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The IT Products-Services Stack and Vendor Quality

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ABSTRACT

This research examines how the portfolio of IT vendor offerings relates to consumer perceptions of vendor quality. Specifically, we examine how the degree of hardware, software, and services technologies—which we refer to collectively as the IT products-services stack—are related to vendor quality ratings. We test our model using over 28,000 IT vendor ratings given by top IT executives between 2004 and 2006. The findings suggest that mean satisfaction and value ratings are such that hardware > software > services and the variance (quality consistency) of satisfaction and value ratings are such that hardware/software < services. Further, vendors with more focused offerings (in terms of percentage of hardware, software, and services) are found to be of higher quality than vendors with more diverse offerings.

Keywords

IT artifact, IT services, vendor quality, customer satisfaction, IT value

INTRODUCTION

The IT products and services industry is a large and growing part of the global economy. In addition to growth, there is a trend towards the expansion of scope for IT vendors, as increasingly firms integrate a portfolio of products and services as part of their offerings. Previous studies argue that IT companies expand their products and services portfolio to internalize indirect network effects (Gao and Iyer 2006) and to achieve economies of scope by leveraging existing technological and customer knowledge (Helfat and Lieberman 2002). Some research suggests the overall expansion from products to services is a natural evolution when products become mature (Abernathy and Utterback, 1978; Klepper, 1996), and the general trend toward growth in services has been noted (Sawhney, Balasubramanian and Krishnan, 2004). While in the past studies have identified conditions which lead organizations to expand the scope of their IT offerings (e.g., Chandler, 1990), we still know little about how customers receive this kind of expansion. In particular, it is not clear how customers perceive the quality of IT vendors with different products/services offerings. Given the important role of customer satisfaction in firm performance (Anderson, Fornell and Rust, 1997), developing an understanding of the role of these offerings is likely to have strategic implications for organizations both providing and consuming IT products/services.

In this paper, we identify the *IT products-services stack* as a relevant framework to understand how differences in vendors' IT offerings influence customer outcomes. The IT products-services stack identified here has three distinct levels: (1) hardware, (2) software, and (3) services. Prior work has examined distinctions between products and services as critical to influencing customer outcomes (e.g., Edvardsson, Johnson, Gustafsson and Strandvik, 2000), making this a natural distinction when considering relevant characteristics of IT provided by vendors. We further distinguish between hardware and software because of the fundamental differences in the nature of delivery. Hardware is typically a general application delivered in the form of a physical product. Software, on the other hand, is an information product that is frequently customized. By providing an integrative view of the nature of the relationship between vendor offerings and customer perceptions through the IT products-services stack, we are able to relate differences in the technology artifact to customer evaluations of vendor quality. In addition, we examine the quality implications of vendors with offerings focused in a single level of the stack as opposed to vendors offering a range of hardware, software, and services. Overall, the IT product-services stack provides a concise way of communicating differences in the IT artifact relevant to the relationship between the vendor and the customer, answering recent calls for a more research in this area (Benbasat and Zmud, 2003; Orlikowski and Iacono, 2001).

A model of the proposed relationships is found in Figure 1, and we test this model using an extensive survey of over 28,000 vendor quality ratings—both satisfaction and value—given by top IT executives over the period 2004-2006. In doing so, we make two key contributions. First, we identify the importance of the level of the IT products-services stack on vendor quality ratings. Our results show that hardware, software, and services show decreasing (hardware > software > services) quality ratings and increasing variance (quality consistency) in the ratings (hardware/software < services). Second, we show that firms with more focused offerings demonstrate higher levels of quality than more diverse firms. Together these findings provide insights into how IT vendor quality ratings and associated rankings are influenced by the nature of their products/services portfolio and as a consequence their relationship with customers.

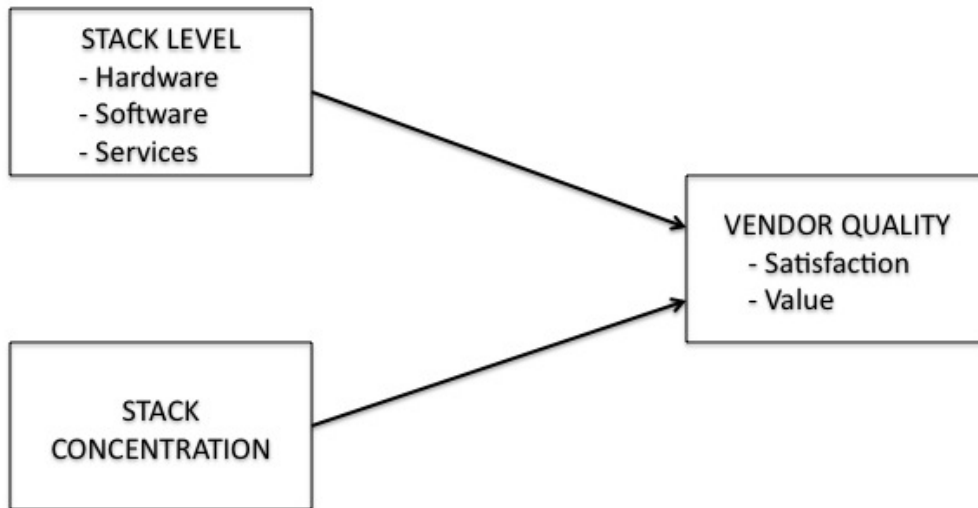


Figure 1. Research Framework

The rest of the paper is organized as follows. In section 2 we provide a brief background on the relevant stream of work examining quality and related customer outcomes. In section 3 we identify the specific hypotheses to be tested. Section 4 contains a description of the data and analysis performed. Section 5 provides the results, and section 6 includes a description of the implications of the findings for theory and practice as well as the limitations and conclusions.

BACKGROUND

Quality has been and continues to be an important topic in the management literature as well as the life of businesses and consumers. Quality is a desirable attribute of products and services, and discerning tradeoffs between price and quality is a key outcome of the purchase process (Chang and Wildt, 1994; Zeithaml, 1988). Initial quality definitions focused on objective attributes of a product or service, such as the conformance to a specification or

objective outcome measure (Gilmore, 1974; Levitt, 1972). While objective measures of performance remain important for many quality focused process improvement procedures—such as six sigma and process excellence—overall much of the focus on quality has shifted from an objective definition of quality to a subjective definition of quality associated with customer expectations and outcomes (Reeves and Bednar, 1994; Shostack, 1977).

This research examines the impact of vendor IT offerings on quality related outcomes. While examining value and satisfaction for each customer can yield a detailed understanding of vendor/customer outcomes in the context of a single relationship, using aggregate levels satisfaction and value provides a general indicator vendor quality. As outcomes are aggregated across all customers, only differences in outcomes linked directly to the vendor remain. Thus, we specifically define quality as the mean of satisfaction and value ratings. Mean level of satisfaction and value provide a customer oriented assessment of the degree to which vendors meet expectations and deliver high quality products and services. We separately define quality consistency as the variance of satisfaction and value ratings. The variance thus captures the ability of the vendor to provide a consistent relationship outcome. The mean and the variance of the satisfaction and value are related aspects of vendor quality that have implications for vendor selection. Utilizing the same outcome measure across vendors offering different combinations of hardware, software, and services enables us to examine ways in which the nature of what is provided to the customer influences the customer related outcome. This builds on prior work on customer satisfaction which has specifically examined differences in outcomes between products and services (e.g., Anderson, 1994; Fornell and Johnson, 1993; Fornell, Johnson, Anderson, Cha and Bryant, 1996).

HYPOTHESES

In this study we examine technology related aspects of the vendors' relationships with their customers—as conceptualized through the IT products-services stack—and quality ratings.

Stack Level

The relationship between vendor offerings and aggregated customer outcomes has been studied extensively in the marketing literature. Findings indicate that complexity and uncertainty associated with the buying experience each negatively influence satisfaction. The underlying theoretical mechanism is linked to disconfirmation, in which the difference between expectations and experience are related to satisfaction (Anderson, 1973; Oliver, 1980). In complex purchase situations, buyers are more likely to rely on marketer supplied materials, which often exaggerate the expected performance (Spreng, MacKenzie and Olshavsky, 1996), increasing expectations and thus decreasing satisfaction (Patterson, Johnson and Spreng, 1997). In situations when there is uncertainty, evaluations of purchase outcomes can be subject to multiple interpretations (Hoch and Deighton, 1989), decreasing the performance of the product and influencing customer evaluations (Patterson et al., 1997). Work by Anderson et al. (1997) found that firms face a trade-off between productivity and customer service for services because of the increased customization requirements. This suggests that firms' attempts to improve productivity may lower satisfaction for services. Consistent with these findings, organizational levels of satisfaction indicate systematic differences between products and services, with products offering a higher level of satisfaction than services (e.g., Anderson, 1994; Fornell and Johnson, 1993; Fornell et al., 1996). Overall, the main point is that differences in the level of uncertainty, complexity, and customization are each important in understanding customer outcomes.

We expect the stack level to be related to mean ratings of satisfaction/value and to the variance in satisfaction/value. Distinctions between hardware, software, and services exhibit systematic differences in the level of uncertainty, complexity, and customization. These differences are illustrated visually in Figure 2. Hardware purchases are often straightforward, with a low level of quality uncertainty and the ability to utilize the same hardware for a variety of tasks. Hardware can be characterized by standardized performance criteria that can be evaluated before purchase. Online reviews are also likely to provide accurate information regarding the capabilities of the products. Also the quality and capability of the hardware is dependent on its sub-systems (e.g. Intel chips in PCs). There is extensive evaluative information about these subsystems that are used in hardware products. Thus, evaluating the quality of hardware products can be done prior to the purchase decision. Software purchases typically have a much higher level of uncertainty and complexity, and implementations frequently require the software to be customized. While demonstrations of software typically show high performance, when actually implementing software many applications must be customized to meet the needs of the specific business application. Hence, it is difficult to evaluate software before purchase. Services represent the highest level of uncertainty, as services are customized for individual customers and there is typically no tangible product to demonstrate before purchase.

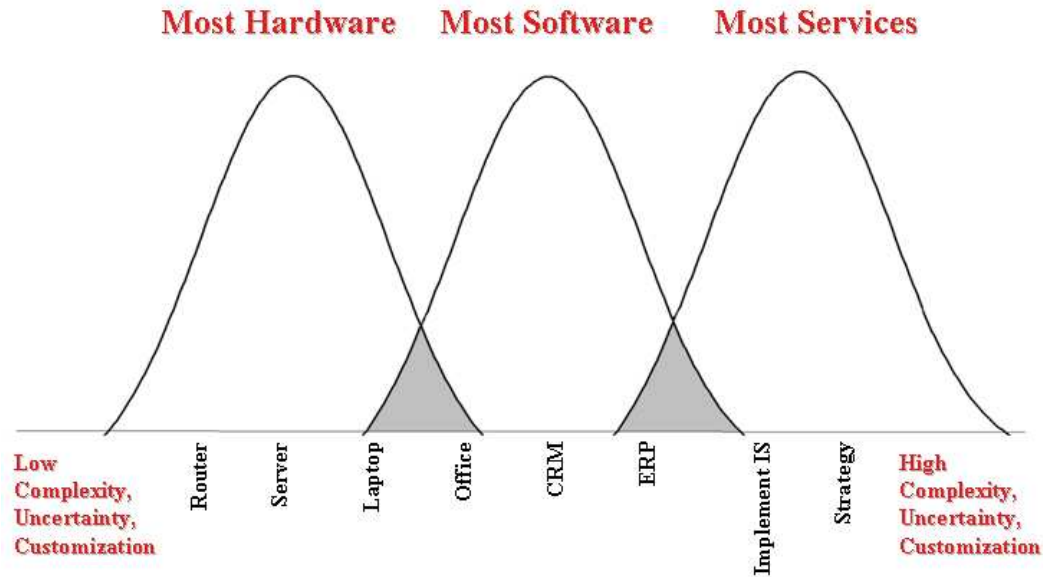


Figure 2. Evaluation of IT (Adapted from Bowman (2008))

Another source of uncertainty and complexity is customer participation during the delivery of products or services (Argote 1982). It is often difficult for the firm to draw boundaries between the “technical core” and the input-output stages of the production process because of the participation of customers (Parsons 1956). The input uncertainty induced by customer participation contributes to the variation of output. Selling hardware, software, and services involves different levels of customer participation. For hardware, its development and production happen before it is sold to the customers. For software, although the majority of programming is conducted before it is sold, it often requires customization based on the business processes of customers and as a result requires participation from customers. For services, the involvement of customers is more intense since services are characterized by the simultaneity of production and consumption, as customers are often viewed as co-producers. As a result, services are subject to greater input uncertainty than software or hardware. In sum, we expect higher levels of uncertainty and complexity associated with evaluating hardware, software, and services to be related to overall ratings of vendor quality as indicated below:

H1a: Mean satisfaction ratings of vendors will be rated such that: hardware > software > services.

H1b: Mean value ratings of vendors will be rated such that: hardware > software > services.

H2a: Variance in satisfaction ratings of vendors will be rated such that: hardware < software < services.

H2b: Variance in value ratings of vendors will be rated such that: hardware < software < services.

Stack Focus

The concept of focus has a long history in the organizational literature, particularly as it relates to firm operations (Hayes and Wheelwright, 1984; Skinner, 1974). Focused operations enable organizations to optimize a narrow range of processes and products (Pesch and Schroeder, 1996), facilitating process optimization and competitive outcomes (Skinner, 1974). While Gao and Iyer (2006) argue that the complementarities stemming from the interoperability between different stack layers provides greater financial benefits to vendors, it is not clear that these benefits will be passed on to customers.

We argue that the focus of a vendor at any given level of the IT products-services stack will be positively related to mean ratings of satisfaction/value and negatively related to the variance in satisfaction/value. The relative degree of focus is a key aspect of business strategy. Research in this area has shown a rather consistent positive relationship between focused business processes and performance (Huckman and Zinner, 2008; McLaughlin, Yang and van Dierdonck, 1995). Business expansion into different layers of the IT products-services stack—for example, from hardware to software or from software to services—reduces focus presents the challenge of increasing complexity in meeting customer expectations and providing value.

It is further possible that offerings at different levels of the software stack may have incompatible incentives which lower quality outcomes. For example, software which is easy to use and simple to implement may provide fewer opportunities for services. Similarly, hardware conforming to open standards may leave fewer opportunities to provide complementary software. In each of the examples, the quality of the core product is sacrificed in order to provide goods at another level of the IT products-services stack. Further, providing offerings at a single level of the products-services stack reduces uncertainty in the vendor selection process, reducing the variance in quality ratings resulting from an inappropriate match with customer needs. Therefore, we hypothesize:

H3a: The stack focus of a vendor will be positively related to mean satisfaction ratings.

H3b: The focus of a vendor of the IT products-services stack will be positively related to mean value ratings.

H4a: The focus of a vendor of the IT products-services stack will be negatively related to the variance in satisfaction ratings.

H4b: The focus of a vendor of the IT products-services stack will be negatively related to the variance in value ratings.

DATA AND ANALYSIS

Data

The data were collected as part of the Ziff Davis Media Inc. annual vendor survey. IT executives from Ziff Davis Media publication lists were invited to participate in the study via email. Survey questions were posted on a password-protected Website. Respondents were asked to indicate whether they had used or continued to use a list of specific IT vendors. This list was constructed each year from *Baseline* magazine's 50 Fastest Growing Software Companies, Gartner (which provided CIO Insight with lists of market share leaders), the *Fortune* 500 and Global 500 lists, the *Forbes* Fastest Growing Technology Companies list, the CBR 50 IT Services Vendors list, Hoover's Online, and annual and financial reports of individual companies. Respondents were then asked additional questions about a selection of up to 8 IT vendors in which they indicated a previous or ongoing relationship. Respondents were first asked the nature of the relationship (indicating the type of products/services obtained) and to rate the vendor on satisfaction and value related indicators of vendor quality. An example of a value related rating included "meeting commitments to my company on time and budget," and an example of a satisfaction related rating included "meeting my company's quality expectations for their products and services." A full listing of the survey items is contained in Appendix A.

The data collected spanned the years 2004-2006 and included a total of 28062 ratings by 4994 unique survey respondents. Data for 2004 included 10553 ratings from 1551 respondents; 2005 included 7738 ratings from 2021 respondents; and 2006 included 9771 ratings from 1422 respondents. Confirmatory factor analysis was completed using EQS version 6.1 for measures of satisfaction and value as reported by respondents. Overall, the measurement model indicated a high degree of fit, ($\chi^2=234.4$; CFI=0.997; RMSEA = 0.47; NFI=0.997), supporting the convergent and discriminant validity of the items.

In order to examine the overall model, appropriate items were averaged to get a satisfaction and value rating for each vendor/customer relationships. The data were then aggregated to the vendor level for each year of the survey, resulting in a unique vendor/year combination for each data point. Vendors with fewer than 30 were eliminated. This lower limit was imposed because 30 is generally used as the rule of thumb for when a selection approximates the normal distribution. The aggregated mean and variance of satisfaction and value measures were calculated for each vendor/year combination. The stack level of the vendor offerings were calculated based on the percentage of respondents indicating they had used the vendor services from a particular stack level. This resulted in a calculation of the percentage of offerings that a vendor had for hardware, software, and services. The percentage of the vendor's offerings of hardware, software, and services were used in the calculation of the focus of the offerings using Equation 1 shown below, which is a modified version of the Herfindahl Index.

$$\text{focus} = (\% \text{hardware})^2 + (\% \text{software})^2 + (\% \text{services})^2 \quad (1)$$

In addition, as the value of IT related products and services are subject to network effects (Gallaughner and Wang, 2002; Riggins, Kriebel and Mukhodapthyay, 1994), we further controlled for the extent of adoption of the vendor across the population of customers. This was calculated for each vendor by calculating the percentage of respondents who indicated using the vendor.

The summary statistics and correlation table for the data is shown in Table 1. There were a total of 153 unique vendor/year combinations used in the data analysis, and on average there were 144 vendor ratings per vendor/year data point. It should be noted that the mean and variance of satisfaction are negatively correlated (-0.52) as is the mean and satisfaction for value (-0.33). This suggests that the mean and variance values are measuring related but different aspects of vendor quality. Mean values of satisfaction and value were highly correlated (0.91).

	Variable	Mean	Std	1	2	3	4	5	6	7	8	9
1	Focus	0.574	0.161									
2	Services	0.382	0.289	0.36								
3	Software	0.404	0.295	0.15	-0.71							
4	Hardware	0.213	0.223	-0.67	-0.36	-0.40						
5	Adoption	0.265	0.194	-0.10	-0.29	0.07	0.28					
6	Satisfaction (Mean)	1.901	0.203	-0.19	-0.55	0.25	0.39	0.24				
7	Satisfaction (Var)	0.756	0.156	0.23	0.55	-0.30	-0.32	-0.52	-0.49			
8	Value (Mean)	1.973	0.199	-0.08	-0.43	0.16	0.35	0.18	0.91	-0.37		
9	Value (Var)	0.955	0.182	0.25	0.42	-0.14	-0.36	-0.46	-0.44	0.75	-0.33	
10	Ratings	182.601	167.445	-0.09	-0.26	0.05	0.27	0.97	0.22	-0.48	0.17	-0.46

Table 1. Summary Statistics and Correlation Table

Analysis

The model examines the mean levels of satisfaction (sat_{MEAN}) and value (val_{MEAN}) as well as the variance in satisfaction (sat_{VAR}) and value (val_{VAR}) as dependant variables. OLS assumes that the error term in each equation is independently and identically distributed. However, there is likely to be some correlation between the error terms of the related dependant variables. As a result, we used Seemingly Unrelated Regression (SUR) to calculate more efficient estimates of the parameters. The full system of equations is shown below:

$$sat_{mean} = \beta_0 + \beta_1(focus) + \beta_2(\%services) + \beta_3(\%software) + \beta_4(adoption) + \epsilon \tag{2}$$

$$sat_{var} = \beta_0 + \beta_1(focus) + \beta_2(\%services) + \beta_3(\%software) + \beta_4(adoption) + \epsilon \tag{3}$$

$$val_{mean} = \beta_0 + \beta_1(focus) + \beta_2(\%services) + \beta_3(\%software) + \beta_4(adoption) + \epsilon \tag{4}$$

$$val_{var} = \beta_0 + \beta_1(focus) + \beta_2(\%services) + \beta_3(\%software) + \beta_4(adoption) + \epsilon \tag{5}$$

The SUR analysis includes the percentage of the sellers’ offerings in services (%services) and software (%software). To meet necessary rank and order conditions for the regression, the value specification for hardware is omitted, meaning that the coefficients for software and services are relative to the value for hardware. A negative and significant coefficient indicates the predicted value for software/services are less than hardware (as predicted for the mean of satisfaction and value), and a positive and significant coefficient indicates the predicted value for software/services are more than hardware (as predicted for the variance of satisfaction and value). Further, as H1a/b and H2a/b require a determination of the distinction between software/services, we conducted an F-test to determine whether the parameter estimates for $\beta_2 = \beta_3$ in each equation. A significant value for the F-test rejects the null hypothesis that the coefficients are equal.

RESULTS

The results of the analysis are shown in Table 2. The SUR analysis supports the majority of the hypothesized relationships, and overall the model examined explained 25.2% of the variance in the outcomes. Supporting H1a/b, we found that the mean satisfaction and value ratings are such that hardware > software > services. H2a/b were partially supported, as findings indicated that for both the value and satisfaction measures, the variance of services was greater than hardware/software, but the variance of software was not significantly greater than hardware. Also, supporting H3a/H4a focus was positively related to the mean levels of satisfaction and value. However, not supporting H3b/H4b, the focus was not found to be related to the variance in the vendor ratings. A summary indicating the results of the hypothesis testing is show in Table 3.

	Satisfaction		Value	
	Mean	Variance	Mean	Variance

Intercept	2.123*** (0.061)	0.714*** (0.044)	2.144*** (0.063)	0.860*** (0.057)
Focus	0.312** (0.113)	0.000 (0.082)	0.459*** (0.118)	0.020 (0.106)
% Services ¹	-0.695*** (0.093)	0.271*** (0.068)	-0.688*** (0.097)	0.296*** (0.087)
% Software ¹	-0.341*** (0.083)	0.045 (0.060)	-0.407*** (0.087)	0.131psi (0.078)
Adoption	0.014 (0.073)	-0.302*** (0.053)	-0.025 (0.076)	-0.313*** (0.068)
F _(Services=Software)	48.27***	37.68***	28.08***	12.08***
R ² (OLS)	0.381	0.447	0.301	0.327
ADJ R ² (OLS)	0.365	0.432	0.282	0.308
R ² (SUR Model)	0.252			

N=153

¹Data is coded such that the % Hardware is not shown.

Table 2. Seemingly Unrelated Regression Parameter Estimates

DISCUSSION, LIMITATIONS, AND CONCLUSIONS

The results of this analysis begin to identify how differences in the nature of the relationship between IT vendors and their customers influence rating, and the findings have both theoretical and practical implications. These findings are discussed below, along with research limitations and conclusions drawn from this work.

Discussion

This research contributes to the theory related to the understanding both of differences between products and services and in developing an artifact specific understanding of the vendor relationship. Past research has addressed differing outcomes related to products and services (Anderson, 1994; Fornell and Johnson, 1993; Fornell et al., 1996). Consistent with past research, we show that the aggregate levels of satisfaction and value are higher for products than for services. We contribute to this literature by showing how these differences also extend to the variance of the ratings and are influenced by the level of focus of the vendor. The differences in the variance suggest that services are associated with greater challenges in providing a consistent customer evaluation, resulting in lower overall ratings.

Practical implications of these findings indicate that the option to expand to different levels of the IT products-services stack may have implications for perceptions of quality. Vendors often begin services businesses to generate steady income to complement the cyclical nature of product purchases. While the move into services represents an opportunity; it is an opportunity not without risk. Vendors offering an array of services are more likely experience a drop in their quality ratings, potentially impacting the market for products. As a result, vendors should weight the risks negative ratings of the product with the capability of the organization to both offer and effectively execute service offerings.

	Description	Result
H1a	Satisfaction _{mean} : Hardware > Software > Services	Supported
H1b	Value _{mean} : Hardware > Software > Services	Supported
H2a	Satisfaction _{var} : Hardware < Software < Services	Partially Supported; Hardware/Software < Services
H2b	Value _{var} : Hardware < Software < Services	Partially Supported; Hardware/Software < Services
H3a	Satisfaction _{mean} : Focus (+)	Supported
H3b	Value _{mean} : Focus (+)	Supported
H4a	Satisfaction _{var} : Focus (+)	Supported
H4b	Value _{var} : Focus (+)	Supported

Table 3. Summary of Results

Conclusions

The coordination and purchase of IT from vendors is both a complex and challenging organizational process. In this research we have examined the role of the IT artifact in influencing customer ratings of vendor quality. We introduce the IT product-services stack as a way to both visualize and communicate important technology differences within the context of the vendor relationship. Findings indicate clear distinctions between hardware,

software, and services in influencing vendor quality ratings, with vendors providing hardware rated higher than software which is higher rated than services. This work thus expands prior work in marketing to the IT domain that has noted distinctions between levels of product and services satisfaction. We further find similar distinctions for measures of quality consistency (i.e., the variance in satisfaction and value measures), with software and hardware vendors having a higher quality consistency (lower variance) than service providers. Finally, our work shows that the degree of focus exhibited by vendors increases overall measures of vendor quality, suggesting that the additional complexity introduced through delivering services on multiple levels of the IT product-services stack lowers customer outcomes. Together these findings begin to develop an understanding of the ways that nature of the IT provided by vendors influences customer outcomes.

APPENDIX A - MEASURES

Individuals were asked to rate vendors on a scale from 1-4, (1 = Excellent, 2 = Good, 3 = Fair, and 4 = Poor). Variables were reverse coded.

Value

1. Meeting my company's expectations for increasing revenue (or achieving mission, if not-for-profit) (VAL1)
2. Meeting my company's ROI (business value) expectations (VAL2)
3. Meeting my company's expectations for lowering business or IT costs (VAL3)

Satisfaction

Individuals were asked to rate vendors on a scale from 1-4, (1 = Excellent, 2 = Good, 3 = Fair, and 4 = Poor). Variables were reverse coded.

1. Meeting commitments to my company on time and budget (SAT1)
2. Solving the business problem their products or services were purchased or engaged to solve (SAT2)
3. Being flexible and responsive to my company's needs (SAT3)
4. Meeting my company's quality expectations for their products and services (SAT4)

Products-services Stack

Individuals were asked to indicate the nature of the relationship with the vendor, (1 = Yes, 2 = No).

Services (A "yes" for any of the following indicated a service relationship)

1. We have used them as consultants on business and IT strategy and/or internal IT projects. (SERVICE1)
2. We have used their services to outsource IT systems and projects. (SERVICE2)
3. We have used their telecommunications services. (SERVICE3)

Hardware

1. We have used their hardware products. (HARDWARE1)

Software

2. We have used their software products. (SOFTWARE1)

Focus

For each vendor the % of relationships involving hardware, software, and services were calculated. Focus was then calculated according to the equation shown below, which based on the Herfindahl index.

$$\text{Focus} = (\% \text{hardware})^2 + (\% \text{software})^2 + (\% \text{services})^2$$

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