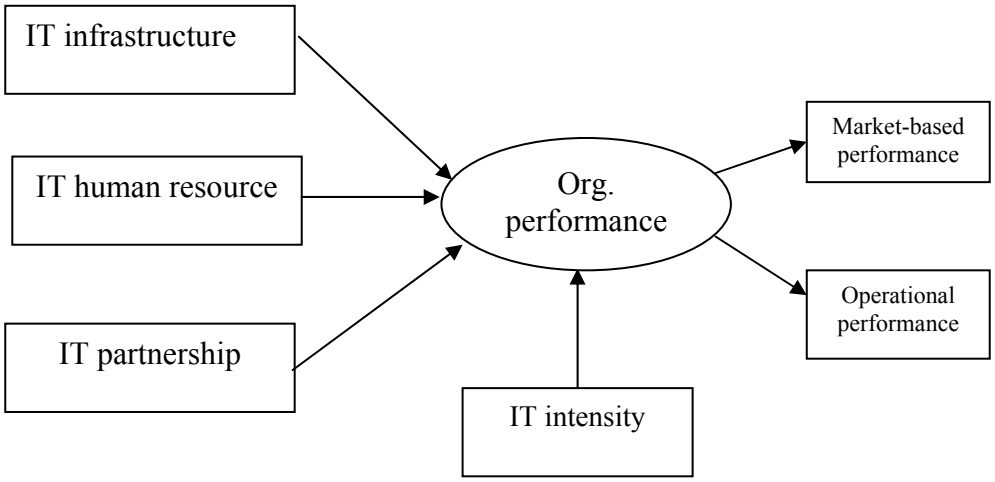

Figure 1. Conceptual framework for this study.

IT infrastructure has been viewed as the foundation of IT components – hardware, software and networks, and recently conceptualised to include shared services such as data, information and standardised applications (Weill, 1993, cited in Mithas et al. 2007). It has been recognised as a key IT resource in IT literature (Ross et al., 1996; Bharadwaj, 2000; Santhanam and Hartono, 2003). Although IT infrastructure components can be seen as commodities, it is reasonable to hypothesise that if IT infrastructure meets business needs, it enhances operational performance. Even though some studies have shown that IT infrastructure is not related to the competitive advantage of firms (Bhatt and Grover, 2005), there is evidence in the empirical study of 129 firms in the United States that IT infrastructure has an indirect effect on organisational performance (Ravinchandran and Lertwongsatien, 2005). IT resources, including both technology and human resource, create business value for a firm, where business value is defined as the organisational performance impacts of information technology (Melville et al., 2004). Recently, Mithas et al. (2007) found that there is an indirectly positive relationship between IT infrastructure capability and companies' performance. So, we propose that there is a positive effect of IT infrastructure on performance.

H1: There is a positive relationship between IT infrastructure and organisational performance.

The IT human resource includes IT technical and managerial skills and IT business and company knowledge. IT skills and business and company knowledge evolve over time through the accumulation of experience and learning. Companies with strong IT human resources are able to:

(a) Integrate the IT and business planning processes more effectively;
(b) Develop reliable and cost effective applications that support the business needs of the company faster than competitors;
(c) Anticipate future business needs of the company and innovate valuable new product features before competitors (Bharadwaj, 2000).

The positive contribution of the IT human resource to organisational performance has been supported by various studies in the literature (Bharadwaj, 2000; Melville et al, 2004; Bhatt and Grover, 2005; Ravinchandran and Lertwongsatien, 2005). It leads to the hypothesis that IT human resources have a positive effect on business performance.

H2: There is a positive relationship between IT human resource and organisational performance.

Creating a good relationship between IT and business groups might take several years. A continuous interaction and communication between IT groups and other functional groups is required to get IT projects delivered quickly to meet business demands. In addition, having good relationships with external partners enables IT services to be provided smoothly to the company. It is evidence that IT partnership has indirect effects on organisational performance (Ravinchandran and Lertwongsatien, 2005). Thus, it is hypothesised that IT partnership has positive effects on business performance.

H3: There is a positive relationship between IT partnership and organisational performance.

3. Research methodology

3.1 Data collection

Data for testing the research model was collected through a mail survey in Australia. Australian companies are collected from Who's Who (2006) database using cluster sampling and purposive sampling method. Only companies with 50 plus employees were chosen for the survey with the assumption that most of the companies which have IT personnel incharged are at least medium size companies, say, more than 50 employees. With this limited types of companies, from Dun and Bradstreet company database, about 1,500 companies are in the survey sample.

A questionnaire was prepared based on the literature and pre-existing questions if available. After Ethics approval from the researchers' University, questionnaires were sent to potential respondents by mail. Potential respondents are IT personnel incharged such as CIOs, IT managers, Information system officers, etc. They are the most informed people in companies concerning information relating to this study. They were able to either answer the questionnaire by returning it in a reply-paid envelope or to answer online through the web-based questionnaire. After three weeks, reminder letters were sent out for non respondents.

A total of 140 responses was collected through both online and mail replies. Some 150 questionnaires were returned to the sender; excluding these from the mailout gave a response rate of 10 percent. This response rate was regarded as acceptable.

3.2 Respondents characteristics

Only 17 percent of respondents' organisations are in public sector, the rest (83 percent) are in the private sector. This reflects the business trend that more organisations are now in the private sector. Most of the respondents are working in the IT function (83.6 percent) and are in middle-management or executives positions (93 percent). This was expected because the survey questionnaires were sent directly to IT managers and executive directors of organisations for forwarding to suitable persons in the organisation. A large part of respondents (86.4 percent) have at least 2 years working experience with their organisations. About 64 percent of them have a bachelor and higher education. With such positions, working experience in organisations and sound education levels, these respondents are believed to have a sufficient understanding and knowledge to give appropriate and accurate answers about their organisations. They are believed to be a good sample for this research.

3.3 Measurement of constructs

Information in the questionnaire was collected based on the respondents' assessment of their company situation on 7 point scales except for some demographic information questions. We chose a 7-point scale rather than a 4- or 5-point scale because it is easier to detect smaller differences with 7 point scales than with others. This research used questions that had been used previously in other research of Ravinchandran and Lertwongsatien (2005) with some

small modifications in preparing questionnaire. Those modifications related to changing items from reversed coded to normal coded and changing words for consistency throughout the study and for being reader-friendly questions (after asking a small group of IT professional and non-IT people). Detail questions are provided in the appendix of the paper.

- The IT human resource construct has two subconstructs which are IT personnel skills measured by four items and IT company knowledge measured by six items.
- IT partnership includes two dimensions: internal partnership between IT and business people measured by 5 observed variables and external partnership between IT people and external partners (vendors and IT service providers) measured by 3 observed variables.
- IT infrastructure comprises two factors: Network and platform sophistication with 5 items and Data and core applications sophistication with 3 items.
- Company performance was measured by respondents'assesment of the company's performance in compared with company's competitors on two dimensions: Operating performance (profitability, productivity and financial performance) measured by four items and market-based performance (success in entering new market and bring new products and services to the market of the company) measured by three items.
- The extent to which suppliers, competitors and company's business partners in an industry use IT will be used with three-item scale to measure the intensity of IT use in an industry.

Although the constructs and scale items are taken from previous studies, these questionnaires are used in the context of Australian companies. Thus, it is reasonable to retest all measurement models of each construct which is discussed in the next section.

4. Data analysis

The research model was tested using AMOS 7.0. After data preparation, measurement models for all constructs were tested and then structural model was tested.

4.1 Data preparation

After collecting data, all mailed responses are keyed in with assigned codes. All online responses are automatically summarised in a data file precoded for each question in the questionnaires. These two data files were combined and screened for data accuracy. The percentages of missing data for each variable and question were examined. The highest missing percentage (9.3 percent) is lower than the maximum acceptable value of 10 percent for missing values treatment recommended by Malhotra et al. (2004). Those data sets were retained subject to missing data treatment. All 140 questionnaires were retained for analysis later.

All missing data were treated in SPSS by maximum likelihood method. The Full Information Maximum Likelihood (FIML) estimation of missing values is a maximum likelihood imputation method that can be implemented in computer programs likes AMOS, LISREL, and SPSS. It is recommended as the best method of treating missing data because it produces the least bias in the missing values (Chou and Bentler, 1995; Arbuckle, 1999; Hair et al., 2006).

4.2 Measurement models

The measurement model for each of the construct of IT resources, IT use intensity and business performance was tested in the following section. The testing method used was the

same for all constructs. Only one test for one construct, namely IT human resource is discussed here as an example. Other constructs were tested in the same way.

From previous studies (Bollen, 1989; Marsh et al., 2004; Holmes-Smithet et al., 2005; Sharma et al., 2005; Hair et al., 2006; Malhotra et al., 2006), a table of acceptable criteria for evaluating measurement and structural models are developed as shown in Table 1.

Table 1. Summary of criteria for evaluating measurement and structural models.

Criteria	Abbreviation	Acceptable level/value criteria
Chi-square	$\chi^2_{(df, p)}$	$p > 0.05$ (at $\alpha = 0.05$ level) good $p > 0.1$ (at $\alpha = 0.1$) is acceptable
Normed Chi-square	χ^2/df	$1 < \chi^2/df < 3$
Root mean square error of approximation	RMSEA	RMSEA < 0.01
Goodness of fit index	GFI	Around 0.9
Comparative fit index	CFI	Around 0.9
Cronbach coefficient alpha	α	$\alpha > 0.70$ good, > 0.6 satisfactory
Standardized regression weights		Good: > 0.7; acceptable: > 0.5
Critical ratio (cr)		Cr >1.96
Variable reliability		Good: > 0.5; moderate > 0.3 < 0.5

IT human resource comprises two factors: firm specific knowledge of IT personnel and IT personnel skills. These two factors were tested separately.

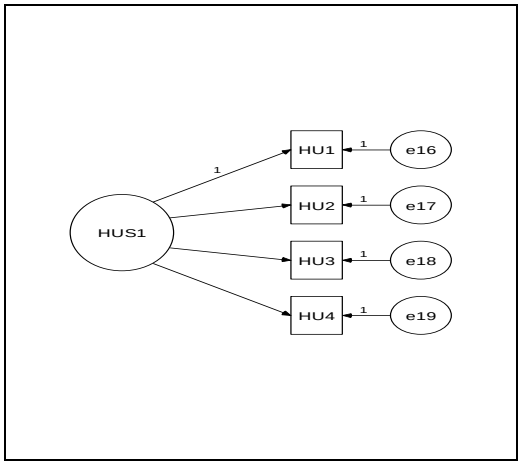

Figure 2. One factor congeneric model of IT personnel skills (HUS1).

IT personnel skills model included four items as shown in Figure 2. The results of the confirmatory factor analysis of the one factor congeneric measurement model are summarised in Table 2. From Table 2 we can see that the Cronbach alpha for IT personnel skills one factor congeneric model is high (0.849), indicating that the variables are a good measure of IT personnel skills. The standardised regression weight and variable reliability for each variable is greater than 0.7 and 0.5. That means this model is a good measurement model for IT

personnel skills with the evidence of convergent validity. In addition, all goodness of fit indices RMSEA, GFI, CFI and the p value are within the acceptable levels of criteria, showing that the model fitted the data well.

Table 2. Standardised and fit estimates of the IT personnel skills model.

Standardized regression weights			Estimate	C.R.	P	Variable reliability
HU1	<---	HUS1	0.805			0.648
HU2	<---	HUS1	0.735	8.594	***	0.540
HU3	<---	HUS1	0.794	9.248	***	0.630
HU4	<---	HUS1	0.725	8.474	***	0.526
				Recommended value		results
Reliability- Cronbach alpha				$\alpha > 0.70$		0.849
Chi-square						5.378
Degree of freedom (df)						2
P				P > 0.05 (at $\alpha = 0.05$ level)		0.068
Root mean square error of approximation (RMSEA)				RMSEA < 0.1		0.110
Goodness of fit index (GFI)				~ 0.9		0.981
Comparative fit index (CFI)				~ 0.9		0.985

Sources: (a). Summarised from maximum likelihood estimation with AMOS 7.0.
(b). Recommended values adapted from Kline (1998); Holmes-Smith et al.(2005); Hair et al. (2006), Schumacker and Lomax(2004).

IT personnel knowledge model initially included six items. The model with all six items did not fit the data well. The model modification procedure suggested by Holmes-Smith et al. (2005) was applied to improve the model. After considering low factor loading items, standardised residual covariances matrix, and the significance of the parameters, item HU5 and HU10 were dropped from the model.

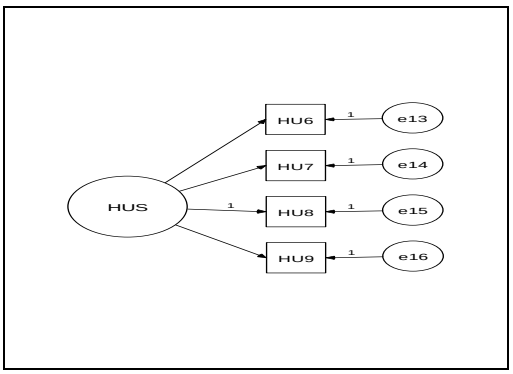

Figure 3. One factor congeneric model of IT personnel knowledge (HUS).

The final model was shown in Figure 3 with the results of the confirmatory factor analysis of the one factor congeneric measurement model summarised in Table 3.

From Table 3 we can see that the Cronbach coefficient alpha for IT personnel knowledge is high (0.849), indicating that the variables are a good measure of the construct. The standardised regression weight and variable reliability for each variable was greater than 0.5 and 0.3. That means this model is a good measurement model for IT personnel knowledge

with the evidence of convergent validity. In addition, all goodness of fit indices RMSEA, GFI, CFI and the p value are within the acceptable levels of criteria, showing that the model fitted the data well.

Table 3. Standardised and fit estimates of the IT personnel knowledge model.

Standardized regression weights			Estimate	C.R.	P	Variable reliability
HU7	<---	HUS	0.872	10.473	***	0.761
HU6	<---	HUS	0.666	7.989	***	0.443
HU8	<---	HUS	0.808			0.654
HU9	<---	HUS	0.734	8.959	***	0.538

	Recommended value	Results
Reliability- Cronbach alpha	α >0.70	0.849
Chi-square		4.589
Degree of freedom (df)		2
P	P > 0.05 (α = 0.05)	0.101
Root mean square error of approximation (RMSEA)	RMSEA < 0.1	0.097
Goodness of fit index (GFI)	~ 0.9	0.983
Comparative fit index (CFI)	~ 0.9	0.989

Sources: (a). Summarised from maximum likelihood estimation with AMOS 7.0.
(b). Recommended values adapted from Kline (1998); Holmes-Smith et al. (2005); Hair et al. (2006) Schumacker and Lomax (2004).

The measurement model of IT human resource was checked by putting these two subfactors together. The initial model did not fit well with the data. The model modification procedure suggested by Holmes-Smith et al. (2005) was applied to improve the model. Standardised Residual Covariances matrix was checked. There were high covariances between HU6 and HU3, HU6 and HU4. After checking significant paths and modification indices, item HU6 was dropped from the model. The final model and related results were shown in Figure 4 and Table 4.

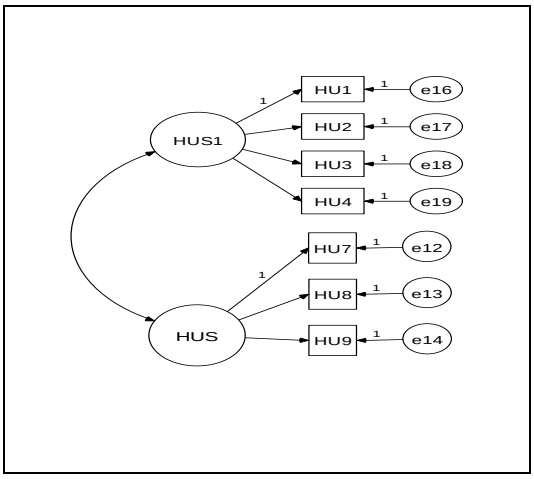

Figure 4. Measurement model of IT human resource.

Table 4 shows that the Cronbach coefficient alpha for IT human resource construct is high (0.836), indicating that the variables are good measures of the construct.

Table 4. Standardised and fit estimates of the IT human resource model.

Standardized regression weights			Estimate	C.R.	P	Variable reliability
HU1	<---	HUS1	0.806			0.650
HU2	<---	HUS1	0.727	8.595	***	0.529
HU3	<---	HUS1	0.797	9.426	***	0.635
HU4	<---	HUS1	0.728	8.601	***	0.530
HU9	<---	HUS	0.751	9.139	***	0.564
HU8	<---	HUS	0.834	9.876	***	0.695
HU7	<---	HUS	0.839			0.704

	Recommended value	results
Reliability- Cronbach alpha	$\alpha > 0.70$	0.836
Chi-square		17.743
Degree of freedom (df)		13
P	$p > 0.05$ (at $\alpha = 0.05$ level)	0.168
Root mean square error of approximation (RMSEA)	RMSEA < 0.1	0.051
Goodness of fit index (GFI)	~ 0.9	0.968
Comparative fit index (CFI)	~ 0.9	0.989

Sources: (a). U*mmarised from maximum likelihood estimation with AMOS 7.0.*
(b). *Recommended values adapted from Kline (1998); Holmes-Smith et al.(2005); Hair et al.(2006), Schumacker and Lomax (2004).*

The standardised regression weight and variable reliability for each variable was greater than 0.7 and 0.5. That means this model is a good measurement model for IT human resource construct with the evidence of convergent validity. In addition, all goodness of fit indices RMSEA, GFI, CFI and the p value are within the acceptable levels of criteria, showing that the model fitted the data well.

For others constructs, the testing processes are the same. As shown in Table 5, all final constructs have very high Cronbach alphas, higher than 0.74 with factor loadings higher than 0.5, indicating that the constructs are measured well by the data and the scales have adequate reliability.

Table 5. Cronbach alpha of constructs.

Composite variable	Name of construct	Cronbach alpha
HUMAN	IT human resources	0.836
INFRA	IT infrastructure	0.810
PARTNER	IT partnership	0.828
MARKET	Market-based performance	0.782
OPERAT	Operational performance	0.742
INTEN	IT use intensity	0.808

4.3 Structural model

After all measurement models are tested, composite variables for IT human resource, IT partnership, IT infrastructure, IT use intensity, Market-based performance and Operating performance are calculated based on Factor score weight matrices in AMOS output. These variables are to be tested for discriminant validity. Because correlations between theoretically similar measures should be high, the correlations coefficients are used to test the discriminant validity of these composite variables. A large correlation coefficient (above 0.80 or 0.90) suggests a lack of discriminant validity of the construct (Holmes-Smith et al., 2004). Table 6 shows correlation coefficients between independent composite variables used in this study. All coefficient correlations are below 0.56, indicating the evidence of discriminant validity for these constructs.

Table 6. Correlations test for variables.

	IT USE	OPERAT	MARKET	HUMAN	INFRA	PARTNER	INTEN
IT USE	1	0.236**	0.273**	0.551**	0.528**	0.369**	0.443**
OPERAT	0.236**	1	0.318**	0.195*	0.240**	0.134	0.136
MARKET	0.273**	0.318**	1	0.289**	0.252**	0.121	0.255**
HUMAN	0.551**	0.195*	0.289**	1	0.460**	0.568**	0.243**
INFRA	0.528**	0.240**	0.252**	0.460**	1	0.361**	0.292**
PARTNER	0.369**	0.134	0.121	0.568**	0.361**	1	0.161
INTEN	0.443**	0.136	0.255**	0.243**	0.292**	0.161	1

Notes: (a). ** Correlation is significant at the 0.01 level (2-tailed).
(b). * Correlation is significant at the 0.05 level (2-tailed).

These composite variables are put together to test the structural model as shown in Figure 5 with statistical results in Table 7.

Table 7. Fit indices of IT resources and performance model.

Goodness of fit indices	Acceptable level	Results
CMIN		1.609
DF		3
P	p>0.05 (at $\alpha = 0.05$ level)	0.657
GFI	~ 0.9	0.996
RMSEA	RMSEA <0.1	0.000
CFI	~ 0.9	1.000

Sources: (a). Summarised from maximum likelihood estimation with AMOS 7.0.
(b). Recommended values adapted from Kline (1998); Holmes-Smith et al.(2005); Hair et al. (2006) Schumacker and Lomax (2004).

In Table 7, a very high value of p (0.657), high value of GFI (0.996) and CFI (1.000) indicate that this research model fits well with the data. Figure 5 shows the path coefficients and the R^2 value of the structure model. The R-square value of 0.29 means 29 percent of the variance in organisational performance is significantly explained by the model with IT human resource, IT infrastructure, IT partnership and IT intensity. A model without the presence of IT intensity was also tested which gave the R^2 value of 0.26. Thus, the addition of the IT intensity variable to the whole model accounted for a small increase of 3 percent (product of

29 percent -26 percent) in R^2 value of business performance. In the main model, the association between IT intensity and business performance is also significant at 0.05 levels (p = 0.042).

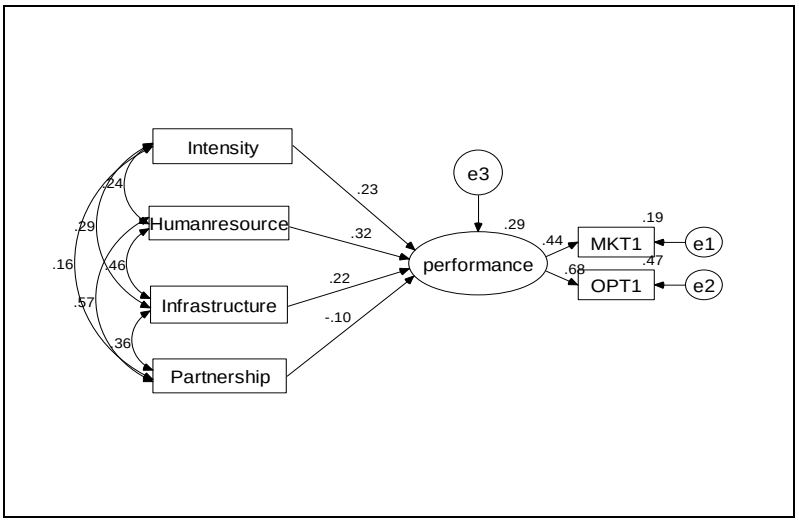

Figure 5. IT resources and business performance model.

Checking the significant paths of the model in Figure 5, the associations between IT Human resources with organisational performance are significant at 0.05 levels (p = 0.02). That means Hypothesis H2 is supported by the data. The association path between IT infrastructure and business performance is not significant at 0.05 levels (p = 0.077); but it is significant at 0.1 levels. That means there is a relationship between IT infrastructure and business performance, and Hypothesis H1 is supported by the data. Hypothesis H3 – the relationship between IT partnership and business performance – is not supported by the data, this path is not statistically significant at 0.05 levels (p = 0.45). Table 8 summarises the results for all hypothesised relationships in the model. From the paths in Figure 5, it is shown that IT human resource has the most effect on organisational performance. IT infrastructure is the second IT resource having effect on while IT partnership has no significant contribution to business performance.

Table 8. Summarised test results for research hypotheses.

No.	Hypotheses	Tested results
1	*H1: There is a positive relationship between IT Infrastructure and Organisational performance.*	Supported
2	*H2: There is a positive relationship between IT human resource and Organisational performance.*	Supported
3	*H3: There is a positive relationship between IT partnership and Organisational performance.*	Not supported

5. Discussion

Drew from the resource-based perspective, this study empirically examined how IT resources affect business performance. We argued and found that variation in companies' business performance is explained by the combination of the three main categories of IT resources (IT human resources, IT infrastructure and IT partnership) with the presence of IT use intensity in industries. Of which two of the three hypotheses are supported by the data. It is argued that the three main categories of IT resources are tightly related and are the foundations of IT capability which helps companies achieve long-term competitiveness (Ross et al., 1996). However, a lack of significant between IT partnership and business performance found in our study suggests that IT partnership might not directly contribute to make the differentiation of companies' performance. We found that IT human resources and IT infrastructure have contributions to business performance.

IT infrastructure has a contribution to business performance but the relation is not strong ($p = 0.07$). This results is consistent with the common view in the field that the development of a high quality IT infrastructure is ambiguous, follows a path-dependent development and provides first mover advantage to the company (Bhatt and Grover, 2005). It is different from results of Bhatt and Grover research (2005) which closely aligned with the notable argument of Carr (2003) that ubiquity of IT infrastructures is accessible to all and not a source of differentiation. The rational for this result could be that studies were conducted in different context in terms of economic development and culture. In the present time and in Australian context, IT infrastructure might be still not a commodity that all companies can afford and access to. IT infrastructure may be still heterogeneous, not convergent and the knowledge of how to deploy it effectively might be different among companies. That might lead to the case that IT infrastructure still has an important role in making companies' performance differentiation.

IT human resources include two factors: IT personnel skills (comprised business, technology, managerial and interpersonal skills) and company specific knowledge of IT people. The development of these skills evolves over time through accumulation of experience and learning and requires organisational efforts. Thus, companies with high competent IT people may be able to create performance differentiation. This study found that the positive relationship between IT human resource and business performance is the strongest relation compared with those of other IT resources. Given the scarcity of companies' resources, companies need to set a right priority for their investment and effort. That means although IT resources are all important, companies need to focus on the more important ones which are suggested in this research firstly IT human resources, then IT infrastructure.

The "not significant" relation between IT partnership and Performance might suggest that companies need to concentrate on improving their IT human resource and IT infrastructure rather than IT partnership in finding the performance improvement. As long as IT personnel have good technical skills, a good business knowledge and a good knowledge of company procedures, in addition to the needed IT infrastructure, they can work and provide needed IT services to improve business performance.

Although this study uses Ravinchandran and Lertwongsatien (2005)'s constructs for its model, it is different from earlier studies in some aspects. The first one is that it analyses the association between IT resources and performance directly with broaden perspectives and detail measurement of constructs. The second one is that it studies the association at a detail level, and provides a clear idea on which IT resource contributes the most to business performance which helps companies focus on the more important resources. This study was

conducted in the context of Australian business which is the third difference from previous studies in the field.

6. Limitations and further research

One limitation of this study is that questionnaire was answered by only one respondent in each company. Although the data reflects the opinion of one person, it represents the perceptions of IT personnel in charged who is the most informed in a company relating to information technology knowledge in the company. This way of selecting respondent is consistent with what is recommended by Huber and Power (Huber and Power, 1985) that when one respondent per unit is solicited, it should be the most informed respondent. However, it would be better for future studies to consider research designs that allow data collection from multiple respondents within a company.

Other limitation of the study is that we use the same respondent for getting both independent and dependent variables. This leads to a common method bias issue. Although, statistically it does not seem to be a major issue (Bhatt and Grover, 2005), future studies should consider to use multiple methods of measurement to alleviate any potential bias.

This study only deals with the association of IT resources as well as each of its three component resources and organisational performance. It would be further extended at least in two directions. Firstly, factors relating to external environment such as industry categories, competitive environment in industries, etc. would be considered to add to the model for future research. Secondly, more studies on factors contributing to improvement of IT resources would be of great help for companies' management in practice.

7. Conclusion

This study refines the constructs and the measures of IT capability/IT resources in Ravinchandran and Lertwongsatien (2005) in the context of Australian businesses. The model of IT resources impacting business performance directly is proposed in this study. Answering the question of which IT resources or which IT capability component has the most effect on performance is really important to help managements to focus their company resources on the right priorities. From a practical aspect, this study is expected to help managements of companies to have a clearer view of how to enhance the benefits of IT capability on companies' performance by understanding and focusing the company's resources on the important components. The results of this study show that human resource is the most important resource which has the strongest effects on organisational performance. Thus, companies those want to improve their performance need to concentrate on improving their IT human resource as the first priority and then IT infrastructure as the second priority rather than IT partnership.

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Appendix: Related constructs questions used in the questionnaire:

1. IT use intensity.

Statements	Strongly disagree						Strongly agree	N/A
1. IT is used extensively by our competitors.	1	2	3	4	5	6	7	0
2. IT is used extensively by our suppliers and business partners.	1	2	3	4	5	6	7	0
3. IT is a critical means to interact with customers in our industry.	1	2	3	4	5	6	7	0

2. Organisation's performance compared to competitors. Please circle a position on the scale that best fits your opinion.

Statements	Strongly disagree						Strongly agree	N/A
1. We have entered new markets very quickly.	1	2	3	4	5	6	7	0
2. We have brought new products and services to the market faster than our competitors.	1	2	3	4	5	6	7	0
3. The success rates of our new products and services have been very high.	1	2	3	4	5	6	7	0
4. Our productivity has exceeded that of our competitors.	1	2	3	4	5	6	7	0
5. Our profit has exceeded that of our competitors.	1	2	3	4	5	6	7	0
6. Our financial performance has been outstanding.	1	2	3	4	5	6	7	0
7. Our financial performance has exceeded that of our competitors.	1	2	3	4	5	6	7	0

3. Information technology resources.
a. IT human resources. Please circle a position on the scale that best fits your opinion.

Statements	Strongly disagree						Strongly agree	N/A
1. Our IT staff has very good technical knowledge; they are one of the best technical groups an IT department could have.	1	2	3	4	5	6	7	0
2. Our IT staff has the ability to quickly learn and apply new technologies as they become available.	1	2	3	4	5	6	7	0
3. Our IT staff has the skills and knowledge to manage IT projects in the current business environment.	1	2	3	4	5	6	7	0
4. Our IT staff has the ability to work closely with customers and maintain productive user or client relationship.	1	2	3	4	5	6	7	0
5. Our IT staff has excellent business knowledge; they have a deep understanding of the business priorities and goals of our organisation.	1	2	3	4	5	6	7	0
6. Our IT staff understands our organisation's technologies and business processes very well.	1	2	3	4	5	6	7	0
7. Our IT staff understands our organisation's procedures and policies very well.	1	2	3	4	5	6	7	0
8. Our IT staff is aware of the core beliefs and values of our organisation.	1	2	3	4	5	6	7	0
9. Our IT staff knows who are responsible for important task in this organisation.	1	2	3	4	5	6	7	0

Statements	Strongly disagree						Strongly agree	N/A
10. Our IT staff is conversant with the routines and methods used in the IT department.	1	2	3	4	5	6	7	0

b. IT infrastructure. Please circle a position on the scale that best fits your opinion.

Statements	Strongly disagree						Strongly agree	N/A
1. The technology infrastructure needed to electronically link our business units is present and in place today.	1	2	3	4	5	6	7	0
2. The technology infrastructure needed to electronically link our firm with external business partners (i.e., key customer, suppliers, alliances) is present and in place today.	1	2	3	4	5	6	7	0
3. The technology infrastructure needed for current business operations is present and in place today.	1	2	3	4	5	6	7	0
4. The capacity of our network infrastructure adequately meets our current business needs.	1	2	3	4	5	6	7	0
5. The speed of our network infrastructure adequately meets our current business needs.	1	2	3	4	5	6	7	0
6. Corporate data is currently sharable across business units and organisational boundaries.	1	2	3	4	5	6	7	0
7. Our application systems are very modular; most program modules can be easily reused in other business applications.	1	2	3	4	5	6	7	0
8. We have standardised the various components of our technology infrastructure (i.e., hardware, network, and database).	1	2	3	4	5	6	7	0

c. IT partnership. Please circle a position on the scale that best fits your opinion.

Statements	Strongly disagree						Strongly agree	N/A
1. Critical information and knowledge that affect IT projects are shared freely between our business units and IT department.	1	2	3	4	5	6	7	0
2. Our IT department and business units understand the working environment of each other very well.	1	2	3	4	5	6	7	0
3. There is high degree of trust between our IT department and business units.	1	2	3	4	5	6	7	0
4. The goals and plans for IT projects are jointly developed by both the IT department and business units.	1	2	3	4	5	6	7	0
5. Conflicts between IT department and business units are rare and few in our organisation.	1	2	3	4	5	6	7	0
6. We seldom have conflicts with our IT vendors and service providers.	1	2	3	4	5	6	7	0
7. We can rely on our IT vendors and service providers to respond to our IT needs in a timely and effective manner.	1	2	3	4	5	6	7	0
8. We have long-term partnerships with our key IT vendors and service providers.	1	2	3	4	5	6	7	0