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Measuring Web Site Information and Service Quality

- An Extended Multi-Attribute Attitude Model

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ABSTRACT

Information and service quality (ISQ) is a critical factor in the success of commercial web sites and is a well-researched area in Information Systems (IS) and Marketing. Our study develops an instrument that measures web site success by evaluating ISQ performance. We deploy a multi-dimensional conception of ISQ from IS literature that we use for measuring dimension relevance and performance perception according to Marketing research. Both are components of a linear compensatory relevance-weighting model. We extend this model by integrating a maximal performance norm and a normalization procedure for calculating an overall ISQ performance score, establishing a maximal perceived-performance gap. In addition, different web site usage contexts are linked to performance perceptions. The applicability of the approach is demonstrated in an empirical study examining the ISQ performance of a commercial web site ($n = 226$). Our instrument adds exploratory power to existing measurement approaches and supports customer-centric web site design.

Keywords

Information and service quality, commercial web sites, multi-attribute attitude model, performance indicator.

INTRODUCTION

A critical concern of both Marketing and Information Systems (IS) research has been how to measure the success of commercial web sites by taking information and service quality (ISQ) into account. Such web sites include transaction-orientated e-commerce web sites that sell products or services directly, but also web sites that focus on providing service and support on products such as manufacturer web sites (Booth and Jansen, 2009). These web sites are distinguishable by their business purposes, reflected in web site structure and design. As a consequence, different success metrics exist. The goal of e-commerce web sites is to get customers to purchase goods or services. Site success is determined in terms of revenue by using metrics that describe the customer lifecycle and customer web usage such as reach, acquisition, conversion, click through and look-to-buy (Lee, Hoch, Podlasek, Schonberg and Gomory, 1999). Web site providers also investigate customers' attitudes towards quality and satisfaction as subjective indicators of web site success. The success of commercial websites that focus on support and service is often measured by investigating customer web site usage in terms of the implicit feedback of web site effectiveness in information provision (Stolz, Viermetz, Neuneier and Skubacz, 2005). All these metrics quantify web site success as an overall effect; i.e. by generating total values such as the amount of clicks per cart in an online shop, or by examining web site quality and satisfaction as latent variables in structural equation modeling (SEM). However, it is more likely that ISQ consists of several dimensions possessing different relevance for individual customers in different usage contexts, and success is thereby perceived differently. Measurement of ISQ as an overall effect excludes the differential desirability of single dimensions (Zhao and Dholakia, 2009). On the other hand, SEM results are often biased and require advanced statistical skills that make handling difficult in practice (Sharma, Yetton and Crawford, 2009).

Our study addresses these issues and develops an instrument for measuring ISQ that refers to recent approaches in IS literature that discuss ISQ as multi-dimensional phenomenon. The developed instrument, however, does not measure ISQ as a latent variable as common in IS research. Instead, we refer to Marketing literature and measure ISQ by deploying a multi-attribute attitude model. According to this methodology, we examine the relationship between customer perceptions of web site performance and their individual relevance. This approach is extended in our study by integrating a maximal performance norm into the developed instrument. With it, a maximal performance gap and an overall ISQ performance metric are calculated, facilitating practical usability and enabling benchmarking. Moreover, different web site usage contexts

are taken into account. The contribution of our study addresses researchers and practitioners: we develop a comprehensive methodology for investigating the ISQ of commercial web sites in terms of e-business research. Existing approaches for examining information systems success in IS research are broadened by integrating Marketing methodologies. With it, the focus shifts from conceptual modeling of ISQ towards strategic issues. Finally, we provide a useful instrument for measuring ISQ of commercial web sites for practitioners.

This paper is structured as follows. At the outset, related research is summarized and discussed. After this, our approach of ISQ performance measurement is described in detail. Application of the instrument is demonstrated by conducting an empirical study for measuring the ISQ performance of a web site from the software production sector. Finally, results and limitations are discussed.

RELATED RESEARCH ON QUALITY MEASUREMENT

There are several theoretical frameworks for a success orientated quality measurement in IS and Marketing. There are approaches from IS that examine behavioral aspects such as technology acceptance for the prediction and reuse of a web site (Loiacono, Watson and Goodhue, 2007). The development of user-orientated measurements has a long tradition of identifying variables that directly reflect information, system and service quality and are therefore useful for measuring information system use and success (i.e. Aladwani and Palvia, 2002; Delone and McLean, 2003). This also includes approaches that deal explicitly with the identification of web site quality demands by users, for example by adapting frameworks of quality function deployment (Barnes and Vidgen, 2000). Also, multi-dimensional definitions exist that view ISQ as a bundle of attributes (Yang, Cai, Zhou and Zhou, 2004; Zhao and Dholakia, 2009). These latter approaches are particularly useful for providing an understanding of the attitudinal structure of customers in terms of differences in quality perception and satisfaction of commercial web sites.

A corresponding approach in Marketing is the multi-attribute attitude model that is useful for determining such attitudinal structures of a product or service. It is a compensatory model that relates the customers' performance perceptions to the relevance weighting of measured attributes (Fishbein, 1967; Wilkie and Pessemier, 1973). And finally, in Marketing exist approaches that provide business orientated quality measurement instruments and quantitative models for assessing service quality (SERVQUAL). These studies are central to marketing strategy, have been applied in nearly all business domains and have important managerial implications (Carman, 1990; Parasuraman, Berry and Zeithaml, 1988). They provide a general measurement model that determines a performance-expectation gap, which has been widely discussed and extended in various approaches (Asubonteng, McCleary and Swan, 1996; Teas, 1993).

This approach has been integrated into IS already, in so-called WEBQUAL studies. These studies focus on web-customer satisfaction and therefore integrate customer expectations and the perceived performance of a web site regarding its quality (McKinney, Yoon and Zahedi, 2002). Gap-analysis approaches can be used for examining web site performance in relation to maximal performance, as they are helpful for quality assessment and benchmarking (Lee, Strong, Kahn and Wang, 2002).

There is no known junction of multi-attribute attitude models and performance-gap analysis for determining web site quality and success. Our study synthesizes these measures and relates customers' perceived performance of a product or service to their individual relevance (multi-attribute attitude model), and compares the relevance-weighted perceived performance to maximal performance (performance-gap).

ISQ PERFORMANCE MEASUREMENT

In this section, we describe our approach to ISQ performance measurement in three steps. First, we explain the understanding of ISQ as a multi-dimensional construct. Subsequently, we extend this framework by adding the calculated constructs of relevance, perceived performance and overall ISQ performance. Finally, we explain the relation between ISQ and customer tasks in specific usage contexts in order to investigate business goals.

Information and Service Quality

The focus of our study is the development of a comprehensive ISQ measurement instrument that deploys recent conceptions of ISQ from IS research and relates those to Marketing methodology. Therewith, no new theoretical framework for ISQ is developed. Instead, we deploy a validated and highly reliable IS approach for user perceived ISQ. The multi-dimensional approach by Yang, Cai, Zhou and Zhou (2004) provides such an adequate IS framework due to three factors: (i) its ability to investigate commercial web sites across different business goals; (ii) its synthesis of relevant frameworks for investigating web site quality and success in IS; (iii) and its rigorous measurement development.

Yang et al. integrate findings from studies that investigate the ISQ of web sites with different business purposes and thereby examine web site success in different manners. In their study, the authors develop a comprehensive approach for investigating the ISQ of commercial web sites that combines different business purposes, such as web portals, that provide aggregated information about products and services and are often used in e-commerce context. Perceived quality of commercial web sites is finally conceptualized as a multi-dimensional model of ISQ that has conceptual foundations in IS and synthesizes the measurement of information- and system quality of information systems (Delone and McLean, 2003; 2004) and technology acceptance (Davis, 1989; Venkatesh, Morris, Davis and Davis, 2003). The framework developed takes account of usability, usefulness of content, adequacy of information, accessibility, and interaction (Yang et al., 2004).

- *Usability* is related to user friendliness and addresses search facilities, web site structure, user interfaces and general web site design and appearance. This dimension also includes privacy and security issues.
- *Usefulness of content* refers to the value, reliability, currency and accuracy of information provided.
- With *adequacy of information*, the comprehensiveness of information is measured. In particular, e-commerce related web sites need to provide information that facilitates customer understanding of the product descriptions, price information and instruction manual. In addition, supplemental services such as company information, hyperlinks to other relevant web sites and archives are included in this dimension.
- *Accessibility* integrates two aspects: availability and responsiveness. Customers expect a web site to be available in different browser types and on different devices. Moreover, they desire fast log-on, search and page load and digital product download.
- *Interaction* finally involves all interactions with a customer – between customer and retailer on a general level, between customer and service employees and among customers.

Yang et al. (2004), use these quality dimensions for measuring overall quality as a latent variable in a structural model, which further measures overall satisfaction as a second-order factor. All constructs as well as the corresponding items are listed in table 1. This highly reliable measurement instrument followed a rigorous methodology of measurement development for Marketing constructs, as proposed by Churchill (1979), which supports the application to contexts such as the study at hand.

ISQ dimension	Items
Usability	<ul style="list-style-type: none"> • Customized search functions • Search facilities (direct search, navigation) • Well-organized hyper links • Customized information presentation • Confidentiality of customer information • Adequacy of security features
Usefulness of content	<ul style="list-style-type: none"> • Relevant information to the customer • Up-to-date information • Valuable tips on products/services • Unique content
Adequacy of information	<ul style="list-style-type: none"> • Complete product/service description • Information comprehensiveness relative to other web sites • Complete content • Sufficiency of information • Detailed contact information
Accessibility	<ul style="list-style-type: none"> • Accessibility of the website • High speed page loading
Interaction	<ul style="list-style-type: none"> • Follow-up service to customers

	<ul style="list-style-type: none"> • Community
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Table 1. ISQ Dimensions and Items (Yang et al., 2004)

Performance Measurement

Our developed performance measurement uses a junction of multi-attribute attitude models and performance-gap analysis for developing a performance metric that measures web site success (figure 1). Moreover, customers’ perceived performance and their need-structure are measured according to the SERVQUAL approach that originally uses a pair-wise, two-level measurement of performance expectation and perceived performance (customer evaluation of ISQ dimensions; figure 1). In this study, the two-level measurement deploys relevance instead of expectation measurement in the multi-attribute attitude model according to the original models by Fishbein (1967) and Wilkie and Pessemier (1973). In addition, we extent this model with a maximal performance value. The performance-gap is finally calculated not by determining a performance-minus-expectation gap as in SERVQUAL and WEBQUAL, but by calculating the maximal-minus-relevance-weighted perceived performance gap. The resulting gap shows underperformance in relation to maximal performance (overall ISQ performance metric; figure 1).

The ISQ performance metric calculation proceeds in three steps: (i) calculation of relevance weightings for the ISQ dimensions; (ii) relevance weighting of perceived performance and integration of maximal performance norm; (iii) and normalization of the previously determined normed relevance-weighted performance value for maximal perceived performance gap calculation (figure 1).

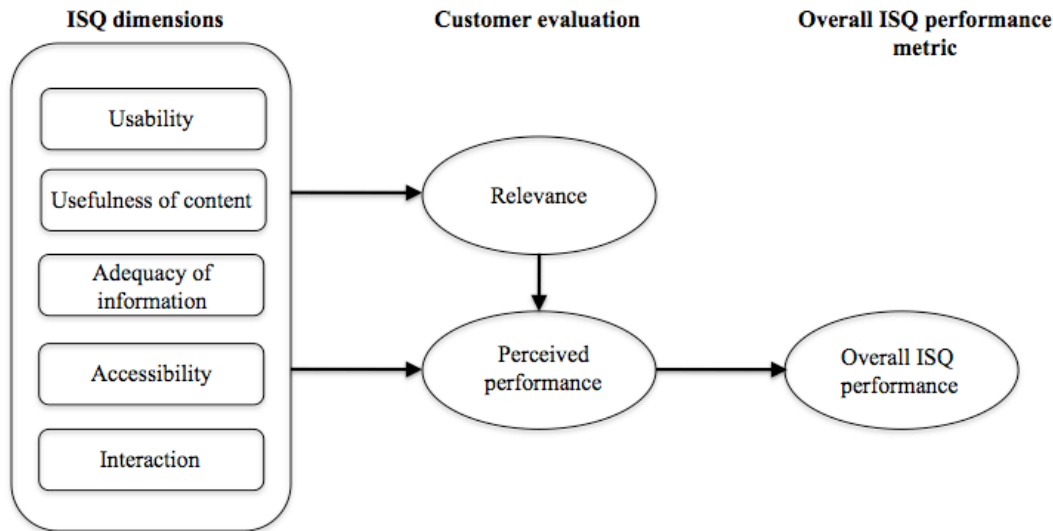


Figure 1. ISQ Performance Measurement

Relevance weighting of ISQ dimensions

Initially, a mean score is calculated for each relevance dimension. All items are measured in a two-level procedure by using 5-point Likert scales anchored by “1” as “very poor” to “5” being “very good” for perceived performance and equivalent by “1” as “irrelevant” to “5” being “very relevant” for relevance evaluation. The mean of the dimensions is thereby transformed into a weighted score by function (1):

$$W_a = \frac{\bar{R}_a}{\sum_{i=1}^n \bar{R}_i} \quad (1)$$

where W_a is the weighting of the relevance of the a th dimension and R_a is the average relevance of the a th dimension of the ISQ relevance model.

Weighted performance and overall ISQ performance

The performance of a commercial web site is illustrated by customers' perceptions of how its performance fulfills their needs, wants, and desires during their user-system interaction. A performance score is therefore an indicator of the web site's ISQ dimensions' performance, measured by an extended multi-attribute attitude model. To incorporate the customers' relevance evaluation and the general norm for a maximal performance in the overall measurement, the product of the previously generated average weighted relevance score and the mean of each ISQ dimensions' perceived performance are divided by the possible maximum performance value after function (2):

$$P_a = W_a \bar{U}_a \frac{1}{c} \quad (2)$$

where P_a is the performance score of an ISQ dimension a , U_a the average perceived performance evaluation of an ISQ dimension a and c the possible maximum value of a performance evaluation of a (the maximum value on the Likert scale; in the study at hand "5" meaning "very good").

The generated performance scores are then normalized for determining the overall ISQ performance of a commercial web site by summarizing all ISQ dimensions' determined performance scores after function (3):

$$G_j = 100 \sum_{i=1}^n P_a \quad (3)$$

where: G_i is the normalized composite performance value of n ISQ dimensions of a web site j .

This overall performance measurement enables us to quantify a web site's performance in a dimension by calculating a relevance weighting for each item in a dimension, as well as by generating an overall ISQ performance score that aggregates a web site's performance across ISQ dimensions to a total score. Due to normalization, a maximal perceived performance gap is displayed on a scale from 0 to 100, with 100 as maximal performance.

ISQ and Web Usage Contexts

The ISQ performance metric thus developed can also take into account different stages of customers' web site usage, which supports investigating different customer groups. This is useful for interpreting ISQ performance with regard to different business goals. For example, while manufacturer web sites often exhibit several business goals by providing product information, support and service, some of them also include a shop area. Consumers who visit such a multi-business-goal commercial web site therefore differ depending on their usage context. As a consequence, their evaluation of a web site's ISQ performance differs significantly as well (Booth and Jansen, 2009; Jain and Singh, 2002).

For integrating this into the developed instrument, consumer web site usage is classified according to different stages of the buying decision process (table 2). To this end, a general classification from consumer research by Blackwell, Miniard and Engel (2001) is used. It distinguishes a pre-purchase phase, a purchase phase and a post-purchase phase. This general classification is deployed because it is applicable to commercial web sites with different business goals. Corresponding business goals for the pre-purchase and purchase phases include marketing viewpoints (i.e. increase customer satisfaction), and transaction (i.e. increase revenue), whereas the post-purchase stage mostly addresses service and support from a B2C-perspective (i.e. decrease other support costs) (Booth and Jansen, 2009). The use of correlation coefficients operationalizes the integration of the classification of different web site usage context.

Stage of purchase	Web site usage
Pre-purchase stage	<ul style="list-style-type: none"> • Product search, comparison of prices and products
Purchase stage	<ul style="list-style-type: none"> • Purchase • Offline reseller search • Product delivery, download
Post-purchase stage	<ul style="list-style-type: none"> • Technical support, community, service

Table 2. Stages of Purchase and the Corresponding Web Site Usage (Blackwell et al., 2001)

DEMONSTRATION OF APPLICABILITY

In order to demonstrate the applicability of the information and service quality (ISQ) performance metric, an empirical study was conducted that measured the ISQ performance of a commercial web site of the software production domain. The web site used for this study provides information and services about its products and also possesses an online-shop. Its structure mirrors these mixed business purposes and addresses the pre-purchase, purchase and after-purchase stages of customer interaction. The main navigation menu contains categories labeled products, support, community, company, media and shop. The web site is dynamic, flash based and available in English, German and Japanese.

Web site success is therefore determined by customer satisfaction with regard to web site performance in information provision in all phases of the buying decision process, as well as by revenue. The current study examines web site performance with regard to ISQ only.

Questionnaire Design and Data Collection

A questionnaire was developed based on Yang et al. (2004). Several pretests were conducted. The questionnaire was initially discussed with experts in the web site's management in order to achieve face validity. Furthermore, an online pretest with 42 respondents took place. Respondents were recruited from employees of the web site and selected consumers. All 19 items were used for the two-level measurement of relevance and perceived performance. The results of the pretest were reliable and satisfying. As additional variables, web site usage, country of origin and gender were integrated into the questionnaire. In the final main study, data was collected with a random sample technique.

Data was collected by posting an official announcement in the community area, which is used for support and knowledge exchange between customers and the vendor, over a period of four weeks. The announcement introduced the research context and included an external link to the online survey. Initially, respondents were asked to define their web site-usage tasks. Respondents then evaluated the perceived performance of the web site according to the ISQ dimensions and directly assess the actual relevance of these dimensions for their web site usage.

The survey link was requested 756 times and 226 finished surveys were eventually available for data analysis, a completion rate of 29%. 98% of respondents stated that they were male while only 2% stated they were female. The geographic distribution of the sample was international with respondents originating mainly in Europe and North America (Europe 56%; North America 35%; Australia 5%; Asia, Africa and South America in total 5%). The respondents' web site usage tasks were divided between 39% for technical support, community and service; 32% for purchase and product download; 25% for product search, and comparison of prices and products; 1% for offline reseller search; and 3% for other tasks (multiple answers).

Data Analysis

Statistical analyses were performed using PASW Statistics 18. Initially, intercorrelation coefficients of the ISQ dimensions relating to perceived performance were calculated with the non-parametric Spearman-Rho coefficient and tested for significance. The standard Cronbach α was used for assessing reliability in each dimension.

In order to analyze the impact of web site usage on perceived performance, a point-biserial correlation coefficient was calculated.

Overall ISQ performance scores were calculated with the average relevance and performance evaluations. The performance of each ISQ dimension as well as the overall web site ISQ performance was examined. In order to calculate performance in a

single ISQ dimensions, the overall performance score was calculated item by item; whereas the overall ISQ performance score is determined across all dimensions. With the aid of the normalized values, the maximal perceived performance gap (maximum is 5, as the highest value of the Likert scale) is displayed on a scale from 0 to 100; with 100 analogous to the percent of maximal performance score.

Results

The intercorrelation of ISQ dimensions shows that ISQ, while multi-dimensional, is a single phenomenon because its dimensions are not inherently independent, with the exception of accessibility and interaction (table 3). Cronbach α values range from 0.91 to 0.67, which indicates that the measures of each dimension are reliable.

Spearman-Rho intercorrelation with Cronbach α on the diagonals							
Perceived performance	Mean	S.D.	Usability	Usefulness of content	Adequacy of information	Accessibility	Interaction
Usability	3.91	0.91	(0.91)				
Usefulness of content	4.10	0.85	0.32**	(0.84)			
Adequacy of information	4.00	0.82	0.29**	0.37**	(0.87)		
Accessibility	3.74	1.06	0.16*	0.24**	0.24**	(0.80)	
Interaction	3.88	0.97	0.22**	0.22**	0.20**	0.127	(0.67)

Table 3. Intercorrelation Matrix of ISQ Dimensions in Perceived Performance

* $p < 0.05$, ** $p < 0.01$

Point-biserial correlation coefficients were calculated for the dichotomous variable web site usage in each ISQ dimension in order to take different usage contexts into account. Accessibility was highly significantly correlated in weak negative linear association with purchase ($r_{pb} = -0.20$, $p < 0.01$) indicating that if purchase was a relevant usage task then the web site's accessibility performance was perceived rather negatively (table 4). Moreover, technical support, community and service were significantly correlated with the ISQ categories of usability ($r_{pb} = 0.15$, $p < 0.05$), usefulness of content ($r_{pb} = 0.13$, $p < 0.05$), and adequacy of information ($r_{pb} = 0.16$, $p < 0.05$). This demonstrates better-perceived web site performance in these usage contexts.

Point-biserial Pearson correlation	Perceived performance				
	Usability	Usefulness of content	Adequacy of information	Accessibility	Interaction
Web site usage					
Product search, comparison of prices and products	0.07	0.07	0.07	0.00	0.04
Purchase	-0.01	0.01	-0.02	-0.20**	-0.04
Offline reseller search	-0.07	-0.02	-0.04	-0.04	-0.08
Product delivery, download	-0.04	0.00	-0.02	-0.12	0.01
Technical support, community, service	0.15*	0.13*	0.16*	0.00	0.06

Table 4. Correlation Matrix of Web Site Usage and Perceived Performance

* $p < 0.05$, ** $p < 0.01$

The average relevance evaluation and perceived performance scores are displayed in table 5. Customers rate the ISQ dimensions of interaction as 'very relevant' ($M = 4.51$) and usefulness of content as 'relevant' ($M = 4.41$). In performance perception, the dimensions usefulness of content ($M = 4.10$) and adequacy of information ($M = 4.00$) perform best.

ISQ dimension	Relevance evaluation (n = 226)		Perceived performance (n = 226)	
	Mean	Standard deviation	Mean	Standard deviation
Usability	4.16	0.66	3.91	0.72
Usefulness of content	4.41	0.62	4.10	0.85
Adequacy of information	4.28	0.61	4.00	0.82
Accessibility	4.10	0.88	3.74	1.06
Interaction	4.51	0.65	3.88	0.97

Table 5. Average Evaluation of Relevance and Perceived Performances

Table 6 displays finally the overall ISQ performance of the web site calculated with functions 1-3 (see section *Performance Measurement*). Results show that the examined web site underperforms in all ISQ dimensions, with accessibility possessing the lowest performance score ($M = 73.06$) - lagging nearly 27% behind the maximal performance, and behind adequacy of information ($M = 79.91$) with only 20% underperformance. The overall performance score ($M = 78.78$) ultimately demonstrates that the web site underperforms nearly 21%. Improving ISQ performance on this web site is therefore generally recommended.

	ISQ dimension	Mean	Standard deviation
Performance of ISQ dimension	Usability	77.36	14.51
	Usefulness of content	81.71	17.65
	Adequacy of information	79.91	16.61
	Accessibility	73.06	22.52
	Interaction	75.10	20.53
Overall ISQ performance		78.78	14.27

Table 6. Overall ISQ Performance Scores

By taking into account the web site usage-relevance correlations (table 4), the performance scores can be interpreted in relation to different customer usage contexts. The gap to maximal performance values is particularly insightful. In this regard, technical support, community and service in particular are addressed, demonstrating that customers who use the web site for this purpose perceive the best performance with respect to usefulness of content with only 18% underperformance. This indicates that the web site provides adequate information about products and services in the product catalogue, the support and community area, although efficiency could be improved – as the maximal performance gap demonstrates. Nevertheless, the low overall performance score for usability shows that search interfaces and information structuring need improvement in this customer segment. By addressing the transaction orientation of the web site, the low interaction score indicates that the web site does not adequately support customers here. Extending follow-up services or offering customer-to-customer interaction such as customer reviews of products could improve interaction efficiency. With respect to the significant correlation of accessibility in a purchase context, the web site's very low accessibility performance score demonstrates that the web site needs to enhance system quality, particularly for the customer segment that uses the web site for purchasing. This could be achieved by providing faster page loading and product download, i.e. by providing other download formats; a broader accessibility across browser types and devices i.e. for mobile commerce that are currently limited due to flash design of the web site.

CONCLUSION

The goal of this study was to develop an e-business research-oriented instrument that synthesizes IS frameworks and Marketing methodology for measuring customers' overall ISQ performance in relation to a commercial web site. Our developed instrument is a useful performance indicator, as demonstrated in the customer ISQ evaluation of a software manufacturer web site. Thus, the instrument adds exploratory power to existing approaches in IS and Marketing for several

reasons: (i) it enables us to determine overall web site performance with regard to the relevance of quality dimensions to customers; (ii) it further depicts the web sites' performance in relation to a performance maximum, which can be used for benchmarking; (iii) it extends existing IS methodology by integrating related Marketing approaches that are useful for strategic management in terms of creating comprehensive approaches for e-business research.

For practitioners, in particular, the identification of customer relevant ISQ dimensions is useful for customer-oriented web site design. Second, quality benchmarking of a web site's performance on the dimensional as well the overall level is possible with repeated measurement. Circumstantial facts affecting the market should be integrated in the data collection to improve performance. Further studies could emphasize benchmarking, i.e. by including longitudinal data collection or by integrating the surrounding market. For IS researchers, further benefits of engaging with the exhaustive quality Marketing research in this area need to be examined.

Our study, however, also possesses various limitations. As mentioned above, our model integrates approaches from the Marketing literature. For the operationalization of ISQ dimensions, questions concerning the classification of dimensions were not considered. Additionally, the aim of the empirical part of our study was the demonstration of the approach's benefits by real data, even if the web site operator stays anonymous. Nevertheless, due to sample size and the male-female ratio, our study lacks external validity.

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