

An Investigation into Business-to-Business Electronic Commerce Organizations

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The issue of information technology (IT) investment evaluation in B2BEC (business-to-business electronic commerce) has generated a lot of interest and discussion among academics and researchers. This research was undertaken to investigate the relationships between the level of IT maturity, the use of IT investment evaluation (IEM) and benefits realization (BRM) methodologies, and the degree of satisfaction with the adoption of B2BEC in Taiwanese B2BEC organizations. The results indicated that the level of IT maturity was a strong predictor of the use of evaluation methodologies while the use of evaluation methodologies had a significant impact on the degree of satisfaction with the adoption of B2BEC. It was also found that evaluation methodologies had played a mediating role between the level of IT maturity and the degree of satisfaction with the adoption of B2BEC. Managerial implications and future research directions are also provided.

ACM Classifications: H.0. (Information Systems – General), K.6. (Computing Milieux – Management of Computing and Information Systems)

INTRODUCTION

Each year, organizations around the world are investing a huge amount of money in information technology (IT). Global IT spending, as forecast by Global Insight, is likely to increase to over US\$3.2 trillion in 2007 (WITSA, 2004). Taiwan, ranked seventh worldwide in terms of effective utilization of IT in 2005/2006 (WEF, 2006), had a total IT spending of US\$6.6 billion in 2001, up

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maturity. The seven elements are strategy, structure, systems, staff, style, skills, and superordinate goals. However, three of the elements (strategy, systems, and staff) were not included in the analysis because they were found not to be good measures of IT maturity for the Taiwanese organizations. The six stages of the revised model are: ad hoc, starting the foundations, centralized dictatorship, democratic dialectic and cooperation, entrepreneurial opportunity, and integrated harmonious relationships. The revised model assesses the organization's capability and readiness to obtain business benefits from IT directly to its level of IT maturity and the results provide crucial information about the organization's ability to effectively utilize IT in order to achieve competitive advantage and business goals.

Degree of Satisfaction with the Adoption of B2BEC

The degree of satisfaction with the adoption of B2BEC refers to the perception of organizations that the B2BEC systems effectively meet their business demands and expectations (Subramaniam and Shaw, 2002). It is the result of a comparison between organizational expectation of the B2BEC adoption and the perceived performance and capability of the system (Armstrong *et al*, 2005; Castro-Lacouture and Skibniewski, 2005). For example, inappropriate implementation of B2BEC has the potential to cause worsening relationships with suppliers and buyers and can lead to lower organizational satisfaction with the adoption of the system. On the other hand, there is also some evidence that evaluation of IT investments such as B2BEC can lead to better perceived organizational outcomes (Tallon *et al*, 2000). Enhancement of corporate image and development of new business as a result of successful adopting B2BEC are some of the ways in which organizational satisfaction can be improved.

CONCEPTUAL MODEL AND HYPOTHESES

The organizational perspective views the performance of an organization as depending heavily on the contribution of its existing IT infrastructures which are capable of supporting business management processes to achieve the desired organizational outcome (Banker *et al*, 1998). According to this view, organizations wishing to achieve the desired organizational outcomes (i.e. B2BEC adoption satisfaction) need to closely align their IT infrastructures (i.e. the level of IT maturity) with business management processes (i.e. the use of IEM and BRM) (Byrd *et al*, 2006). In other words, in order for organizations to achieve the desired level of B2BEC adoption satisfaction from IT investments in B2BEC, senior managers have to ensure a clear linkage between business goals, the level of IT maturity, and the use of IT evaluation methodologies (Chan *et al*, 1997). Therefore, this research seeks to test the following three hypotheses:

- H1:** The level of IT maturity is positively related to use of IEM and BRM by organizations.
- H2:** The level of IT maturity is positively related to the degree of satisfaction with the adoption of B2BEC by organizations.
- H3:** The use of IEM and BRM by organizations is positively related to the degree of satisfaction with the adoption of B2BEC.

These hypotheses can be represented by the following model in Figure 1.

RESEARCH METHOD AND DESIGN

This survey targeted Taiwanese organizations involved in B2BEC activities. Prior to determining the sample size for the survey, a pilot survey of IT managers/CIOs of 10 B2BEC organizations was conducted. The response rate for this pilot study was 100% and comments about the questionnaire and its IEM

For the main survey, 275 Taiwanese organizations were randomly selected from the top 5000 Taiwanese organizations (which were involved in B2BEC activities) listed by a semi-governmental organization, the Institute for Information Industry (III, 2004). The questionnaire, accompanied by a covering letter to explain briefly the purpose and aim of the survey and a reply-paid return envelope was hand-delivered to the IT managers/CIOs of 275 Taiwanese organizations involved in B2BEC activities (III, 2004). Two follow-up mailings or phone calls were carried out to increase the response rate. A total of 106 questionnaires were returned, giving an overall response rate of 38.5%. Late returns were compared with other responses received earlier in order to check for non-response bias. No significant differences were detected between the two samples.

Measurement

The survey was conducted to examine the relationships between the level of IT maturity, use of IEM/BRM, and the degree of satisfaction with the adoption of B2BEC in Taiwanese organizations. Respondents were asked to indicate their agreement on a 5-point scale (1 for strongly disagree and 5 for strongly agree) with statements concerning three main constructs: (1) the level of IT maturity; (2) the use of IEM and BRM; and (3) the degree of satisfaction with the adoption of B2BEC. In the absence of objective data on these constructs, the perceptions of IT managers and CIOs were used. Although there has been some debate about the legitimacy of perceptual measures as a proxy for objective measures of IT outcomes (e.g. B2BEC adoption satisfaction), research has succeeded in alleviating some of the concerns by showing that perceptual measures of organizational outcomes have strong positive relationship with more traditional objective measures (Boynton *et al*, 1994; Grover *et al*, 1998).

Prior to analysis, data were screened for possible response sets, outliers, and missing or out-of-range values. One questionnaire containing several missing values was discarded, giving a total of 105 questionnaires for analysis. Next, missing values were estimated with the EM-algorithm in the

	S.D.	V1	V2	V3	Alpha ^a	CR ^b
V1 Level of IT maturity	1.08	<i>0.50^c</i>			0.76	0.80
V2 IT investment evaluation and benefits realization methodologies	2.82	0.484**	<i>0.50^c</i>		0.89	0.75
V3 Degree of satisfaction with adoption of B2BEC	3.30	0.300**	0.291**	<i>0.50^c</i>	0.89	0.80

*p < .05; **p < .01; ***p < .001

^a Internal Consistency Reliability Cronbach's coefficient alpha.

^b Composite Reliability (Fornell and Larcker, 1981).

^c The diagonal (in italics) shows the average variance extracted (Fornell and Larcker, 1981) for each construct.

Table 1: Correlation Matrix for Variables

the measures (Nunnally, 1978). Table 1 presents the descriptive statistics and Pearson correlation for the variables used in this study. There was no evidence of multicollinearity in the data as the coefficients were all under 0.50.

The *level of IT maturity* scale was based on Galliers and Sutherland's Revised Stages of Growth Model (Galliers and Sutherland, 1991). The scale was revised into a four-item measurement and the alpha value for this scale was 0.76, indicating acceptable values of internal consistency (Nunnally, 1978). This scale measured the IT maturity of an organization in terms of its stage of growth for each of the four elements – structure, style, skills and super-ordinate goals. The other three elements (strategy, systems, and staff) had very low Cronbach's alphas and were, therefore, deleted from the analysis.

The *IT investment evaluation methodology (IEM) and IT benefits realization methodology (BRM)* scale was adapted from Ward *et al* (1996). The scale measured the use of IT investment evaluation methodology and IT benefits realization methodology by organizations seeking to adopt B2BEC. The scale has three items and the alpha values for the scale was 0.89. The IEM and BRM scale measured the wide use of these methodologies and the evaluation process that links IT projects with business objectives.

The *degree of satisfaction with the adoption of B2BEC* scale was derived from Tsao *et al* (2004). The scale has four items and the alpha value for this scale was 0.89. The scale measured the benefits obtained through the adoption of B2BEC. According to Tsao *et al* (2004), adoption of B2BEC, for example, can help the organizations to enhance better corporate image, establish better relationship with suppliers, and develop new business opportunities.

Data Analysis

All measures were analyzed for reliability and validity in accordance with the guidelines set out by Anderson and Gerbing (1988) and Jöreskog and Sörbom (1993). The reliability of these constructs was evaluated using Cronbach's coefficient alpha (α) and their α values were all above 0.7, indicating a reliable measurement instrument (Nunnally, 1978). In addition, three types of validity were assessed to validate our measurement model: content validity, convergent validity, and discriminant validity. Content validity was established by ensuring consistency between the measurement items and the extant literature. This was done by interviewing IT managers and pilot-testing the instrument before sending out the main survey. Churchill (1979) has suggested that convergent and discriminant validities should be examined for construct validity. Therefore, we

assessed convergent validity by examining composite reliability (CR) and average variance extracted (AVE) from the three constructs (Hair *et al*, 1998).

CR is calculated by squaring the sum of loadings, then dividing it by the sum of squared loadings, plus the sum of the measurement error whereas the AVE measures the variance captured by the indicators relative to measurement error. Our CR values of the three constructs were between 0.75 and 0.80 and all are above the suggested minimum of 0.70 (Hair *et al*, 1998). Their AVE values were all 0.50 and these values provided further evidence of convergent validity (Fornell and Larcker, 1981) (please refer to Table 1). These AVE values could also be used to assess discriminant validity (Fornell and Larcker, 1981) which was evident in the results of this study as AVE values for three constructs were higher than the largest squared pairwise correlation between three constructs (0.23) (Espinoza, 1999).

The other way to evaluate construct validity is to examine the pattern and structure coefficients in determining whether constructs in measurement models are empirically distinguishable (Chin, 1998). The factor loadings of each measurement item should be consistent across subgroups and load higher on the construct of interest than on any other constructs (Chin, 1998). Results presented in Table 2 demonstrate adequate discriminant and convergent validity.

Both SPSS 11 and Amos 5 were used to analyze the survey data. SPSS was used initially to obtain some descriptive data and SEM (Structural Equation Modeling) using Amos 5 was then applied to estimate direct and indirect effects for the model (Figure 1). SEM is a multivariate technique that examines a series of dependence relationships simultaneously (Arbuckle, 1996). A two-step SEM approach was followed to first evaluate the quality of the measurement items and then estimated the structural model (Hulland *et al*, 1996). All variables within the model were

Construct	Item Name	Items Description	V1	V2	V3
V1 IT Maturity	Mat1	Structure	0.692	0.416	0.132
V1 IT Maturity	Mat2	Style	0.587	0.353	0.112
V1 IT Maturity	Mat3	Skills	0.729	0.438	0.140
V1 IT Maturity	Mat4	Superordinate goals	0.677	0.407	0.129
V2 Evaluation Methodologies	Evaluat1	Process linkage between IT projects and business objectives	0.413	0.687	0.219
V2 Evaluation Methodologies	Evaluat2	Effective use of IT investment evaluation methodology	0.580	0.965	0.307
V2 Evaluation Methodologies	Evaluat3	Effective use of IT benefits realization methodology	0.551	0.917	0.292
V3 Satisfaction	Sat1	Overall satisfaction with B2EC usage	0.158	0.263	0.826
V3 Satisfaction	Sat2	Enhancement of corporate image	0.159	0.264	0.830
V3 Satisfaction	Sat3	Establishment of stronger linkage with suppliers/buyers	0.174	0.290	0.910
V3 Satisfaction	Sat4	Development of new business opportunities	0.136	0.227	0.713

Table 2: Measurement item loadings

regarded as separate reflective measures. The model (Figure 1) was run as a structural model. It was

RESULTS AND DISCUSSION

Background Information

Most of the information presented in this section was based on descriptive statistics, but some comparisons between groups were made using one-way ANOVA tests and correlation statistics. Table 3 provides background information collected from the responding organizations for the postal survey.

Most responding organizations involved in B2BEC were from manufacturing (54.7%), retail and services (24.5%) and IC designs and semi-conductor (9.5%) industries. The figures here are not surprising given that B2BEC is more widely diffused in the manufacturing sector than other sectors

Range		Percent (%)	Standard Deviation
(a) Industry sectors			N/A
Manufacturing		54.7	
Retails and Services		24.5	
IC Designs and Semi-Conductor		9.5	
Information Technology Services		3.8	
Optics and Electronics		1.9	
Financial Services		1.9	
Transportation		1.9	
Other		1.8	
Total		100	
(b) Net revenue (US\$m)			1.467
<1	(=1)	42.5	
1-10	(=2)	10.0	
11-100	(=3)	17.5	
101-500	(=4)	20.0	
501 and above	(=5)	10.0	
Total		100	
(c) Spending on B2BEC (US\$m)			0.700
<0.01	(=1)	64.0	
0.02-0.49	(=2)	20.0	
0.50-0.99	(=3)	12.0	
1 and above	(=4)	4.0	
Total		100	
(d) Total number of employees			1.461
<49	(=1)	29.3	
50-249	(=2)	25.2	
250-999	(=3)	17.2	
1000-4999	(=4)	12.1	
5000 and above	(=5)	16.2	
Total		100	

Table 3: Background information of the responding organizations

in Taiwan (Chen, 2003). In addition, the responding organizations were almost evenly divided between multinational and national. Half of the responding organizations had less than US\$10 million in net revenue and 250 employees. Only 1% of responding organizations had spent more than US\$1 million on B2BEC. Moreover, the responding organizations were mostly flat (68.3%) and centralized (58.3%), and almost evenly divided between divisional/functional and cross-functional structure. The ANOVA revealed that net revenue did not significantly vary with firm size in terms of employee numbers, but significant differences were found between net revenue and the spending on B2BEC ($p < 0.00$). This indicates that organizations with larger revenue generally can afford to spend more on B2BEC.

Respondents were asked about the usage of formal IT investment evaluation (IEM) and benefits realization (BRM) methodologies for various IT activities and revealed a reasonably high adoption of methodologies for IT investment evaluation (52.8%) and IT benefits realization (52.8%).

The ANOVA revealed that organizations tend to adopt either both methodologies or none at all. However, 47.2% of responding organizations failed to adopt an IT investment evaluation methodology or an IT benefits realization methodology. Therefore, overall, their use was found to be commonplace but by no means universal. In particular, the level of usage of IT investment evaluation methodology and IT benefits realization methodology by respondents were significantly correlated (0.849).

In terms of effectiveness of those methodologies in ensuring successful information systems, respondents who had methodologies indicated that investment evaluation and benefits realization were effective (4 or 5 out of a five-point scale) in only 31.2%, and 29.2% of cases, respectively. The level of effective use of IT investment evaluation methodology was significantly correlated with the effective use of IT benefits realization methodology (0.885).

Overall, the IT investment evaluation and benefits realization methodologies were not effective in ensuring successful information systems. Moreover, the usage of these methodologies was not significantly correlated with the size of the organizations in terms of both the net revenue and employee size. The results from this study and other similar studies are summarized in Table 4. The result is interesting when compared with other studies carried out in Australia and the UK. The table shows that while the usage of IEM by Taiwanese organizations is lower than organizations in Australia and the UK, the usage of BRM is quite high among the responding organizations in Taiwan. In addition, Taiwanese organizations are more likely than UK and Australian organizations to prepare benefits delivery plans and hold formal processes to ensure that lessons are learned and benefits are identified and realized after IT implementation. However, it should be noted that the UK studies are from the early-mid 1990s and further UK research is needed to update their conclusions and validate these comparisons.

Discussion of the Model

As anticipated, the level of IT maturity was positively related to the use of evaluation methodologies ($\beta = 0.60$, $p < 0.01$). This suggests that the level of IT maturity had a significant impact on the effective use of IT investment evaluation and benefits realization methodologies. In addition, the level of IT maturity can also affect the organization's ability to implement a formal evaluation process to link IT projects and organizational business objectives. This provides full support for **H1**.

H2, which predicted that organization's the level of IT maturity could affect the degree of satisfaction with the adoption of B2BEC, was not supported. The relationship was not significant and it appeared that without adopting other business management processes (e.g. use of evaluation

methodologies) the level of IT maturity alone could not significantly affect the B2BEC adoption satisfaction within the responding organizations.

On the other hand, B2BEC adoption satisfaction was positively influenced by the use of evaluation methodologies ($\beta = 0.32, p < 0.01$). This shows that the effective adoption of IT investment evaluation and benefits realization methodologies and a formal evaluation process to ensure the linkage between IT projects and organizational business objectives could have significant impact on the degree of satisfaction with the adoption of B2BEC. Thus, **H3** was supported.

The level of IT maturity was a strong predictor of the use of evaluation methodologies while the use of evaluation methodologies had a significant impact on the degree of satisfaction with the adoption of B2BEC. It was also found that there was no direct relationship between the level of IT maturity and the degree of satisfaction with the adoption of B2BEC. This confirms that the use of IT investment evaluation and benefits realization methodologies had played a mediating role between the level of IT maturity and the degree of satisfaction with the adoption of B2BEC. The level of IT maturity could only directly impact on organization's ability or capability to effectively utilize IT evaluation processes but not on the degree of satisfaction with the adoption of B2BEC.

Questionnaire Items	This Study	Love <i>et al</i> (2005)	Lin and Pervan (2003)	Ward <i>et al</i> (1996)	Willcocks (1992)
	Taiwanese Organizations	Australian SMEs	Large Australian Organizations	Large UK Organizations	UK Organizations
Usage of:					
• IT investment evaluation methodology (IEM)	52.8%	67.7%	65.7%	60%	>50%
• IT benefits realization methodology (BRM)	52.8%	–	32.8%	12%	–
Effective use of:					
• IEM	31.2%	–	–	–	–
• BRM	29.2%	–	–	–	–
Current process was able to identify relevant benefits	46.2%	–	50.0%	78.0%	–
Overstated the benefits in order to get approval	47.7%	–	26.2%	47%	–
Prepared a benefits delivery plan	60.4%	45%	43.0%	27%	–
Had a formal process to ensure that lessons were learned	65.1%	20.8%	52.3%	29%	44.0%
Had a formal process to identify and realize any further benefits after implementation	61.3%	–	18.2%	19%	–

Table 4: Summary of findings from this study and other similar studies

CONCLUSIONS AND IMPLICATIONS

The results from this survey on Taiwanese B2BEC organizations show relatively high usage of IT investment evaluation and benefits realization methodologies. However, these methodologies were generally not used effectively within the responding organizations when compared with organizations from other countries such as UK and Australia (Table 4). The SEM results have also shown that the level of IT maturity had significant impact on the use of evaluation methodologies while the use of evaluation methodologies had a positive relationship with the degree of satisfaction with the adoption of B2BEC. However, it was also found that the level of IT maturity had no significant relationship with the degree of satisfaction with the adoption of B2BEC. This had revealed that the use of IT evaluation methodologies had a mediating role between the level of IT maturity and B2BEC adoption satisfaction.

The findings have some implications for senior managers. The IT investment evaluation and benefits realization methodologies have a direct bearing on the B2BEC adoption satisfaction since understanding and measuring the IT investments in B2BEC has a positive impact on the degree of satisfaction since stakeholders realize the value being delivered by their B2BEC systems. Therefore, it is necessary for senior managers to ensure that these evaluation processes are fully understood and properly carried out. Alternatively, if organizations are not in a position to properly carry out these evaluation processes, more should be done to improve the level of IT maturity. Higher levels of IT maturity will enhance organizations' ability and willingness to undertake evaluation processes which will, in turn have a direct positive impact on B2BEC adoption satisfaction. In light of the recent interest in IT investments in B2BEC, it is critical for senior IT managers to exercise greater control and authority over their B2BEC investments and ensure that the required levels of IT maturity and IT evaluation methodologies are appropriate in order to improve their organizational B2BEC adoption satisfaction which will have a great impact on organizational performance and outcomes.

Based on our findings we also recommend that organizations should focus on making IT evaluation processes an integral part of their business management strategy. They should conduct an assessment of the IT available so that features and benefits can be readily identified and matched with the strategic vision of the organization. This can be done, for example, by developing an IT Strategic Impact Grid (Nolan and McFarlan, 2005) to identify how much it relies on IT for operations and competitive edge through B2BEC providing new value-added services and products, and then locate them as defensive or offensive IT users and hence determine appropriate strategic modes for improving their levels of IT maturity and the use of evaluation methodologies. Using this, organizations can further refine their evaluation plans or processes and determine if sufficient B2BEC adoption satisfaction and expected organizational outcomes exist (Ash and Burn, 2003; Nolan and McFarlan, 2005). Therefore, in order to achieve the desired organizational outcomes, organizations can adapt the appropriate organizational culture that is supportive of adopting IT infrastructures and other business management processes (Hackbarth and Kettinger, 2004).

Finally, some limitations in this research also need to be acknowledged. The views expressed in the survey responses are of a single individual from the responding organization and perhaps those interested in the research topic may be more likely to complete and return the questionnaire. Those replying may be more likely to carry out evaluation and be satisfied with their evaluation processes than the average non-respondent. Moreover, our study took place at a particular point in time. Further research could also be conducted to capture opinions of respondents on benefits realization and investment evaluation at various phases of an IT projects life cycle and also in terms of other critical success factors for IT investment evaluation. Alternatively, our study could be replicated in

a few years' time to examine how IT benefit realization and investment evaluation have changed and are being managed in light of new emerging e-commerce technologies.

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