

# Evaluating Prospective e-Providers: An Empirical Study

## AUTHORS

Ajay Das

*is a professor of operations management in the Zicklin School of Business at Baruch College in New York, New York.*

Lee Buddress

*is Robert G. Gleason Professor of Supply and Logistics at Portland State University in Portland, Oregon.*

**It has been problematic to evaluate prospective providers prior to actual adoption and use of their technologies and services. This research uses the resource-based view of the firm to identify, prioritize and relate e-provider evaluation criteria and evaluation process factors to user satisfaction levels, using cluster analysis and ANOVA on data**

## SUMMARY

**gathered from 103 companies. The results suggest that firms prioritize intangible evaluation criteria over tangible criteria. Project performance is associated with e-provider performance on intangible evaluation criteria, as well as cross-functional participation in the evaluation process.**

## INTRODUCTION

While academia has conventionally treated supply chain management and information technology (IT) as two distinct streams of research, practitioners have long realized the importance of IT in coordinating and integrating intra- and interorganizational business operations (Shah, Goldstein and Ward 2002). Investments in IT for effective e-business<sup>1</sup> are growing at a rapid pace. For instance, TowerGroup estimates that IT spending for supply chain management will rise from \$30.9 billion in 2004 to \$49.3 billion by 2008 (Garcia 2004). Firms are seeking more sophisticated capabilities and faster time to market, and e-providers<sup>2</sup> are beginning to respond. The market for e-purchasing software, also called spend management or supplier relationship management solutions, is growing at a compound annual growth rate (CAGR) of 10 percent (Bartels 2007). Recognizing these trends, current work in supply chain coordination places emphasis on information flows in addition to material flows (Frolich and Westbrook 2001). IT enables information and activity coordination, leading to tangible benefits in areas as diverse as supply chain forecasting, production scheduling, new product development, procurement, ordering, customer relationship management and inventory location and tracking information (Shah et al. 2002). E-providers of IT\_SCM systems promise these deliverables, and more (Kotzab, Skjoldager and Vinum 2003). However, it has been problematic to evaluate these publicized product benefits before actual adoption and use of the technologies. Reports of losses of revenue and profits have been attributed to ill-designed or under-performing e-business systems, and post hoc complaints from users highlight the need for effective a priori evaluation of offered products. "Many of those purchases proved to be big disappointments . . . [and] often provide little return on investment" (Lavelle, 2002). There is, therefore, a need to a priori identify provider evaluation criteria and

<sup>1</sup>The term e-business is used as a broad description of supply chain management, logistics, ERP, CRM, B2B and B2C electronically transacted commerce (excluding design/payroll/e-mail/HRM software or hardware systems).

<sup>2</sup>The term "e-provider" represents providers of e-business software.

evaluation process factors that can predict post-hoc performance. This study seeks to address this need.

Customer goals and desired capabilities in e-business can vary widely, ranging from simple order and invoice processing to complex goals such as the exchange of technical road maps with core suppliers, design collaboration, graphical interchange, contract bidding and design of supply chain/delivery management processes (Bernstein 2001). E-business, as defined in this paper, adapts two perspectives from Kalakota and Whinston's (1997) definition: an online perspective, which describes e-business as the capability to transact B2B exchanges, and a business process perspective, which presents e-business as the application of technology for business process and workflow automation. Within both of these perspectives, objective measurements of prospective e-provider value have not seen much use. The reason may lie in the paucity of established objective a priori evaluation criteria. Validated routines are lacking for formalizing the strategic and tacit gains expected from e-business investments, including implicit support of business objectives, response to competitor moves and other issues. Users seek suppliers, systems and processes that are stable, secure, available, flexible and scalable, and are based on open standards to enable evolution. Many of these criteria are difficult to quantify, and yet find extensive use in IT package selection and adoption.

This research seeks to identify and prioritize e-provider evaluation criteria from buyers' perspectives. It further investigates how these criteria relate to evidence of achieved performance, using data gathered from e-business projects in more than 100 companies. The objective is to develop a list of critical performance-linked criteria and associated evaluation processes that buyers can use to develop a business case to acquire e-business software or evaluate e-providers more effectively before adoption. The resource-based theory of the firm provides a theoretical underpinning to this work.

The study informs the e-sourcing practice and literature in several ways. It is evident that an identification of critical provider evaluation criteria and process factors would benefit all parties concerned — the organization that develops and markets the software (by providing customer-driven evaluation criteria for product design and marketing), the organization that implements the system for itself (by performing prepurchase product analysis) and an organization trying to understand the evaluation process and advantages of using such technology. Also, disciplinary intersections present interesting scholarly opportunities. Applying the resource-based perspective from strategy literature to the supply management domain provides an improved theoretical understanding of the relationship between provider evaluation criteria and experienced project performance. Finally, the study seeks knowledge in a new realm.

A review of previous research did not find any substantive empirical inquiry on e-provider evaluation criteria or process that was linked to performance outcomes.

The next section reviews the literature on supplier evaluation and selection to develop a backdrop for this inquiry. Subsequent resource-based perspectives of e-provider evaluation criteria and their relative significance culminate in a set of research hypotheses. The section following describes construct operationalization, instrumentation, sampling and methodology choices. The results of the study are presented and discussed next. The paper concludes with a brief recapitulation of the research objectives and findings.

## A REVIEW OF THE PROVIDER EVALUATION LITERATURE

While the term "supply chain management" may have evolved comparatively recently, the core concepts — supplier evaluation and selection — have been a focus of writings as far back as 1832, when Charles Babbage wrote of the "materials man" and the importance of selecting suppliers who could deliver necessary materials. By 1931, standardization, financial stability, capacity, capability, performance record and above all, quality, were noted as essential supplier selection criteria (Davis 1932). More recently, Ellram (1990) studied supplier selection in situations where buyer-supplier relationships are characterized as strategic partnerships. Her case studies identified several broad categories of supplier selection criteria covering financial, organizational and technological dimensions. The "Financial" category included supplier's economic performance and financial stability. The "Organizational Culture and Strategy" category included issues of trust, strategic fit, management attitude and compatibility and organizational structure. "Technology" categorical issues such as capability, both present and future and supplier's speed in development were also reported. A number of other studies have examined supplier selection criteria in diverse settings. For example, Lambert, Adams and Emmelhainz (1997) examined attributes used in the evaluation of suppliers in the healthcare industry. Key selection criteria included product reliability, product performance, supplier technical capability and assistance and product availability. In their study, the resources and capabilities of suppliers and their products ranked ahead of price. In an international study of the electronics industry, product quality, price and supplier performance characteristics were all determined to be of greater influence on supplier selection than any keiretsu-type relationship with potential suppliers. Reciprocity and equity relationships were set aside in favor of supplier resources and performance. This was especially true when purchases were of a nonstandard nature (Hirakubo and Kublin 1998). Vonderembse and Tracey (1999) evaluated buying organization performance in the

context of supplier selection criteria and supplier involvement. These and supplier performance were found to be significantly related to manufacturing performance.

A notable conclusion of the study was that firms should focus on a set of multidimensional supplier evaluation criteria. Elements of supplier selection and assessment were also investigated by Kannan and Tan (2002) where they found that soft, nonquantifiable selection criteria such as the supplier's commitment to the buying organization and the supplier's willingness to share information are greater influences on buying firm performance than more quantifiable criteria such as supplier capability and quality. The study also provided reinforcement for the notion that suppliers and their resources be viewed as extensions of the buying firm.

The literature thus suggests that the supplier evaluation process has been at the core of purchasing activity from the earliest writings on the topic. However, the literature on e-provider evaluation is scant. Ngai and Wat's (2002) review and classification of research in electronic commerce (EC) does not include any study of e-provider evaluation or selection. Conceptual frameworks for evaluating enterprise resources planning (ERP) and other IT projects, and white papers on e-provider evaluation exist but lack empirical validation (Teltumbde 2000; Hutchinson 2001). Studies have been conducted in similar contexts, the closest being ERP project software evaluation. Even so, given the importance of EC and IT in corporate success, the evaluation phase has received remarkably little theoretical or empirical examination in the literature. A few studies are noteworthy: Fitzgerald (1998), Shankarnarayanan (1999) and Teltumbde (2000) variously suggest frameworks and criteria for evaluating ERP project systems and software. Notably missing are subsequent efforts toward the external validation of these frameworks and evaluation factors with field data.

### Provider Evaluation Criteria

Taking the various supplier evaluation criteria of the preceding research collectively, it is worthwhile to sort them into several broad categories and transpose them into the context of this research. Categories of evaluative criteria include availability and implementability, provider credentials, provider technology, risk and cost. Implementability is exactly the notion earlier authors defined as fitness for intended use. Availability is time to roll out and training time. Provider credentials include financial stability, capability and capacity and performance. Provider technology focuses on the proximity of supplier's offerings to state of the art. Risk to the buying organization's continuing operations and cost to the buying organization are the remaining central considerations. Based on the literature and discussions with domain experts, a broad list of strategic and operational evaluation criteria was developed for this research.

These criteria are consistent with those identified as the traditional core elements of the supplier evaluation process. Table I lists the provider evaluation criteria adopted and their corresponding sources.

An elaboration follows:

**Strategic Fit:** The scope of e-business extends beyond operational issues to its strategic impact on the competitive position of the firm. It is important for the company to identify specific strategic needs that e-business application can satisfy, and confirm compatibility and support from the e-provider in these goals. Too often, software becomes "bloatware" redundant with functionalities that the user may never find or use. Understanding business needs and ensuring that the nature of the need is shared with the prospective e-provider is essential. Strategic fit therefore represents a principal criterion for prospective e-provider evaluation.

**Implementability:** Besides strategic fit, issues of functional fit also become relevant in e-provider evaluation. It is rare to find perfect functionality across all business processes in any one provider. The extent of the match with existing processes, legacy systems, user skills and data protocols of external members of the supply chain are issues for careful consideration. Softer issues such as compatibility with organizational culture, and provider consistency of commitment are more difficult to measure and evaluate, but nonetheless are likely to be important to project success. Roll-out time and user-training time are also conventionally factored into evaluation decisions. "Market liquidity" or the availability of alternate qualified providers for postinstallation services emerged as an important criterion in discussions with industry experts.

**Provider Credentials:** Financial health, including cash burn rate and cash in hand, is an increasingly important factor in e-provider evaluation, heeding the closures and consolidations in the evolving market of e-providers. Earnings provide resources for consistent investments in Research and Development (R&D) and infrastructure. Market share also matters, with weaker firms becoming marginalized or being acquired. Recognizing the lead player in the market is important. Customer references, trust, a good working environment, low turnover of key employees, one-stop services and 24/7 after-sales support can indicate provider commitment, ability and management maturity for the long term.

**Provider Technology:** Technology capability and access rank perhaps as among the most commonly used evaluation criteria for e-provider selection. In existing technologies, features such as scalability, flexibility, data security and clarity of the upgrade path have significant implications for project implementation as well as long-term operation and cost.

Table I

E-PROVIDER EVALUATION CRITERIA				
Criteria	Fitzgerald (1998)	Shankarnarayan (1999)	Teltumbde (2000)	Other <sup>a</sup>
Strategic fit	✓		✓	✓
Availability and implementability	✓	✓	✓	✓
Implementation time				
Product can be supported by other suppliers <sup>b</sup>				
24/7 after sales support <sup>b</sup>				
Match with:				
Legacy systems				
Company culture <sup>b</sup>				
Existing processes				
User skills				
Data protocols of external supply chain members <sup>b</sup>				
Ease of migration path <sup>b</sup>			✓	
Provider credentials				✓
Market share			✓	
Earnings			✓	
R&D			✓	✓
Industry experience			✓	
Key employee turnover <sup>b</sup>			✓	
Trust <sup>b</sup>				
Service record			✓	
1-stop shop <sup>b</sup>			✓	
Customer references				✓
Product Technology	✓	✓	✓	✓
Risk	✓		✓	✓
Range of variability of outcomes				
Possibility of catastrophic loss m <sup>b</sup>				
Adverse impact on company liquidity				
Cost	✓	✓	✓	✓
Purchase				
Integration				
Maintenance				
Training				
Upgrade				
Scalability				
Customization				

<sup>a</sup>Body of literature on supplier evaluation criteria in traditional purchasing environments.

<sup>b</sup>Emerged from discussions with domain experts.

*Risk:* Due diligence on quantifiable facts such as a provider's financial or market or technological profile is necessary. More difficult but equally consequential is the assessment of e-provider risk profile. Variations from time or cost commitments are familiar themes to industry

professionals. As Trepper (1999) notes, about 90 percent of ERP projects show cost or time budget overruns.

*Cost:* With margins under pressure across the board, cost considerations become paramount. It is imperative to establish a total cost structure for provider offerings, with



clear and bounded estimates on implementation cost, integration cost, maintenance costs, training cost and the anticipated costs of scalability, customization and upgrades.

### Project Performance Criteria

While e-providers promise much, there is growing corporate skepticism about the value of IT and EC investments. Brynjolfsson (1993) provides an overview of major concerns, attributing the paucity of factual evidence to four primary reasons: mismeasurement, lags, redistribution and mismanagement. Postimplementation performance provides a measure of true accomplishment, but is confounded by the presence of multiple performance dimensions, increasing the possibility of mismeasurement. Previous research has used metrics such as impact on market share, impact on operations and impact on satisfaction (Ezingeard, Irani and Race 1998; Bartholomew 1999; Marri, Gunasekaran and Grieve 2000; Murphy 2001). To avoid proliferation and maintain clarity in response and analysis, postimplementation e-business project performance was examined in terms of satisfaction metrics, tapping end-consumer satisfaction, user satisfaction and the satisfaction of personnel who participated in the provider evaluation/selection process. Satisfaction ratings from systems users have been used as performance metrics in the past (Raymond 1985; Guinan, Coopriider and Sawyer 1997).

These dimensions of satisfaction were developed in association with domain experts in business and academia, drawing from a variety of literature, research and professional experience.

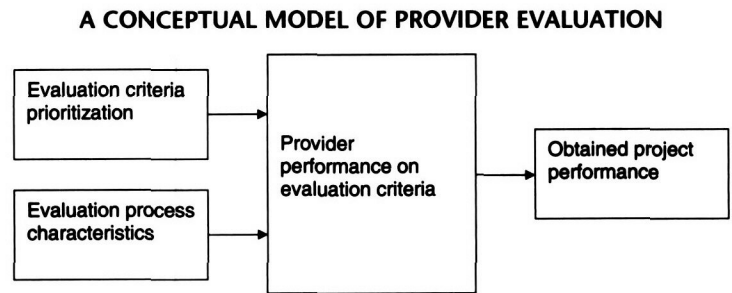
### HYPOTHESIS DEVELOPMENT

Figure 1 shows a conceptual model of the relationship between project evaluation criteria and process elements and project performance. The relationship is mediated by provider performance on these evaluation criteria.

The homological objective is to understand the relationship between a firm's choice of e-provider evaluation criteria and its performance outcomes. The resource-based view (RBV) provides useful theoretical guidance in this regard.

The RBV of the firm is among the seminal frameworks in the strategy literature. Developing from Penrose's (1959) original conceptualization of firms as bundles of heterogeneous resources, later contributors tied the nature of firm-specific resources and their manner of use to firm-specific competitive advantage (Rumelt 1984; Wernerfelt 1984). Further refinements by Barney (1991) and Peteraf (1993) led to the explication of the nature of resources that contribute to competitive advantage — namely, value, rarity, imperfect imitability and imperfect substitutability. The RBV, at the time, implicitly assumed

Figure 1



that rent-generating resources were "owned or controlled by the firm" (Barney 1991; Amit and Schoemaker 1993), satisfying the criteria of resource immobility and imperfect imitability. Suppliers were treated as entities that competed with the firm for a slice of economic rent. The 1990s witnessed a change in this essentially introspective view of the firm, with an expanded focus on the role of external value-network-sourced resources in developing firm-specific capabilities (Gnyawali and Madhavan 2001; McEvily and Marcus 2005). This perspective reasons that the locus of learning and knowledge resides in the network, and not just with the individual firm (Powell, Koput and Smith-Doerr 1996; Dyer and Singh 1998). Access to network resources facilitates individual entity accomplishment. A superior network position can offer improved opportunity to obtain information about network organizations (suppliers), speedier access to resources and early intelligence about environmental opportunities and threats (Powell and Smith-Doerr 1994). Firms that are unable to or choose not to avail of network capabilities may be at a competitive disadvantage, essentially not being able to access the "diversity of knowledge that resides within a network" or benefit from the economic rationales that may advantage external transactions (Powell et al. 1996; Von Hippel 1998; Dyer and Nobeoka 2000).

Consistent with contemporaneous theory, this study considers provider attributes and capabilities as external resources of competitive value that can be identified and accessed by a buyer firm through a careful application of evaluation criteria. There is empirical support for this perspective (Vonderembse and Tracey 1999; Kannan and Tan 2002). Not all provider capabilities, though, would confer advantages to a buyer. A determination of which provider attributes would be valuable (and which would not) underlies an appropriate choice of provider evaluation criteria. The RBV provides grounds for discriminating between provider evaluation criteria, as also predicating the performance effects of provider capabilities on such criteria. E-provider evaluation criteria can probe provider capabilities in multiple dimensions. RBV confers competitive value to a resource only under sustainable

conditions of rarity, imperfect imitability and imperfect mobility. Accessing tangible resources such as a low-cost product or specialized tooling and technology from its supply base may confer competitive advantage to the buying firm, but not on a sustainable basis. Transparency and financial incentive will lead its competitors to imitate and/or bid away these supplier-based tangibles. In contrast, intangible resources such as trust or cultural fit are much more difficult to imitate or acquire. Ramsay (2001), in a perceptive discussion on RBV in purchasing, saliented the value of obtaining intangible resources from the supply base. Provider resources in "intangibles" such as experience, trust, reputation or familiarity with buyer culture and skills therefore are likely to more valuable to a buyer, because these are ambiguous and may require considerable complementarities or historical endowments for rivals (buyers or providers) to replicate. If a buyer can lock in (through contractual and/or relational means) a provider that possesses such intangible resources, it would, in theory, enjoy performance differentials over its competitors. Analogously, provider capabilities that are relatively "tangible" such as purchase price, training or maintenance costs and product technology would arguably represent a lower value to a buyer, being conceivably more transparent and easier for others to acquire or imitate. For this reason, a distinction is made between provider evaluation criteria that examine intangible versus tangible resources. Table II shows a breakdown of provider evaluation criteria into assessments of tangible and intangible provider resource categories, with brief reasoning for such classifications.

Among intangible evaluation criteria are factors such as match with company culture and user skills, provider experience and reputation for trust, risk profile and integration and customization cost estimates. These factors are, in the main, knowledge based, complex, causally ambiguous and incorporate experiential and learning benefits over an extended period of time. In contrast more tangible criteria involve purchase cost, maintenance cost, upgrade cost, provider market share and earnings and data protocols.

Based on the above reasoning, buyers who prioritize intangible over tangible criteria would enjoy superior project performance (satisfaction). Accordingly:

- H1:** Buyers who experience higher levels of project performance place proportionately more importance on provider evaluation criteria that assess intangible provider resources, relative to criteria that assess tangible provider resources. Implicitly,
- H2:** Buyers who do not experience higher levels of project performance attach similar levels of importance to provider evaluation criteria that assess intangible provider resources as well as tangible provider resources.

And it follows that:

- H3:** Buyers who experience higher levels of project performance place proportionately more importance on provider evaluation criteria that assess intangible provider resources, relative to lower performing buyers.

Since evaluation criteria reside and function within a provider assessment process:

- H4:** Buyers who experience higher levels of project performance use higher levels of due diligence in their provider evaluation process relative to lower-performing buyers.

The above hypotheses enclose a mediating hypothesis: it is evident that selecting and using evaluation criteria to discriminate between potential providers cannot directly affect project performance in itself. The provider eventually chosen has to actually perform well on prioritized criteria to enable satisfactory project performance outcomes. Therefore:

- H5:** Buyers who experience higher levels of project performance obtain higher levels of provider performance on intangible criteria relative to lower performing buyers.

## METHODOLOGY

### Survey Design and Data Collection

Published material in leading industry research reports (Forrester, Gartner, IDC, etc.), magazines and other industry publications was searched to identify the types of information systems and technologies in use and to locate metrics used to quantify and/or measure the benefits of e-business. A preliminary survey instrument was developed based on the information collected in the above exercise. The instrument was pretested among domain experts in academia and industry. Triangulation was used in tests of the survey instrument with senior personnel during several site visits. Interviews were conducted separately with academic and professional experts, followed by written responses to draft questionnaires. Except for percentage metrics, all item measures were measured on a "very low-very high" Likert scale. The sample frame for final survey administration consisted of about 1,000 CIOs/senior executives potentially involved in e-provider evaluation decisions. The final frame was drawn from a commercial mailing list purchased for the study, which was cross checked with other available databases (APICS, CSCMP and ISM). Primary field data collection was conducted through a combination of mail surveys,<sup>3</sup> phone calls, faxes and e-mail Web-based surveys. A total of 103 usable responses were received, representing a response rate of slightly in excess of 10 percent (around 15 percent if undeliverables are excluded).

<sup>3</sup>Final instrument details are available on request from the corresponding author.

Table II

## EVALUATION CRITERIA CLASSIFICATION

Criteria	Relatively Intangible	Relatively Tangible	Details
Strategic fit			Provider ability to understand business needs — requires a deep insight into buyers operations and goals. An ambiguous, time-dependent and valuable resource
Availability and implementability	✓		Reflects provider ability to assess client needs and own capabilities credibly
Implementation time		✓	Technical functionality
Product can be supported by other suppliers		✓	Personnel and equipment availability
24/7 aftersales support			
Match with			
Legacy systems		✓	Technical functionality
Company culture	✓		Provider ability to understand and develop a fit with buyer organizational culture — a “soft” capability
Existing processes		✓	Product functionality
User skills	✓		Provider ability to understand and measure user skill levels and design accordingly
Data protocols of external supply chain members		✓	Technical functionality
Ease of migration path	✓		Linked to understanding of user skills, organizational culture and technical compatibility
Provider credentials			
Market share		✓	Quantitative marketing financial
Earnings		✓	Quantitative financial
R&D		✓	Quantitative financial (% of sales, etc.)
Industry experience	✓		Represents accumulated learning and knowledge, resistant to easy replication
Key employee turnover	✓		Reflects knowledge depth and retention ability
Trust	✓		Reputation for faith and consistency of commitment - ambiguous and time dependent.
Service record		✓	From stored data
1-stop shop		✓	Completeness of product package
Customer references	✓		Reflects consistency of commitment, trust, competence — develops over time
Product Technology		✓	Technical functionality
Risk			
Range of variability of outcomes	✓		Accurate a priori assessment difficult for all three criteria — a low-risk provider profile
Possibility of catastrophic loss	✓		represents strong capabilities in risk identification and management
Adverse impact on company liquidity	✓		

Table II

EVALUATION CRITERIA CLASSIFICATION			
Criteria	Relatively Intangible	Relatively Tangible	Details
Cost	✓	✓	Quantitative. Relatively imitable
Purchase Integration	✓		Difficult to estimate — reflects considerable provider capability in combining ambiguous inter- and intraorganizational elements
Maintenance		✓	Provider product based
Training		✓	Quantitative
Upgrade		✓	Technical functionality
Scalability		✓	Technical functionality
Customization	✓		Provider capability that demands agility and requires substantial knowledge about how to access and meet customer needs and agility — develops over time

The IT profession currently has an extraordinarily high rate of personnel attrition). Considering the extreme difficulty of obtaining field data in quantity, the response rate was considered to be reasonable. Similar studies were generally case-based or focused on a few companies (Ezingard, Irani and Race 1998; Marri et al. 2000; Tel-tumbde 2000). Table III provides a respondent profile.

The respondents were mainly drawn from senior executives with IT, software, Web, systems, logistics and business system responsibilities. Firms represented the software, IT, industrial manufacturing, consumer products and logistics industries, strengthening the external validity of the responses. In a single-respondent situation, senior positions connote greater accuracy and reliability of response adding credence to the reliability of the data (Philips 1981). Providing added credence and authenticity was the fact that a majority of respondents had over 5 years of experience with their present company and considered e-business an important part of their business plans.

**Data Analysis and Results**

The research goal was to identify and prioritize e-provider evaluation criteria and examine how these criteria relate to performance. Accordingly, data analysis followed a three-step approach: initially clustering respondents into high and low user project satisfaction groups, and then comparing within- and across-group means and a range of intangible and tangible evaluation criteria. The third step was identifying evaluation criteria that relate to satisfaction. The data were submitted to a hierarchical cluster analysis (Ward’s method, Euclidean distance), using end-consumer satisfaction, user satisfaction and participating personnel satisfaction as the clustering variables. A two-cluster solution was retained, based on an examination of incremental changes in the agglomeration coefficient values. The two-cluster solution was retested using K-means clustering with satisfactory results (Ketchen and Shook 1996). Criterion-related validity was examined and confirmed using performance variables not used in defining the clusters. Table IV shows the cluster profiles and the results of the criterion-related validity tests.

To test whether high-satisfaction projects prioritize intangible criteria over tangible criteria (H1), we examined the mean importance of criteria in that cluster as shown in Table V.

Table V shows that out of the 14 intangible criteria of a total of 30 criteria, five found mention in the top six criteria (top 20 percent of 30 criteria) in terms of importance in the evaluation process. In other words, even though intangible criteria represented just 47% of all criteria, a disproportionate share of such intangible criteria (83%) was considered to be of primary importance. The data thus support the first hypothesis: projects with



Table III

RESPONDENT PROFILE							
Number of respondents: 103							
Respondent Titles	CEO	VP	Director	CIO/GM	Manager Missing		
Number (%)	7	23	24	7	26	18	
Industry coverage	Software and IT	Industrial manufacture and mining	Consumer products	Publishing	Financial	Logistics	Other
% Valid response	21	27	16	10	4	12	10
Annual sales (\$):	< 50m (million)	51–100 m	101–500 m	501 m–1b (billion)	1.01b–5b	5.01b–10b	> 10b
% Valid response	10.1	9.0	20.2	19.1	31.5	5.6	4.5
Respondents year in company	< 1 year 5.6%	1–2 years 15.7%	3–5 years 21.3%	> 5 years 57.3%			
Importance of e-business to company	Not important 5.4%	Somewhat important 36.6%	Very important 44.1%	Critical 14%			
E-business project size for which data are provided	< \$.10m (million) 21.5%	\$.11–.50 m 19%	\$.51–1.0 m 13.9%	\$1–\$5 m 30.4%	> \$5 m 15.2%		

high performance and satisfaction place commensurately more importance on intangible provider evaluation criteria relative to tangible criteria.

A similar analysis of criterion means was conducted within the low-satisfaction cluster of firms to examine our second hypothesis, namely that projects experiencing lower satisfaction consider both intangible and tangible evaluation criteria to be of a similar value. Table IV reports the findings.

A higher proportion of intangible criteria were reported to be of greater importance relative to tangible criteria.

Four of the 14 intangible criteria from the total of 30 criteria appeared in the top 20 percent in terms of evaluation criteria importance. The data thus did not support H2.

The third hypothesis anticipated that high-satisfaction projects place proportionately more importance on intangible evaluation criteria relative to their low-satisfaction counterparts. A comparison of Tables V and VI shows that H3 is not supported by the data — the intangible criteria that led in importance for the high-satisfaction cluster were essentially identical in

Table IV

RESULTS OF CLUSTER ANALYSIS			
Cluster	Clustering Variables <sup>a</sup>		
	End-Consumer Satisfaction	User Satisfaction	Participating Personnel Satisfaction
1 (n=24)	2.71 <sup>b</sup>	3.21	2.79
2 (n=57)	4.23	4.35	4.12
	Criterion (performance) Variables <sup>c</sup>		
	Create new Markets	Reduce Time to Market	Reduce Order Fulfillment Time
1	2.43	2.61	2.74
2	2.61	3.29	4.00
Significance of difference in means	0.012	0.034	0.000

<sup>a</sup>Criteria measures that define the theoretical differences between anticipated groups and are used to develop groups (clusters).

<sup>b</sup>"1 very low — 5 very high" scale for all clustering and performance variables.

<sup>c</sup>Performance variables that are, in theory, expected to differ among defined clusters (besides the clustering criteria themselves).

Table V

## RELATIVE IMPORTANCE OF EVALUATION CRITERIA — HIGH-SATISFACTION CLUSTER

Criteria	N	Mean	Standard Deviation
Product technology	56	4.41	0.682
Strategic fit	56	4.39	0.846
Service track record	57	4.21	0.818
Customer references	55	4.18	0.696
Trust	55	4.16	0.856
Implementation time	55	4.05	0.731
Ease of immigration path	55	4.00	0.694
Industry experience	55	4.00	0.882
Low maintenance cost	55	3.91	0.752
Low scalability cost	55	3.85	0.951
Low integration cost	55	3.84	0.834
Low customization cost	55	3.76	0.744
24/7 after-sales support	55	3.76	1.071
Low upgrade cost	55	3.75	0.844
Low training cost	55	3.71	0.896
Match with user skills	55	3.65	0.927
Range of variability in outcomes	55	3.65	0.927
Match with legacy systems	55	3.65	1.158
Low purchase cost	54	3.59	0.981
Possibility of catastrophic loss	55	3.58	1.197
1-stop provider	56	3.57	0.871
Match with data protocols of external supply chain members	55	3.49	1.069
Match with company culture	55	3.45	0.919
Match with existing processes	55	3.38	0.913
Provider's product can be supported by other companies after install	53	3.34	1.073
Adverse impact on company liquidity	53	3.34	1.176
R&D investment	53	3.28	1.007
Market share	57	3.23	1.118
Earnings profile	57	3.16	0.996
Low key employee turnover	55	2.98	1.080

magnitude and nature to those identified as high priority by the low-satisfaction cluster.

H4 expected that firms in the high-satisfaction cluster use greater due diligence in their provider evaluation process compared with the low-satisfaction group. Table VII reports the mean scores of both groups on four different measures of evaluation process diligence and rigor.

The only aspect where the groups differed statistically was in the greater use of cross-functional participation in the evaluation process by high-satisfaction firms. The absolute difference in means was not remarkable (3.89

versus 3.29 on a 1–5 scale). H4 thus lacked substantive support from the data. Evidently, evaluation process rigor may not be a strong discriminator of buyer/user satisfaction, although the general degree of attention and diligence was uniformly quite high across both low- and high-satisfaction groups (means ranged from 3.29 to 3.89 on a 1–5 scale).

The final hypothesis stated that provider performance on intangible evaluation criteria is higher for high-satisfaction projects relative to the low-satisfaction group. ANOVA results generally support the hypothesis. Table VIII provides more details in this regard.

Table VI

RELATIVE IMPORTANCE OF EVALUATION CRITERIA — LOW SATISFACTION CLUSTER			
Criteria	N	Mean	Standard Deviation
Service track record	24	4.50	0.590
Product technology	24	4.42	0.654
Customer references	24	4.42	0.584
Strategic fit	24	4.25	0.676
Trust	23	4.13	0.626
Low customization cost	24	3.92	0.717
24/7 after-sales support	23	3.91	0.733
Implementation time	24	3.88	1.076
Industry experience	24	3.88	0.797
Ease of migration path	24	3.79	0.932
Low scalability cost	24	3.75	0.737
Low integration cost	24	3.71	0.859
Range of variability of outcomes	22	3.64	0.902
Low upgrade cost	24	3.63	0.824
Low maintenance cost	24	3.54	0.977
Match with user skills	23	3.43	0.843
1-stop provider	24	3.42	0.881
Possibility of catastrophic loss	22	3.41	1.221
Match with legacy systems	23	3.39	1.270
Low purchase cost	24	3.33	0.868
R&D investment	23	3.26	0.864
Low training cost	24	3.25	0.794
Match with company culture	24	3.21	0.932
Market share	24	3.21	1.215
Provider's product can be supported by other companies after install	24	3.17	1.167
Match with data protocols of external supply chain members	23	3.13	1.290
Earnings profile	24	3.12	1.116
Adverse impact of company liquidity	22	3.09	1.019
Match with existing processes	24	2.92	1.139
Low key employee turnover	23	2.83	0.937

In summary, the data analysis suggested the following:

- That intangible evaluation criteria are ranked higher in importance than tangible criteria by both high- and low-performing e-projects;
- That both high- and low-performing e-projects place a substantive emphasis on due diligence and rigor in their provider evaluation process;
- That high-performing e-projects obtain higher levels of provider performance on intangible criteria relative to low-performing projects.
- That cross-functional participation in the evaluation process may be a significant determinant of project satisfaction.

The implications of these results are discussed next.

### IMPLICATIONS

The study makes two key contributions to supply chain management theory. First, it applies RBV to distinguish the relative importance of supplier evaluation criteria. To our knowledge, this is the first research effort to empirically apply RBV tenets to supplier evaluation criteria. While tacit resources are recognized in theory for their enduring value, this study tests and validates the concept of tacit value for resources obtained outside firm boundaries. The study's findings also highlight the importance of resource assimilation, as distinct from acquisition.

Table VII

Source	ANOVA — MEANS DIFFERENCES IN EVALUATION PROCESS PRACTICES BETWEEN HIGH- AND LOW-SATISFACTION FIRMS		Significant
	Means		
	Low Satisfaction	High Satisfaction	
Evaluation performed at high levels	3.83	3.62	0.460
Use of standard operating procedures during evaluation	3.37	3.75	0.139
High levels of cross-functional participation during evaluation	3.29	3.89	<b>0.014</b>
Use exhaustive information gathering and rigorous analysis	3.29	3.54	0.303

Successful projects were seen to obtain higher levels of performance from their supply base. Second, it strengthens current RBV thinking that treats capability generation as a supply chain centric rather than a single entity activity (Nelson and Wright 1992; Rosenblum & Spencer 1996). The expanded perspective offers a richer and fuller explanation of firm-level outcomes. Firms may improve their capabilities and performance by carefully managing their relationships with suppliers, customers and other resource providers.

The findings have implications for both providers and users of e-business products. Both constituencies will be interested in (a) provider evaluation criteria and evaluation practices in use and (b) such provider criteria and evaluation practices that are specifically associated with high-satisfaction users.

The results indicated that relatively intangible criteria were accorded greater importance in the provider evaluation process, suggesting that evaluators do realize their implicit advantages over tangible criteria. Intangible criteria such as provider strategic fit, customer references, trust, service track record and implementation time figured prominently in the evaluation process. The mean values of the importance attached to these criteria in the data were above 4.0 (1–5 scale). The resource-based view finds vindication in our study. These findings are in sharp contrast to past research in similar contexts that have shown a selective focus on functional aspects of software, justification of investments on “faith” and a general neglect of strategic evaluation criteria (Kumar 1990; Ezingard, Irani and Race 1998).

Table VIII

	DIFFERENCES IN PROVIDER PERFORMANCE BETWEEN HIGH- AND LOW-SATISFACTION FIRMS				
	Means		Significant	Importance of Criteria	
	Low Satisfaction	High Satisfaction		Low Satisfaction	High Satisfaction
Actual performance of provider selected for the project on evaluation criteria					
Low key employee turnover <sup>a</sup>	2.61 (1–5 scale)	3.30	0.008	Very low	Very low
Trust in provider <sup>a</sup>	3.13	3.71	0.035	Very high	Very high
Strategic fit <sup>a</sup>	3.75	4.15	0.053	Very high	Very high
Product technology	3.71	4.20	0.052	Very high	Very high
Match with company culture <sup>a</sup>	3.04	3.48	0.048	Low	Low
Match with user skills <sup>a</sup>	3.17	3.58	0.021	Medium	Medium
Low implementation time <sup>a</sup>	3.08	3.63	0.043	Very high	Very high
Low maintenance cost	2.67	3.68	0.001	Medium	High
Low training cost	3.00	3.48	0.028	Low	Medium
Low upgrade cost	2.92	3.47	0.020	Medium	Medium

<sup>a</sup>Intangible evaluation criteria.



Interestingly, few differences were observed between the high- and low-satisfaction groups in terms of the importance attached to intangible evaluation criteria. These results suggest that most companies are conceptually cognizant of, and perform structure provider evaluation in terms of a broad range of evaluation criteria. Also as a point of interest, both low- and high-satisfaction groups reported almost all the remaining listed provider evaluation criteria to be of substantive importance in the evaluation process (>3 on a 1–5 scale. See Tables V and VI). Considering these results, we are encouraged to suggest that (a) a similar set of intangible provider evaluation “core” criteria are prioritized by all buyers and (b) that an additional set of provider evaluation criteria is regarded as fundamental but of lower importance. The latter could be regarded as “standard operating criteria” in the provider evaluation process, and include factors such as provider earnings profile, market share and R&D investment. The primary managerial lesson from these findings is that care should be taken to ensure that bid profiles and business case preparation reflect the full range of market, financial, risk cost and implementability criteria valued by users. All-round competence, not selective capability, seems to be the order of the day.

However, the findings raise a natural question: if evaluators attach similarly high weights to intangible evaluation criteria, why do we see differences in project performance? Do evaluation processes work similarly well in selecting providers who can deliver on such criteria? Apparently, not so. The data show disparities in actual provider performance on important evaluation criteria between the low- and high-satisfaction groups (Table VIII). Firms reporting high-satisfaction levels with their projects reported significantly higher provider performance on several high-importance evaluation criteria.

In all, provider performance on a selective set of 10 evaluation criteria discriminated the high-satisfaction group from the low-satisfaction group. Six of these were intangible criteria, of which three had been reported as high importance factors in the evaluation process (see Tables V and VI). High-satisfaction firms obtained greater provider performance on the intangible criteria of trust, strategic fit, implementation time, match with company culture, match with user skills and low-key employee turnover. It was surprising to find that high- (or low-) satisfaction firms did not rate such intangible criteria as “match with company culture,” “match with user skills” or “low key employee turnover” as high importance evaluation factors. The data bear out anticipations in that provider performance on these criteria was relatively and significantly higher for high-satisfaction firms. The remaining four criteria where provider performance differed were the tangible criteria of product technology, low maintenance, training and upgrade costs. Barring product technology, neither high- nor low-satisfaction firms had

deemed these of primary importance in the evaluation process. Service track record and customer references, two intangible criteria rated as being of high importance, did not figure as performance differentiators, although providers performed strongly on both counts (3.67–4.02 on a 1–5 scale) for both low- and high-satisfaction groups. It is possible that these criteria have also become part of buyers’ standard expectations and do not offer any special advantage, although poor provider performance in these areas would cause user dissatisfaction. The results suggest that buyers are not prescient enough to rate criteria importance entirely accurately, and consequentially may fail to emphasize the “right” criteria or in fact, ascribe spurious importance to certain criteria, at the beginning of the evaluation process.

This leads to the question of why high-satisfaction firms exhibit superior provider selection ability using essentially the same set of criteria as low-satisfaction firms. One explanation could lie in provider evaluation process differences. The data showed that all firms conducted the evaluation process with due diligence, with centralized decision making at senior levels and used standard operating procedures with rigorous information gathering and analysis. The only evaluation process characteristic that differed between the high- and low-satisfaction groups of firms was in the use of cross-functional participation in the evaluation process. High-satisfaction firms reported greater levels of cross-functional participation, consistent with the well-researched benefits associated with this practice. A closer look at the data revealed three more differences of interest — project spend, credential validation practice and risk analysis. On average, high-satisfaction firms reported a much lower project spend relative to low-satisfaction firms (< \$0.5 million versus > \$1.0 million). Organization size does not seem to matter as much as the size of the individual project, because annual sales across high- and low-satisfaction firms were not statistically different. The literature is mixed on this issue, some studies associating smaller project size with positive outcomes (Ezingard, Irani and Race 1998), while others reported lower satisfaction levels (Guinan et al. 1997) or no relationship between project size and user satisfaction (Raymond 1985). However, larger projects have higher labor unit costs, require more coordination and management and are still “very difficult to manage and to successfully complete” (Guinan et al. 1997). Large projects could also have numerous users including external entities, confounding efforts to increase user satisfaction. Compactness of scope and spend could be associated with a number of advantages. In discussions, practitioners had pointed out that smaller projects may have less challenging goals, lower implementation times and thus lower exposure to uncertainty and a sharper focus that is more visible and easily understood by the organizational personnel.

The other two differentiators of performance, credential validation practice and risk analysis, were components of the provider evaluation process. We found that while credential validation practices such as installation visits, provider premises inspection and information validation from third parties were common to most firms, two practices were exclusive to the high-satisfaction group — gain-sharing options and bank guarantees (performance bonds) from providers. The former provides an incentive to the provider to work with the buying organization to reduce costs and time — the benefits that accrue are split between the buyer and the provider. High-satisfaction firms also obtained bank guarantees from bidding providers. The motivation to avoid a substantial monetary loss would be a considerable driver of performance, and a bank guarantee is a tangible and constant reminder of the consequences of underperforming.

The study also found that most firms did not make significant use of formal financial or risk evaluation techniques in their provider evaluation process. The only notable difference between high- and low-satisfaction firms was in their use of risk analysis techniques such as sensitivity and risk simulation analysis. High-satisfaction firms reported use of these methods at almost twice the rate of low-satisfaction firms. This finding offers limited support for the claim that the use of risk management methods improves performance (Ropponen and Lyytinen 1997). Conceivably, simulation and similar techniques, while familiar in academia, have not yet become user-friendly enough to encourage general use by buyers and other nontechnical evaluators.

Overall, the results suggest that satisfaction with e-project outcomes is better managed using a combination of factors. Identifying and selecting appropriate evaluation criteria, keeping project size manageable (large projects can be broken-up/phased), investing in credential validation practices and obtaining experience in risk management techniques are some actions for consideration. These characteristics associated with high-satisfaction level firms should be the logical locus of attention for the low-satisfaction group of firms.

Buyers and would-be adopters of e-business products can take note of the principal pre-evaluation criteria as identified by the data, for incorporation in bid invitations and evaluations. Listed below are the top 10 a priori e-provider evaluation criteria used by the high-satisfaction group of firms (ranked in descending order) — intangible criteria predominate:

1. Provider product technology.
2. Provider strategic fit.
3. Service track record.
4. Customer references.
5. Trust in provider.
6. Implementation time.

7. Ease of migration path.
8. Industry experience.
9. Low maintenance cost.
10. Low scalability cost.

Buyers seek strong provider credentials in these areas. The results also identified the following two provider characteristics of eminent importance in terms of distinguishing between high and low levels of user satisfaction.

11. Match with user skills.
12. Match with company culture.

## CONCLUSION

This research adopted the resource-based view of the firm as a theoretical lens to prioritize e-provider evaluation criteria and evaluation process factors, and examined how these criteria relate to performance. Data collected from e-business projects suggest that while a wide assortment of criteria are considered in provider assessment, intangible criteria predominate in importance. Firms experience different levels of satisfaction with e-business projects, based in part on superior provider performance on intangible evaluation criteria and process factors such as use of cross-functional teams in evaluation, provider credential evaluation and project spend. Marketers of e-products can highlight these criteria in their product design and presentations, while users can develop systems to identify, select and monitor e-providers that can fulfill such evaluation criteria.

The study findings clearly identified and prioritized criteria of importance in the process of evaluating e-providers. Further, they demonstrate that intangible criteria dominate in importance. Interestingly, the research demonstrated that emphasis on intangible evaluation criteria did not differ between high- and low-satisfaction projects. However, *performance* by e-providers on these intangible criteria was noticeably different. Both suppliers and buyers of e-business software should find the study insights valuable in structuring and evaluating offerings for achieving project satisfaction. Future research could apply the RBV to examine supplier evaluation and selection criteria in a larger context, examine interactions among criterion factors and look at other measures of firm performance.

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