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A MULTIDIMENTSIONAL ASSESSMENT OF THE CONTRIBUTION OF INFORMATION TECHNOLOGY TO FIRM PERFORMANCE[1]

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ABSTRACT

Empirical research on the contribution of IT to firm performance has yielded contradictory and inconclusive findings. Many of these studies used firm-level output, which while useful, provide only a limited understanding of the dynamic process behind the creation and measurement of business value. Process-oriented research has been proposed as a possible solution to this predicament. Using a process-oriented framework proposed by Mooney, Gurbaxani and Kraemer (1995), this study indicates, through structural equation modeling, how the impact of IT on intermediate business processes can be used to measure IT business value.

INTRODUCTION

The contribution of information technology (IT) to firm performance remains a classic issue in the information systems (IS) field stimulating interest among senior executives, chief information officers (CIOs) and IS researchers alike. Despite the uncertainty in recent years surrounding the payback and productivity gains from investment in IT, senior executives and CIOs continue to increase their IT investment. IT investment has accounted for as much as 50% of corporationsí annual capital investment (Kriebel 1989), while a recent

International Data Corporation report (1995) predicts that corporate IT investment will increase from its current 2.5% to 5% of revenues by 2010. Faced with IT investment on this scale, the need for a comprehensive and guiding model of IT business value, defined as the contribution of IT to firm performance, becomes that much more compelling.

In analyzing business value, IS researchers have focused mainly on productivity gains from IT at the firm-level. However, a comprehensive assessment of IT business value encompasses more than measures of economically-derived productivity gains. It calls for a multidimensional assessment involving measures of efficiency and effectiveness, combining behavioral and economic perspectives, with process-level and firm-level measures. This paper contributes to the growing body of business value research by performing a systematic, empirical test of a behavioral-focused measurement model of IT business value, and a preliminary test of the utility of this model for process-level analysis. We begin by reviewing the literature on business value, focusing on economic and behavioral perspectives. We then propose a behavioral and process-oriented approach to the measurement of IT business value and proceed to perform an empirical test of this approach. Finally, we conclude on the appropriateness of our behavioral approach as a mechanism for measuring IT business value.

BUSINESS VALUE LITERATURE

Economic perspectives

The most comprehensive body of research to date on business value is grounded in economic and econometric analyses. Economic perspectives provide useful insights for investigating a range of IT impacts, using established theories of production economics, information processing and industrial organization (Bakos and Kemerer 1992). Although theoretical papers take a broader stance, most empirical studies tend to define IT business value largely in terms of a single dependent variable -- productivity. Unfortunately, the overall findings from this branch of research have been contradictory, thus fueling the debate on the existence of a productivity paradox. Findings have ranged from identifying negative relationships between IT investment and various organizational performance criteria (Berndt and Morrison 1992; Weill 1992; Loveman 1994), to neutral or bi-modal impacts (Cron and Sobol 1983; Strassman 1990; Weill 1992), to suggesting positive and significant returns from IT (Lichtenberg 1993; Barua, Kriebel and Mukhopadhdyay 1995; Brynjolfsson and Hitt 1996; Hitt and Brynjolfsson 1996).

A primary criticism of economic-based studies concerns their limitations in capturing intangible impacts such as improved product and service quality, increased managerial effectiveness, or enhanced customer relations. Furthermore, although economic perspectives offer a high degree of objectivity, they provide limited insights into the dynamic process by which business value is created and, therefore, ultimately measured. As an alternative, a behavioral assessment of IT business value goes some way towards providing these insights, although the subjective nature of the data upon which behavioral analysis is based remains a point of contention.

Organizational and behavioral perspectives

Whereas there is an established body of research founded on economic perspectives, there is a noticeable paucity of business value measures derived from an organizational or behavioral perspective. Nevertheless, perceptual measures of firm performance have appeared (Venkatraman 1989; Chan and Huff 1993; Raymond, ParÈ and Bergeron 1993; Bergeron and Raymond 1995). Despite a perception among researchers that perceptual data is somewhat ìsoftî and subject to exaggeration by the respondent, perceptual measures of firm performance have been shown to correlate highly with objective measures (Dess and Robinson 1984; Venkatraman and Ramanujam 1987).

The use of senior executives as key informants on subjective measures of organizational performance is prevalent in behavioral research. However, the validity and credibility of results obtained from such research is conditional on the ability of the informant to accurately evaluate the performance variables in question—in this study, the contribution of IT to firm performance. Researchers have argued that senior executives are sufficiently knowledgeable to act as key informants in a qualitative assessment of IS success in their own organizations (Dess and Robinson 1984; DeLone and McLean 1992). This argument is based on executives functioning as both direct and indirect consumers of IT. For instance, many executives are end-users of IT who rely heavily on computer-based reports, from which they form their own impressions of the utility of IT (McLean 1979; Rockart and Flannery 1983; Davis and Olson 1985; Kraemer, et. al. 1993). In addition, when participating in decisions addressing investments in IT infrastructure and major applications, executives are exposed to the opinions of their direct reports and business unit executives regarding ITís performance in the organization. Thus, there is justification for believing that senior executives are superior informants in subjectively assessing the contribution of IT to firm performance.

Research on executivesí perceptions of IT has appeared in a number of studies. For example, Parker and Benson (1988) propose that managersí value systems and their interpretation of their organizationsí value systems are central to their judgment of the costs, benefits, and risks associated with IT projects. Broadbent and Weill (1993) posit a relationship between managerial perceptions of the role of IT infrastructure, the perceived value of that infrastructure, and their IT investment biases. Jarvenpaa and Ives (1990) found that a CEOís perceptions and attitudes towards IT and the degree of importance attributed to IT by the CEO, was strongly associated with the organizationís progressive use of IT. Taken together, these studies confirm the importance of executivesí perceptions as indicators of the contribution of IT to organizational goals.

A PROCESS-ORIENTED VIEW OF IT BUSINESS VALUE

Various researchers have indicated the potential benefits from adopting a process-oriented view of business value (Crowston and Treacy 1986; Bakos 1987; Gordon 1989; Kauffman and Weill 1989; Wilson 1993). However, where process-oriented studies have appeared (Banker and Kauffman 1988, 1991; Banker, Kauffman and Morey 1990), their application has centered on specific

technologies thus limiting the generalizability of their findings to other technologies and organizational contexts. These observations led Mooney, Gurbaxani and Kraemer (1995) to develop a process-oriented framework based on the premise that organizations derive business value through the impact of IT on intermediate business processes. This study builds upon that framework.

An important concept which highlights the role of IT in a company's business processes is the value-chain. This divides a corporationís activities into distinct processes necessary for engaging in business activities (Porter and Millar 1991). These include processes such as supplier relations, production, marketing support, and customer relations, as illustrated in Figure 1. Besides being discrete, these processes are also interdependent. Therefore, how well they perform individually and how well they are linked are important determinants of business value. IT creates value for the business by improving individual business processes, or inter-process linkages, or both. For example, when a firm's production schedule is linked to real time sales data and to suppliers' logistics systems, these linkages may not only create production efficiencies but may also markedly improve customer relations through greater responsiveness. In general, the greater the extent to which IT impacts individual business processes and their linkages, the greater the contribution of IT to firm performance.

Insert Figure 1 about here

In an effort to better understand the dimensions of IT business value, Mooney (1996) conducted an extensive review of the practitioner and academic literature. He identified a set of 10 key intermediate business processes where senior executives appear to focus IT resources as a means of achieving organizational goals. These intermediate business processes are: *organizational efficiency*, *organizational effectiveness*, *inter-organizational coordination*, *customer relations*, *supplier relations*, *competitive dynamics*, *marketing support*, *product and service enhancement*, *production economies*, and *business innovation*.[2]

The impact of IT on these intermediate business processes is a potential source of IT business value. Since the intermediate business processes span the value-chain and represent the set of management and operational processes where senior executives are likely to concentrate IT resources, combining these processes into a single model effectively creates an organization-wide IT business value construct. As shown in Figure 2, measuring this construct is equivalent to measuring each of its constituent components. Since each component corresponds to an intermediate business process, each process is in effect an indicator or dimension of the business value construct. Hence, our model of IT business value uses intermediate business process variables as its indicators. The goal of this analysis, therefore, is to test such a model to determine whether measuring the impact of IT on intermediate business processes provides an effective measure of IT business value.

Insert Figure 2 about here

A further goal is to test how process-level interactions influence business value measurement. Value-chain models of organizational processes, such as shown in Figure 1, suggest an ordering of intermediate processes where value created at earlier stages of the value-chain has implications for value-

adding possibilities further down the value-chain. By implication, the impact of IT on a particular process could have downstream effects on the impact of IT on subsequent processes. In effect, there will likely be some degree of interaction between the various processes, as illustrated by the shaded interaction zone in Figure 2. Therefore, not only should we assess the extent to which the impact of IT on individual intermediate business processes provides an overall measure of IT business value, we should also investigate how the interaction of IT impacts between intermediate processes influences IT business value measurement.

METHODOLOGY

Data collection

The data for this study were collected by surveying business executives on their assessment of the contribution of IT to firm performance.[3] Survey packets containing 10 business value questionnaires were mailed to the CIO across 350 Fortune 500 companies during 1995. Each CIO was asked to forward a copy of the survey to key business executives within their firm. The questionnaire asked that individual respondents reply directly to the authors. By soliciting multiple responses from each organization, we sought to avoid problems associated with key respondent bias.

The business value survey contained 56 items. Respondents were asked to rate the extent to which they believed IT contributed to overall firm performance across a broad range of process-level impacts. Respondents were also asked to restrict their responses to realized impacts of IT, rather than expected impacts. Individual survey items were rated using a ten-point Likert scale where 1 indicated ìno realized impactî and 10 indicated ìhigh realized impactî.

Responses were received from 180 executives across 42 corporations. Those responding to the survey ranged in seniority from company president to senior business managers. To check for non-response bias, we compared these 44 corporations with the Fortune 500 for a set of key financial variables reported by Compustat. The results of this analysis indicate that our sample was not biased.

Factor analysis

Instrument validation is essential in empirical research (Straub 1989). Therefore, we used exploratory factor analysis to identify whether the 56 items in our survey instrument were correctly capturing the impact of IT on firm performance for each of the 10 dimensions of business value. A general rule of thumb in exploratory factor analysis is that the ratio of respondents to items should exceed 5 (Nunnally 1978; Gorsuch 1983). However, the fact that the ratio in this study (180:56) fell below the recommended minimum did not preclude the use of factor analysis. Gorsuch (1983: p. 150) advocates using Bartlettís test for the significance of a correlation matrix in instances where the minimum ratio is not achieved. However, as Bartlettís test is highly sensitive to sample size (Knapp and Swoyer 1967), Tabachnick and Fidell (1989: p. 604)

suggest supplementing it with Kaiserís measure of sampling adequacy (MSA). Kaiser and Rice (1974) suggest that the MSA value should be at least 0.60 before proceeding with factor analysis, though realistically it should exceed 0.80 if the results of the factor analysis are to be credible. In this study, Bartlettís test was highly significant (10846.7, $p < 0.001$) while Kaiserís MSA was 0.926. On this basis we felt that it was appropriate to relax the earlier ratio rule and proceed with an exploratory factor analysis.

Insert Table 1 about here

The results of the exploratory factor analysis are shown in Table 1. Our analysis was based on principal component extraction with oblique rotation. This method was premised on our desire to maximize the variance explained while anticipating that some of the factors might be intercorrelated. Seven factors were extracted using the eigenvalue greater than one rule. By examining the factor loadings, the following dimensions were identified: *supplier relations*, *production economies*, *product and service enhancement*, *customer relations*, *marketing support*, *competitive dynamics*, and *efficiency and effectiveness*. Factor loadings were in the range 0.88 to 0.37. Interpreting the factors indicates that our data failed to distinguish between efficiency and effectiveness as both sets of items loaded on the same factor. Finally, the interorganizational coordination dimension was not identified while the business innovation and production economies dimensions loaded together. To the extent that business innovation was operationalized as production-led innovation, we felt that it was appropriate to retain this factor, labeling it production economies.

Validity and reliability

In order to validate a measurement instrument, it must first be subjected to tests of both validity and reliability. In this study, we viewed validity as incorporating content and construct validity. Bollen (1989: p. 185) defines content validity as ìa qualitative type of validity where the domain of a concept is made clear and the analyst judges whether the measures fully represent the domain.î Content validity is achieved by grounding the meaning of a concept in a theoretical definition that reflects past research efforts at exploring the concept under review. Furthermore, each definition should have at least one measured item. Since the 10 dimensions of business value used in this study, and the 56 items used in their measurement, were the result of an extensive literature review, we feel that content validity has been adequately supported.

Construct validity, on the other hand, asks whether a measure relates to other observed variables in a manner consistent with theoretically founded propositions (Bagozzi 1980, Bollen 1989: p. 188). Construct validity refers to the extent to which different constructs are unique and separable from each other. This view has led researchers to subdivide construct validity into two components, convergent and discriminant validity.

Discriminant validity is achieved by testing that the indicators of each dimension load higher on that dimension than on competing dimensions. Convergent validity, as the flip side of discriminant validity, expects that

indicators of a dimension should correlate higher with other indicators of the same dimension than with indicators of different dimensions.

If our measurement instrument is to pass a test of both convergent and discriminant validity, then the shared variance between each 2 factor pairing should be less than the corresponding variance extracted for each factor in turn. When we initially computed these values, we observed that certain items designed to measure customer relations measured efficiency and effectiveness instead, and vice versa.

To identify the specific items that led to the failure of the discriminant validity check, we computed a multi-trait multi-item matrix for the 56 items. Campbell and Fiske (1959) suggest that if discriminant validity is to hold, then an item should not report a higher correlation with other items used in measuring other traits in more than 50 percent of all possible cases. If this limit is exceeded, then the item is deemed to have failed the discriminant validity check and could be removed from further consideration. This technique led us to discard 4 items from the efficiency and effectiveness dimension, 3 items from the customer relations dimension, and 1 item from the production economies dimension.

Having removed the 8 variables that failed the discriminant validity check, we re-ran a factor analysis using principal component extraction with oblique rotation. Bartlettís test and Kaiserís MSA were again used to justify using factor analysis. Once again, 7 factors were extracted using the eigenvalue greater than one criterion. The remaining 48 variables loaded on the same factors as previously. An abbreviated form of the 48 items used to measure IT business value appears in Appendix 1.

Reliability is an assessment of the extent to which a set of items consistently measure a concept. Cronbachís alpha was used to compute the reliability of the items used in measuring each dimension. Reliability estimates ranged from 0.90 to 0.97, clearly surpassing the 0.80 minimum considered necessary for empirical research (Straub 1989).

Structural model specification

Structural equation modeling (SEM) allows the researcher to model relationships between unobserved (latent) variables and observed variables using a combination of factor analysis and multiple regression (Ullman 1996). The theoretical relationships between variables are represented by a series of directed paths. The direction of each path determines whether the observed variables are labeled as either predictors or indicators of the latent variables. The objective of a structural model is to estimate the scale and significance of each path, and provide an indication of the overall ability of the hypothesized model to fit or explain the sample data under review.

Recall that the goal of our study was to test if the impact of IT on intermediate business processes could provide a measure of business value. As previously indicated, our factor analysis yielded 7 dimensions of business value. These dimensions correspond to first order factors. Since we posit that these dimensions are indicators of a higher order latent variable (corresponding to

business value), this is equivalent to a second order confirmatory factor analysis. This, however, would create a very complex model, with 48 items, 7 first order factors and one second order factor. In the interests of interpretability of results, we decided to collapse the items loading on each first order factor into a single composite indicator variable, thereby relegating the status of the business value latent variable to that of a first order factor. Factors were collapsed by averaging the scores on the items within each factor.

To test if there was a single first order factor underlying these composite indicator variables, we factor analyzed the matrix of collapsed factors. Our exploratory analysis found that there was only one eigenvalue greater than 1, explaining 71 percent of the variance. This confirmed that there was a single first order factor underlying the 7 composite indicator variables. This result allowed us to derive the structural model of IT business value shown in Figure 3. The model denotes a confirmatory factor analytic model consisting of a single latent variable (business value) and 7 indicator variables (dimensions of business value). Such models are labeled measurement models in the SEM literature (Bollen 1989: p. 182).

Insert Figure 3 about here

As mentioned in our conceptual discussion, there is a strong theoretical basis for hypothesizing an interaction between certain processes. To provide some preliminary investigation of this notion, we decided to extend our measurement model by incorporating an exploratory set of links, indicative of the links between processes along the value-chain. The set of links suggested for inclusion is given earlier in Figure 1. When combined with the measurement model in Figure 3, we derived a Value-Chain Model of IT Business Value shown in Figure 4.

It is important to note that a test of the Value-chain model is still a test that business value can be measured using the same dimensions of business value given under the measurement model. However, by linking processes on an experimental basis, we hope to explore whether this type of process model provides a better means of measuring IT business value than if each process was simply viewed in isolation.

Insert Figure 4 about here

With 7 variances and 21 covariances, 14 parameters were estimated in the measurement model (7 path estimates and 7 error term variances) returning 14 degrees of freedom. The ratio of 180 respondents to 14 estimated parameters clearly meets the recommendation given by Bentler and Chou (1987) who advocate a sample size to estimated parameter ratio of 5 to 1, under assumptions of normality. Similarly, the Value-chain model returns an acceptable ratio of 180 respondents to 18 estimated parameters. The software used to estimate the adequacy of both measurement and Value-chain models was EQS v6.0 (Bentler 1995). To allow the reader to reproduce our analysis, Table 2 contains the correlation matrix, and other useful descriptive statistics.

Insert Table 2 about here

RESULTS

Testing for multivariate normality

A preliminary analysis of our data yielded evidence of multivariate non-normality (Mardiaís normalized coefficient was 13.3, while a rule of thumb for multivariate normality would suggest a normalized coefficient of 3). Non-normality may be explained by the presence of outliers or data that follow a different distribution than the normal distribution. A cursory search for significant outliers failed to remove any observations from our data. For this reason, our models used robust maximum likelihood estimation. The use of robust estimation gives standard errors that are correct where distributional assumptions surrounding the data are unspecified (Bentler and Dijkstra 1985). Bentler (1995: pp. 47-48) states that ì[robust statistics] perform better than uncorrected statistics where the normal distribution assumption is false.î In addition to corrected standard errors, robust estimation in EQS also reports the Satorra-Bentler scaled test statistic. This test statistic produces a distribution that is better approximated by a χ^2 distribution than a test statistic reported under conditions of non-normality (Satorra and Bentler 1988, 1994; Bentler 1995).

Fit statistics

The results obtained for both measurement and Value-chain models are given in Table 3. We report a menu of fit statistics on the basis that there is little consensus as to what constitutes the best index of overall model fit in SEM (Bollen 1989; Marsh, Balla and McDonald 1988; Tanaka 1993, Hoyle and Panter 1995). Issues such as sample size and model complexity are known to impact differently on certain fit statistics (Browne and Cudeck 1993; Gerbing and Anderson 1993; Tanaka 1993). Therefore, if a model is to be seen as an adequate representation of the data, some convergence across several fit indices would be expected.

Insert Table 3 about here

Although the χ^2 statistic and scaled χ^2 statistic for the measurement model are statistically significant ($p<0.001$), suggesting poor model fit to the data, the model does have some merit as the NFI, CFI and IFI indices are above their suggested minimum fit values. Furthermore as shown in Table 4, the path estimates for all 7 dimensions are statistically significant. Therefore, in the context of a confirmatory factor analytic model, there is evidence to suggest that the intermediate business processes underlying the 7 dimensions of business value provide an effective measure of the latent IT business value construct.

The Value-Chain model consistently yields better fit statistics than those reported for the measurement model. Each fit criterion is within the suggested cut-off range and, in certain respects suggest, that the Value-Chain model is ìnear perfectî. Since the Value-Chain model is a derivative of the measurement model (4 additional paths were added to the measurement model to produce the Value-Chain model), we performed a χ^2 difference test between the two models using both the standard and scaled χ^2 statistics. Each difference was found to be significant at $p<0.001$. This indicates that the inclusion of the 4 additional paths in the Value-Chain model prove highly significant and worthwhile from the point of view of business value measurement. Further

analysis indicates that omitting any one of the 4 paths leads to a significant reduction in the degree of model fit.

These results enable us to conclude that the impact of IT on intermediate business processes serves as an effective measure of IT business value. In particular, our exploratory Value-Chain model indicates that there is some empirical justification for linking individual processes or dimensions as a means of enhancing our ability to measure IT business value.

DISCUSSION

Parsimony in model estimation

Chin and Todd (1995) identify a temptation inherent in SEM to use modification indices to force a better fitting model in defiance of theoretical considerations or the need for a parsimonious model. Modification indices, as reported in SEM software such as EQS or LISREL, suggest inserting paths into, or deleting paths from the model, the objective being merely to improve the overall model fit. MacCallum, Roznowski, and Necowitz (1992) cast doubt upon the generalizability of models that rely heavily on modification indices. They suggest that as ìthis [modification] process is data driven, it is inherently susceptible to capitalization on chance characteristics of the data, thus raising the question of whether model modifications generalize to other samples or to the populationî (p. 490). Thus, allowing the data to drive the model will complicate the model and only hinder its generalizability (Blalock 1964).

Consistent with these views, our analytical approach was strictly driven by theoretical considerations rather than allowing the data to drive our analysis. Thus, for the purposes of this study, we concentrated only on those paths suggested by the value-chain (Figure 1).

Model interpretation

Researchers using SEM techniques are on occasion inclined to accept their models purely on the basis of fit statistics alone. In such cases, failure to examine and interpret the path or parameter estimates (equivalent to regression coefficients) could lead the researcher to misinterpret the underlying model.

Insert Table 4 about here

Table 4 indicates the total effect parameter estimates for both models. The total effects reported for each model are statistically significant, indicating that each of the 7 dimensions is an integral component or indicator of IT business value. Although, there would appear to be no significant differences between the total effects across both models, a deeper analysis provides some interesting comparisons. Recall that the original purpose behind constructing the Value-chain model was to test if incorporating a degree of process interaction would improve our overall ability to measure business value. This was accomplished by linking certain variables in the measurement model. The variables in question were supplier relations, production economics, marketing support and customer relations.

We have already argued that the impact of IT on upstream variables can cascade downstream into subsequent processes. As a result, downstream variables could become better indicators of business value since they could inherit some of the impacts of IT from previous processes. Partial support for this notion is provided by the mean scores reported for the value-chain variables, which increase as we move down the value-chain -- supplier relations (4.75), production economics (5.385) and customer relations (5.881). The

results reported in Table 4 provide further support as there is an increase in the total effects for the downstream variables included in the Value-chain model over those reported for the measurement model; production economics increases from 1.594 to 1.676, marketing support increases from 1.541 to 1.578, while customer relations increases from 1.418 to 1.465. Thus by allowing upstream processes to influence downstream processes, there is a corresponding increase in the contribution of those downstream processes to business value.

In conclusion, this exploratory exercise yields further evidence that the impact of IT on intermediate business processes can be used to measure IT business value. However, we emphasize the exploratory nature of this aspect of our study since our survey instrument was designed to measure the impact of IT on intermediate business processes, rather than the extent to which IT impacts carry into other processes. Nevertheless, we find these results both interesting and deserving of further research.

CONCLUSION

This study of IT business value was founded on executivesí perception of the contribution of IT to firm performance. Previous research had indicated that executives play a key role in determining resource allocation in pursuit of organizational goals, and that their perceptions of IT closely mirror both the extent to which IT resources are used and their satisfaction with the performance of those resources. Therefore, we posited that an important component of executiveís perceptions would be their assessment of the realized or historical contribution of IT to firm performance. We further believe that executives can distinguish this contribution along multiple dimensions corresponding to the business processes through which a firm creates value.

We examined this proposition by assessing the degree to which executive perceptions of the impact of IT on intermediate business processes could serve as a measure of IT business value, and by investigating how process-level interactions could influence this measure. Towards this end, two structural equation models were developed and tested.

Our findings suggest that the contribution of IT to firm performance can be measured across intermediate business processes where organizations have traditionally focused IT resources as a means of accomplishing business goals. By considering IT business value as a holistic construct, we can begin to disaggregate its measurement into distinct components or dimensions corresponding to intermediate business processes. Executivesí perceptions of the impact of IT on such processes provide a means for measuring IT business value since these perceptions clearly mirror the degree to which IT enables the organization to accomplish its goals.

Using the value-chain as an example of how business processes interact, we were able to extend our basic model. In testing this model, we found further evidence to suggest that the impact of IT on intermediate business processes can act as a measure of business value, besides finding that our ability to measure IT business value was enhanced. We also found evidence to support

Porter and Millarís (1991) claim that an important source of IT-supported value-added is support for coordination between value-adding activities.

We hope that IS researchers will look upon this study as providing preliminary evidence of the multidimensional nature of IT business value, and will adopt this approach as a starting point from which to continue IT business value research.

ACKNOWLEDGMENTS

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Table 1. Factor analysis results

Factors Extracted / Dimensions Identified	Eigenvalue	Cumulative Proportion of Variance Explained	# items
Competitive Dynamics	31.077	55.5	7
Supplier Relations	3.138	61.1	7
Marketing Support	2.916	66.3	10
Efficiency and Effectiveness	2.269	70.4	11
Product and Service Enhancement	1.181	73.6	6
Customer Relations	1.393	76.1	7
Production Economies	1.130	78.1	8

Table 2. Correlation matrix and descriptive statistics

Correlation Matrix*	Items**	1.	2.	3.	4.	5.	6.	7.
1. Supplier Relations	7	1.000						
2. Production Economies	7(8)	0.586	1.000					
3. Marketing Support	10	0.674	0.698	1.000				
4. Customer Relations	4(7)	0.634	0.627	0.580	1.000			
5. Product & Service Enhancement	6	0.596	0.802	0.716	0.615	1.000		
6. Competitive Dynamics	7	0.649	0.772	0.714	0.691	0.717	1.000	
7. Efficiency and Effectiveness	7(11)	0.623	0.656	0.630	0.658	0.607	0.642	1.000
Mean		4.750	5.385	4.499	5.881	4.898	5.097	6.056
Standard Deviation		1.693	1.831	1.873	1.861	1.974	1.856	1.656
Kurtosis		0.101	-0.049	-0.224	-0.229	-0.517	-0.191	-0.097
Skewness		0.170	-0.283	0.298	-0.340	-0.011	-0.044	-0.332

* $N = 180$. All correlations are significant at $p < 0.01$.

** The value in brackets indicates the number of items loading on each dimension before items were removed for violation of convergent and discriminant validity.
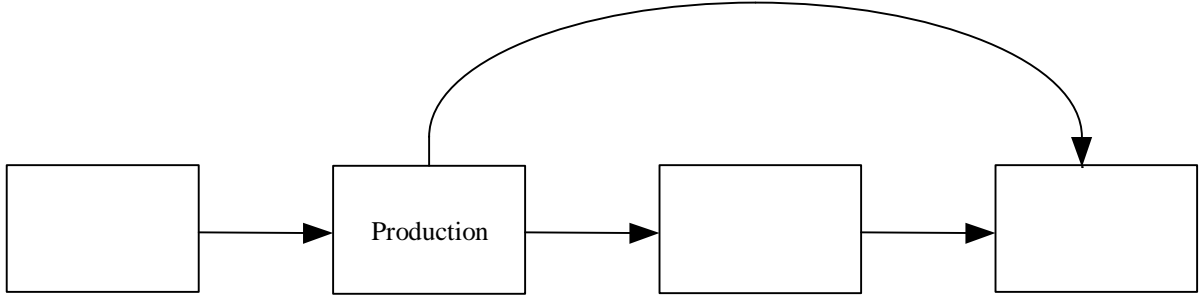
Table 3. Results of estimating measurement and value-chain models

Overall Model Fit Statistics	Suggested For Good Fit	Measurement Model (Figure 3)	Value-chain Model (Figure 4)
χ^2 (df)	$p > 0.05$[1]	50.787 (14), $p<0.001$	15.054 (10), $p = 0.13$
Satorra-Bentler Scaled χ^2 (df)	$p > 0.05$[#]	33.239 (14), $p = 0.003$	9.698 (10), $p = 0.467$
Bentler-Bonett Normed Fit Index (NFI)	≥ 0.90[2]	0.947	0.984
Comparative Fit Index (CFI)	≥ 0.90[#]	0.96	0.995
Goodness-of-Fit Index (GFI)	≥ 0.95[#]	0.923	0.976
Root Mean Sqr. Error of Approx. (RMSEA)	$= 0.05$[3]	0.121	0.05
Bollen's Incremental Fit Index (IFI)	≥ 0.95[4]	0.961	0.995

\# Denotes the minimum fit criteria (rule of thumb) imposed by the authors for the purposes of this study.

1. Bentler (1995: p. 93)   3. Browne and Cudeck (1993: p. 144)

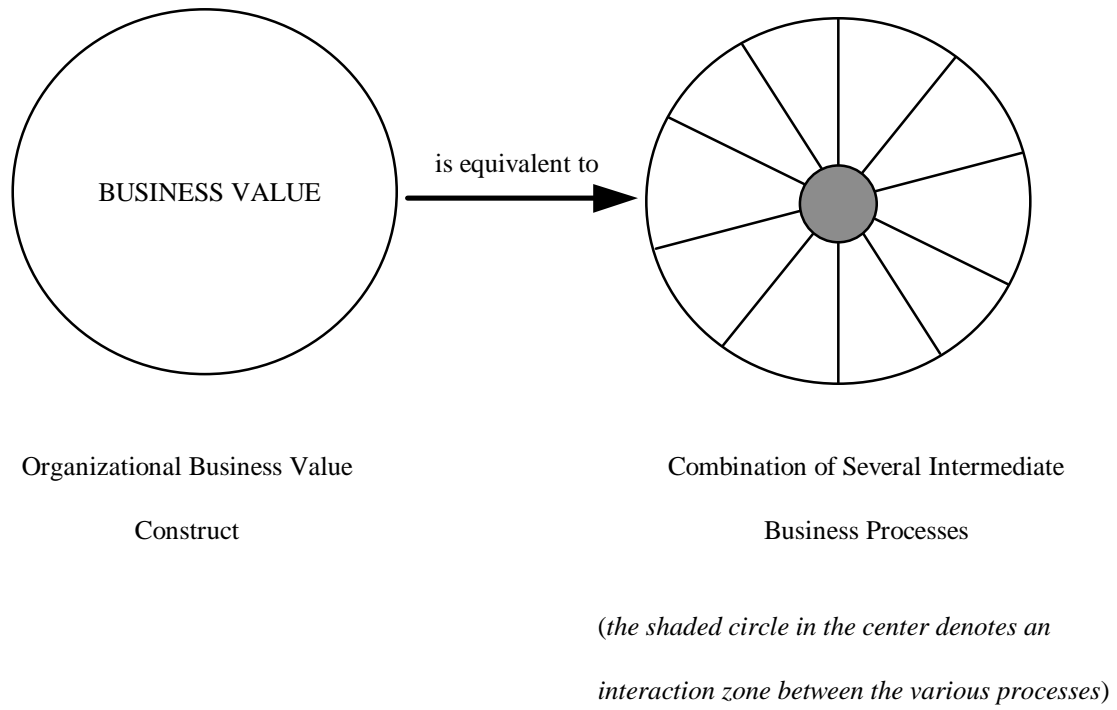2. Bentler and Bonett (1980: p. 600)   4. Bearden, Sharma and Teel (1992: p. 429)

Table 4. Parameter estimates for measurement and value-chain models

Total Effect Parameter Estimates*	Measurement Model (Figure 3)	Value-chain Model (Figure 4)
Supplier Relations	1.267	1.263
Production Economies	1.594	1.676
Marketing Support	1.541	1.578
Customer Relations	1.418	1.465
Product and Service Enhancement	1.675	1.664
Competitive Dynamics	1.613	1.583
Efficiency and Effectiveness	1.264	1.248

* total effect parameter estimates are significant at $p < 0.001$ (*based on Robust Maximum Likelihood estimation*)
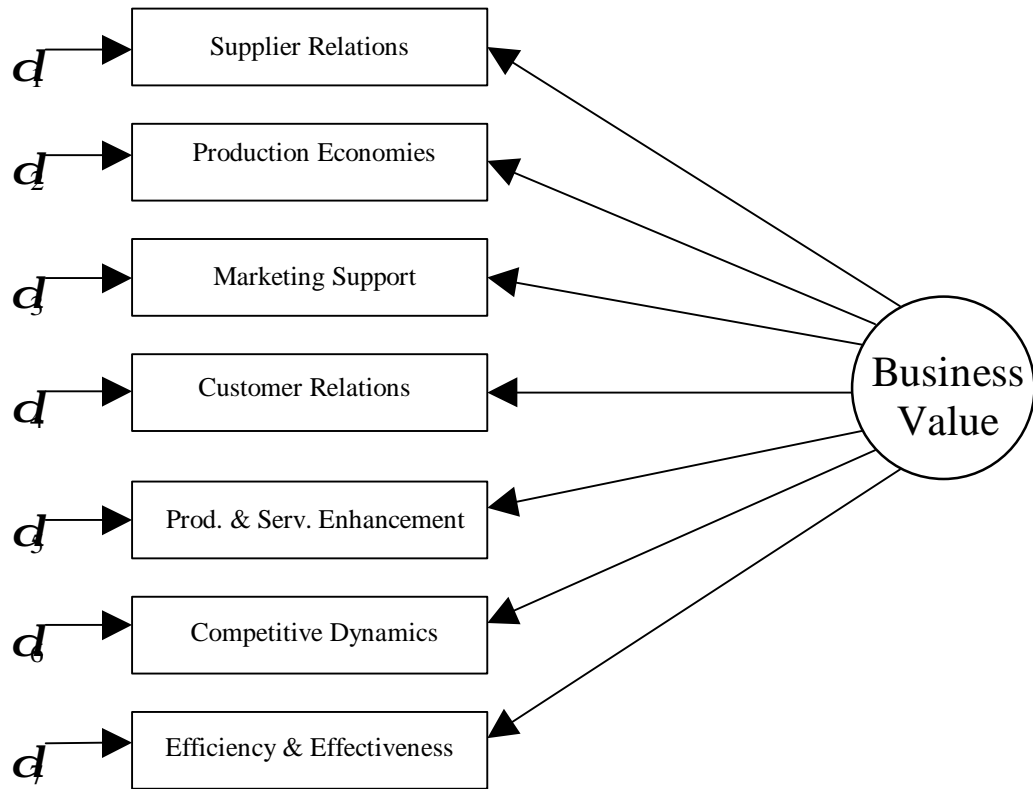
Figure 1. A typical representation of the value-chain

BUSINESS VALUE   is equivalent to

Organizational Business Value

Construct

Combination of Several Intermediate

Business Processes

(*the shaded circle in the center denotes an*

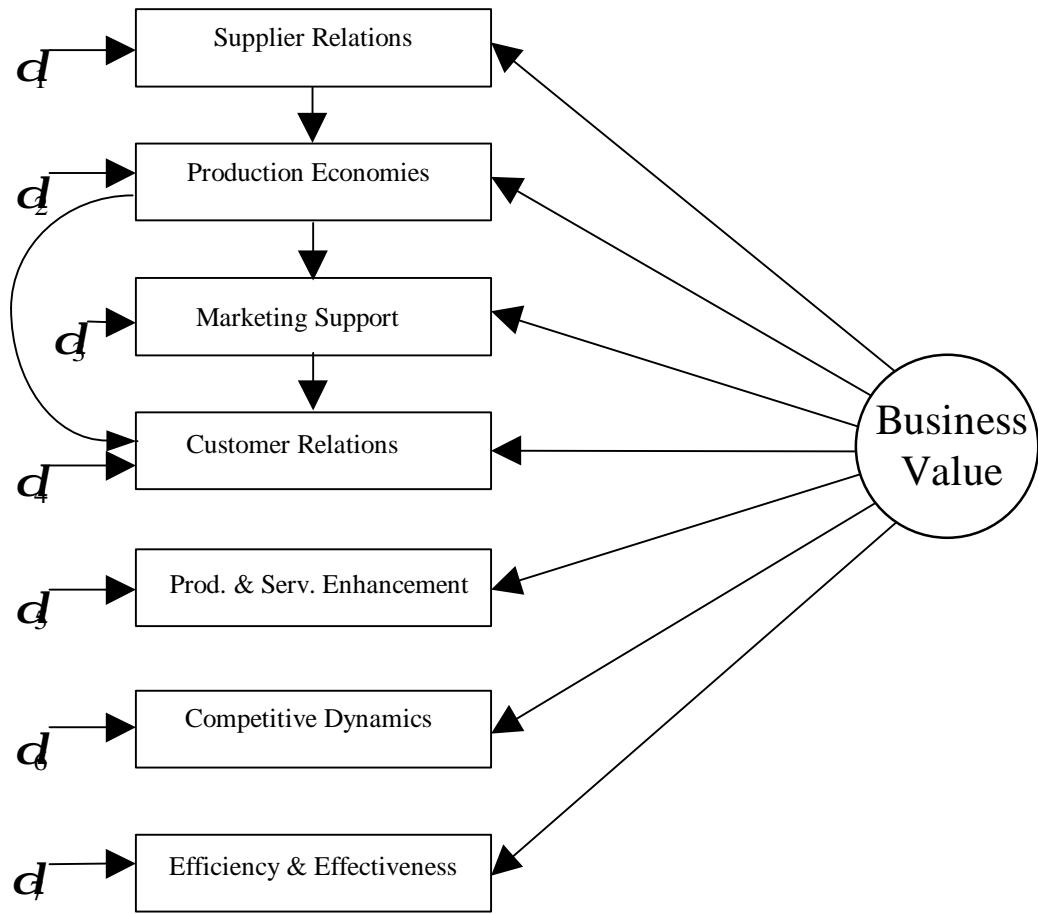*interaction zone between the various processes*)

Figure 2. Business value as a combination of intermediate business processes

Figure 3. Measurement model of IT business value

Figure 4. Value-chain model of IT business value

APPENDIX 1. Items used to measure IT business value

Supplier Relations

- Help to enlarge your corporation's geographic market area
- Help your corporation coordinate closely with its suppliers
- Reduce transaction costs by making it easier for suppliers to handle orders
- Help to reduce variance in supplier lead times
- Enhance the ability to monitor the quality of products/services received from suppliers
- Facilitate the development of close relationships with suppliers
- Help your corporation to gain leverage over its suppliers

Production Economies

- Reduce variance and uncertainty in product/service quality
- Improve the levels of production or throughput
- Reduce the level of production/service delivery required for economies of scale
- Improve the utilization of machinery
- Improve the productivity of labor through automation
- Make new areas of business technologically feasible for your corporation
- Enhance the creative capacity of your corporation through support for collaboration

Marketing Support

- Provide support for identifying market trends through powerful analytical tools
- Assist your corporation in serving new market segments
- Enhance the accuracy of sales forecasts
- Increase your corporation's effectiveness in locating new markets
- Increase your corporation's ability to anticipate customer needs
- Help to track market response to pricing strategies
- Track market response to discounts
- Track market response to promotional or introductory pricing
- Facilitate targeted response to customer's pricing strategies
- Improve the effectiveness of your corporation's research and development activities

Customer Relations

- Enable your corporation to provide administrative support to customers
- Facilitate a higher level of flexibility and responsiveness to customer needs
- Facilitate the development of detailed customer databases
- Position customers to rely increasingly on your corporation's electronic support systems

Product and Service Enhancement

- Reduce the development time for new products/services
- Reduce the time to market for new products/services
- Reduce the cycle time for development of new products/services
- Facilitate the tailoring of products/services to individual market segments
- Reduce the cost of designing new products/services
- Reduce the production cost of tailoring products/services to market segments

Competitive Dynamics

- Increase your corporation's market share

- Support your corporation in offering a product/service that your competitors cannot immediately match
- Help your corporation to provide substitutes for your competitors' products/services
- Help to delay competitor entry into your corporation's product/service areas because of new investments required in information technology
- Make it easier to capture distribution channels and thereby increase the cost and difficulty for competitors to enter a new or existing market segment
- Provide your corporation with unique opportunities for product and service innovation
- Enhance the value of products/services by becoming a part of these products/services

Organizational Efficiency and Effectiveness

- Improve the process and content of decision making
- Improve internal communication within your corporation
- Facilitate the automation of core business processes
- Provide better coordination among functional areas in your corporation
- Facilitate implementing new processes that constitute a better way of doing business
- Improve coordination among geographically separate units of your corporation
- Enhance the reliability of value chain linkages through integration of IT systems

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[1] A later version of this paper is available on request from the first author.

[2] The theoretical and empirical basis for each of these business processes is described in Mooney (1996). However, to aid the reader's understanding, we include a description of one such discussion here. "*Supplier relationships*: IT-based initiatives can be implemented to tie-in and gain leverage over suppliers or reduce the organization's search costs (McFarlan 1984; Bakos 1991). Suppliers may use IT-based mechanisms for communicating information about their prices and products (Bakos and Kemerer 1992). Total Quality Management and Just-in-Time approaches point clearly to the competitive advantages of close coordination with suppliers which can be achieved through IT (Cash and Konsynski 1985; Srinivasan, Kekre and Mukhopadhyay 1994)."

[3] The executive business value survey is part of the Intercorporate Measurement Program (IMP), a joint project between the Center for Research on Information Technology (CRITO) at the Graduate School of Management, University of California, Irvine, and Computer Sciences Corporation (CSC), Cambridge, Massachusetts. IMP involves an annual survey of IT managers and business executives across Fortune 500 companies on a range of IT value management issues.