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Development and validation of an instrument to measure user perceived service quality of information presenting Web portals

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Abstract

Increasing numbers of organizations have set up material on their Web portals as a way of providing users with information about their products or services. This study developed and validated an instrument to measure user perceived service quality of such portals. Based upon conceptual models in the areas of IS and technology adoption, and using responses from 1992 users, we validated a five-dimension service quality instrument involving: usability, usefulness of content, adequacy of information, accessibility, and interaction. This scale provides a useful instrument for researchers who wish to measure the service quality of Web portals and for portal managers who want to improve their service performance.

Keywords: Web portal service quality; Scale development; Electronic commerce; Information presenting Web portal; Web site design; Web site quality

1. Introduction

An information presenting Web portal (IP Web portal) is a site that provides users with online information and information-related services, such as search functions, community building features, commerce offerings, personal productivity applications, and a channel of communication with the site owner and peer users [20]. During the past decade, an increasing number of organizations have established IP Web portals to complement, substitute for, or extend their existing services to users [49].

By integrating an IP Web portal with existing business processes, portal owners hope to create a cost effective channel to communicate with users, e.g., potential and existing customers, as well as other stakeholders. For potential customers, IP Web portals are a platform that enables them to become acquainted with an organization, to explore its goods and services, and to make inquiries. For existing customers, IP Web portals are a place to become more familiar with the organization, to obtain product and service-related information, to request services, and to exchange

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information with peer users of the same goods and services. Moreover, IP Web portals are a good medium for their owners to communicate with other stakeholders, such as shareholders, public, and the government. As more people use IP Web portals, providing user-oriented, quality IP Web portal services have become an important way for owners to satisfy their users (e.g. [48]).

Customers realize that services provided by IP Web portals are substantially different from traditional ones, which normally involve human interactions (between customers and service provider). In contrast, services provided by IP Web portals generally consist of three types of interactions: (1) between customers and the portal employees via either Internet-based communication tools (e.g., email, chat room, etc.) or traditional channels (e.g., mail, fax, etc.); (2) between customers and the portal; and (3) among peer users of similar goods and services via email, chat rooms, etc. The quality issues concerning the first type of interactions are mainly traditional ones, while those of the second and third include Web design. A study of the service quality of the portal needs to integrate both traditional and Web design quality (the technical quality of a Web site).

Most previous studies, however, have focused either on the service quality of transaction-based or retailing oriented Web sites [9,19,35,51–56] or on the Web design quality [5,33,57,58]. Only a few empirical studies have examined the quality of both types of interaction. Furthermore, these few studies did not employ a rigorous and systematic procedure to develop and validate an instrument.

Our study is aimed at developing and validating an instrument to measure user perceived overall service quality of IP Web portals. It follows the guidelines of measurement development proposed by Churchill [10].

2. Research on service quality of Web sites

2.1. Research domain

The service quality of Web sites is still an underdefined construct [2]. Our literature review revealed that there was considerable confusion in defining and interpreting the meaning of service quality for Web sites. The main reason was because there are various types of Web sites. Hoffman et al. [24], for instance, classified commercial Web sites into six types: online storefront, Internet presence, content, shopping mall, incentive site, and search agent. Consequently, service quality dimensions differ according to the Web site. For example, dimensions such as fulfillment/reliability, ease of use, and security/privacy are important for Web sites that market products which require physical delivery [42,44]. For Web sites providing digital products or services, factors like information quality, search capacity, and information reliability are relevant [2,30,39,40,47]. A global measure of Web site service quality, therefore, is difficult to develop and is likely to suffer from the same criticisms confronting the SERVQUAL scale (the global measure of service quality) being industry or context dependent.

Hence, a clear research domain was needed in developing a valid measurement scale for our study. Our focus was on Web portals that function as an information presenting and communication enabling site for users. Web portals of this type include commercial portals that provide information about corporations and their products or services, and non-commercial Web sites built by government agencies, universities, and non-profit organizations. Online transactions are not the focus of these portals, though users may conduct transactions offline or occasionally online. Consequently, some important service quality dimensions of transactional-based Web sites such as ‘‘fulfillment,’’ ‘‘delivery,’’ and ‘‘easy payment’’ do not apply. To date, little research has examined user perceived service quality of IP Web portals.

2.2. Research on service quality of retailing oriented Web sites

Several measures have been devised for e-tailing service quality measures; e.g., .comQ, eSQ, and SITEQUAL [54]. The .comQ (dotcom service quality) scale established by Wolfinbarger and Gilly [52] includes four major factors—Web site design, fulfillment/reliability, privacy/security, and customer service. The eSQ (electronic service quality) scale developed by Zeithaml et al. [55] developed eleven dimensions of service quality by using focus group interviews of consumers. They are: access,

ease of navigation, efficiency, flexibility, reliability, personalization, security, responsiveness, assurance/trust, site aesthetics, and price knowledge. By asking college students to evaluate online retailers' Web sites, Yoo and Donthu [54] developed a measurement instrument for Internet shopping sites: SITEQUAL (site quality). It has four dimensions: ease of use, aesthetic design, processing speed, and security.

These scales were established for transactional Web sites. For example, one of the major components of .comQ is reliability/fulfillment. It involves such items as ''The product that came was represented accurately on the Web site'' and ''The product is delivered at or before the time promised by the company.'' These dimensions and items may not be applicable for IP Web portals, which typically do not offer online transaction options. Nevertheless, e-tailing Web sites also provide information and communication functions to some extent. Some service quality attributes, such as usability (ease of use/navigation or Web design) and security, can be adapted to measure IP Web portals.

2.3. Research on Web site design quality

Most studies that address service quality of Web sites have focused on its dimensions; e.g., one instrument, WEBQUAL (Web site quality) [35], has 12 dimensions: information fit to task, interaction, trust, response time, design, intuitiveness, visual appeal, innovativeness, flow, integrated communication, business process, and substitutability. The scale, however, has limitations. First, the scale helps Web site designers to improve the users' perception of the site and thus is more involved with interface design. Second, the scale does not cover any aspects of customer–employee interaction. Third, the survey simply asked students to visit Web sites and evaluate their quality.

In addition, most studies of Web site quality are exploratory or conceptual in nature having no empirical validation. For instance, Liu and Arnett [33] identified four key dimensions, based on a survey of Fortune 1000 companies (information quality, system use, system design quality, and playfulness), as determinants for the success of Web sites in the context of Internet commerce. However, the dimensions were not confirmed empirically.

A study using student samples was conducted by Aladwania and Palvia [2]; it resulted in a 25-item scale measuring four dimensions of Web design quality (specific content, content quality, appearance, and technical adequacy). One hundred and twenty-seven students evaluated different types of sites including a bank, bookshop, car manufacturer, and electronic retailer. However, while student samples are appropriate in an exploratory study, they are not suitable for confirming critical Web site features of all types of customers.

2.4. Research on Web portal service quality

The only published research addressing Web portal service quality that we have found was conducted by Van Riel et al. [48]. It employed exploratory factor analysis (EFA) to identify underlying dimensions. Based on a sample of 52 subscribers from a portal that publishes a weekly medical newsletter, they found three key aspects of portal service: core service, supporting services, and user interface. The small sample, coupled with a low response rate (7%) ''severely limited the generalizability of the conclusions.'' A number of industry-specific items were included in their questionnaire (e.g., ''I'm satisfied with the capability of having discussions with other doctors'' and ''I get additional information from the site, within the same context as that I get from journals''). Hence, a focus on a specific industry limits the generalizability of the findings.

In sum, prior research across various disciplines developed some fundamental knowledge about Web site service quality. However, the lack in the area of IP Web portals resulted in our study.

3. Conceptual framework

There is currently no established conceptual foundation for developing and measuring the service quality of Web sites in general, and IP Web portals in particular. Thus, we integrated several conceptual methods to identity important service quality dimensions related to IP Web portals for our study. Fig. 1 lists these foundations and their relationships to the proposed service quality factors studied.

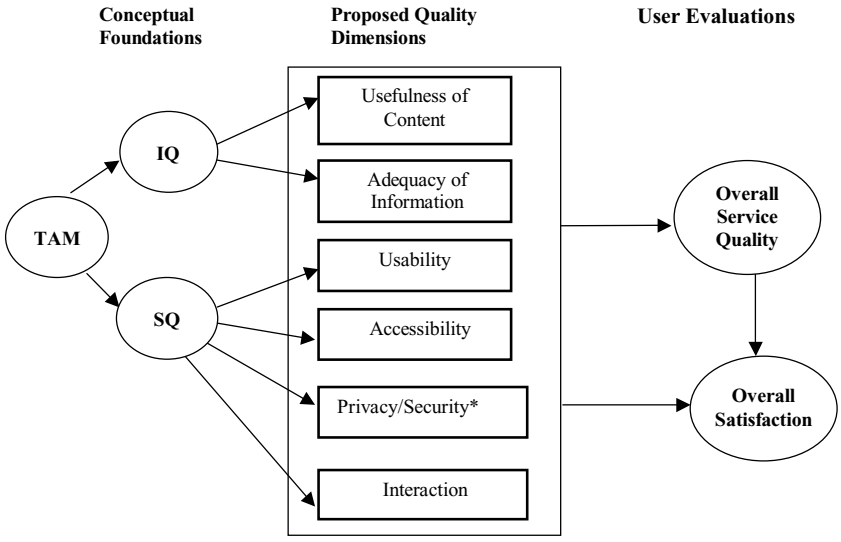

Fig. 1. Proposed conceptual foundations and quality dimensions of information presenting Web portals. *Notes*: TAM: technology adoption model; IQ: information quality; SQ: system quality; (*) this factor was merged into ''Usability'' in the final scale.

First, a user must have a reason to adopt the Internet as an information and communication channel. The well-known technology adoption model (TAM) is thus embraced. Second, an IP Web portal essentially is an IS, consisting of digital information and an information delivery infrastructure (browsers, search engines, encryption, networking systems, etc.). Accordingly, information quality and system quality are of importance for IP Web portal users.

3.1. Adoption of the portal as information and communication media

TAM was developed by Davis [13]; it suggests that users' decision to adopt an IT is primarily determined by their attitudes toward: (1) usefulness and (2) ease of use [13,14]. The causal relationships have been widely investigated and verified in many studies [1,13,14,22,25].

If usefulness and ease of use of information and communication through the Internet do not outweigh customers' losses caused by impersonal experiences, technical difficulties, learning effort, etc., customers may simply switch back to traditional channels. A question is therefore: what aspects of ''usefulness'' and ''ease of use'' of Web portals do customers expect?

3.2. Information and system quality

Information and system quality are two major determinants of user perceived usefulness and ease of use [16,45]. Separating content or information from the delivery system can elucidate the process by which users evaluate service quality of a Web site [37].

3.2.1. Information quality

McKinney et al. [37] defined Web-based information quality as ''users' perception of the quality of information presented on a Web site.'' Scholars in the area of traditional computing settings have established well-known models to measure information quality. In a study on the determinants of information system success, Delone and McLean [16] highlighted the importance of relevance, timeliness, and accuracy of information. Similarly, the end-user computing satisfaction model developed by Doll and Torkzadeh [17,18,22] also emphasized three determinants of user satisfaction: content, accuracy, and timeliness. The dimensions suggested in these two studies and others [2,4,7,26,30,47] could be classified into usefulness of content and adequacy of information.

3.2.1.1. Usefulness of content. This refers to the value, reliability, currency, and accuracy of information.

Specifically, information value is concerned with relevancy and clearness. Information reliability refers to its accuracy, dependability, and consistency. Information currency is concerned with information timeliness and continuous update. Information accuracy describes the degree to which the system information is free of error.

3.2.1.2. Adequacy of information. This is the extent of completeness of information. Web sites need to provide information to facilitate user understanding of the products and system decision making (e.g., detailed product description, transparent price information). In addition, users need supplemental services, such as company information, professional advice, research reports, hyperlinks to relevant Web sites, contact information, and archives in addition to the core offerings [9,31,48].

3.2.2. System quality

This refers to ''customers' perception of a Web site's performance in information retrieval and delivery.'' Research on IS has resulted in various instruments to measure system quality. Among them, ease of use has been regarded as the most frequently used factor in measuring IS success or user satisfaction. In the context of Web sites, researchers have identified factors such as interactivity, navigation, access, hyperlinks, entertainment, and security/privacy [31,34–37,48,58]. We categorize factors into four major attributes: usability, accessibility, privacy/security, and interaction.

3.2.2.1. Usability. In the context of Web sites, usability is related to user friendliness [23,38]. Researchers have identified various factors, primarily content layout and classification [9], Web site structure, user interface, Web site appearance and visual design, intuitiveness, readability/comprehension/clarity, search facilities, and ease of navigation. One critical requisite is technical adequacy, which concerns Web site technical features; e.g., capacities of systems, networking, hardware and software, and system integrity.

3.2.2.2. Accessibility. The convenience benefit of using a Web site as an information center can not be achieved without accessibility. It involves two aspects: availability and responsiveness. Customers expect the Web-based services to be available at all times and they also desire speedy log-on, access, search, and Web page download.

3.2.2.3. Privacy/security. Web sites often collect a variety of sensible, personal information from their users in order to understand and service its users. Accordingly, privacy and security features have become a serious concern [32]. Some frequently used measures include vendor guarantees of personal information protection, confidence resulting from promises on the site, and the reputation of the organization.

3.2.2.4. Interaction. This involves three types of operations between: users and service providers' employees, users and the Web site, and among peer users of similar products. Although using an IP Web portal is primarily a self-served process, users may still expect to receive personalized or customized services from a knowledgeable, responsive, and caring contact person. It may also be expected to be provided automatically, without human involvement or using email, message boards, chat rooms, and discussion forum. This reduces the burden of addressing some of the customer concerns, while grasping customers' comments and thoughts.

The six major attributes of Web portal service quality have been separately addressed in various studies. As shown in Fig. 1, these can constitute a workable preliminary framework for further assessment of the portal service quality. They also contribute to the content validity of the constructs to be measured.

4. Methodology

4.1. Scale items development

Following the guidelines of scale development procedures proposed by Churchill [10], we conducted a focus group of six registered users and four middle- and high-level IT and marketing managers from a leading commercial property developer in Hong Kong that has an IP Web portal which was established in 1998 to target

customers, property agents, bankers, and other users.

Major service quality dimensions identified included the importance of information quality, content richness, and usability (e.g., content classification, valid linkages, and layout). But, managers and users differed in their emphases. The managers were concerned more with marketing functions (advertising effectiveness, etc.) while users emphasized the degree of customization of services.

We then drafted a survey questionnaire and asked the managers and the users to screen it. Four statements were refined in accordance with their suggestions. In addition, a pilot study was conducted by sending the questionnaire to 300 selected users of the portal by email. A total of 112 effective responses were received. We performed correlation analyses and reliability tests for each construct. Ten items with the lowest reliability were deleted.

The final questionnaire consisted of 37 items. All were measured by using a 5-point Likert scales anchored by "1" as "strongly agree" to "5" being "strongly disagree." We also included four demographic variables—age, sex, marital status, and education levels.

4.2. Data collection

Our sample was obtained through a simple random sampling technique (cf. [11,29]). First, a sample frame of 170,000 subscribers with an email address was provided by the Technical Department of the property developer. Second, each subscriber was assigned a number, ranging from 1 to 170,000. Then, 10,000 subscribers were chosen by matching the number with output from a random number generator.

The questionnaire was posted on the company's portal. An invitation letter with a hyperlink to the Web page with the questionnaire was sent to each selected subscriber. The letter explained the purpose of the study and encouraged the subscribers to participate in the survey to help improve the portal's service quality.

A total of 2120 subscribers responded within a week. After data screening, we eliminated 128 incomplete and repeat questionnaires. As a result, the total effective sample was 1992 or 19.92% of the sampled subscribers. As all the questionnaires were collected within a week, we did compare earlier and later responses. The non-respondent question was examined by comparing respondents' demographic variables, i.e., age, sex, marital status, and education levels, with those of non-respondents, which was available from the portal's subscriber database. A *t*-test indicated that there were no significant differences. Thus, our data were suitable for further analysis.

4.3. Sample profile

Sixty-three percent of the respondents were male and 37% were female; 74% were between the ages of 25 and 39; 53% were married; and 58% had at least college education. The characteristics of the respondents were similar to Internet user profiles gathered in other studies (e.g. [27,46]).

5. Data analysis and results

5.1. Key service quality dimensions

To identify major service quality dimensions of the portal, we randomly selected 996 (i.e., half) of the responses and conducted a principal component factor analysis with a varimax rotation. The initial factor analysis extracted six factors that were evident on the scree plot and had an eigenvalue greater than one. Then, we eliminated items that did not load strongly on any factor (values below 0.5) or had cross-loadings. A total of 16 items were therefore deleted after four iterations. The remaining 21 items were again factor analyzed. Each item was found to load strongly on only one factor. Five factors were generated; they accounted for 57.7% of the variance. They were labeled: (1) usability, (2) usefulness of content, (3) adequacy of information, (4) accessibility, and (5) interaction (see Table 1).

Among the five factors, usability appeared to be the most important because it explained the largest portion (35.5 %) of the total variance (this included the variance shared by all the variables, the variance unique to individual variables, and the error variance [41]). This factor had six scale items that addressed the organization, structure, and security features of the portal. The second factor, usefulness of content,

Table 1
Exploratory factor analysis

	Factors				
	1	2	3	4	5
Usability					
Well-organized hyperlinks	0.712				
Adequacy of security features	0.637				
Search facilities	0.603				
Customized search functions	0.601				
Customized information presentation	0.593				
Confidentiality for customer information	0.591				
Usefulness of content					
Unique content		0.783			
Relevant information to the customer		0.757			
Valuable tips on products/services		0.620			
Reliable professional opinions*		0.569			
Up-to-date information		0.556			
Adequacy of information					
Information comprehensiveness relative to other portals			0.741		
Complete content			0.703		
Sufficient information for potential and existing customers			0.611		
Complete product/service description			0.580		
Detailed contact information			0.542		
Accessibility					
Accessibility of the site				0.854	
High speed of page loading				0.761	
Interaction					
Interactive feedback between customers and the company*					0.828
Follow-up services to customers					0.553
Message board forum for customers-to-customer/company					0.549

Note: Extraction method: principal component analysis. Rotation method: Varimax with Kaiser normalization. (*) Items were deleted in the final scale.

explained 6.4% of the variance. It measured whether the contents of the portal were valuable to their users, i.e., whether the information was unique, reliable, up-to-date, and relevant. The third factor, adequacy of information, accounted for 5.4% of the variance. It consisted of five items related to the comprehensiveness of the information provided by the portal. The fourth factor, accessibility, represented 5.4% of the variance and consisted of two items measuring whether users could easily access the Web site and whether Web page loading speeds were fast. The last factor, interaction, explained 5.0% of the total variance and consisted of three items that addressed interactions (1) between users and the portal and (2) among users.

5.2. Confirmatory factor analysis of the model

In order to test the factor structure more rigorously, we conducted confirmatory factor analyses using the remaining 996 cases in the dataset. We first tested a first-order measurement model (see Fig. 2) using the EQS 5.7b [6]. Following Byrne [8], we specified this model in such a way that (1) the model included the identified five factors as first-order factors; (2) the five factors were correlated; (3) the five factors were one level away from the observed variables; (4) each observed variable had a nonzero loading on its designated factors and zero loadings on other factors; and (5) the measurement error terms associated with the observed variables were uncorrelated.

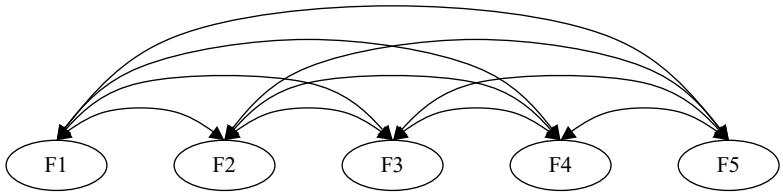

Fig. 2. The first-order measurement model. Chi-square = 509.45; $P = 0.00$; CFI = 0.94; RMSEA = 0.05.

The first-order measurement model showed a reasonable model fit, with a ratio of Chi-square to degree of freedom of 3.47, RMSEA of 0.05, CFI of 0.94, NNFI of 0.93, and SRMR of 0.04. However, two items were found to be inappropriate by the CFA. Specifically, one item (reliable professional opinions) had an unacceptably small loading on its designated factor (0.294). Another item (Interactive feedback between customers and the company) was found to significantly load on more than one factor. Cross-loading was indicated by the results of the Lagrange Multiplier (LM) test, which suggested that the overall model fit would be significantly improved if the second item were allowed to cross-load on the factor *usability* (Chi-square drop by more than 45). Accordingly, these two items were deleted and only 19 items remained. The revised first-order measurement model showed an excellent model fit, with a ratio of Chi-square to degree of freedom of 3.58, RMSEA of 0.05, CFI of 0.95, GFI of 0.95, NNFI of 0.93, and SRMR of 0.04. All items loaded on their designated constructs significantly. The item loadings on their corresponding dimensions ranged from 0.47 to 0.80 (see Table 2).

Additionally, since the current study was intended to develop an instrument for measuring IP Web portal service quality, we assumed that there existed a second-order factor of overall portal service quality that explained the five first-order factors. The existence of such a second-order factor was supported by the argument made by Parasuraman et al. [39] that there exists a single overall service quality construct.

Therefore, a second-order factor measurement model was developed (see Fig. 3). Following Byrne, we constructed the model in a way that (1) the model included the five first-order factors identified in the factor analysis process and one second-order factor (overall portal quality); (2) covariance among the five first-order factors were fully explained by their regression on the second-order factor; (3) each observed variable had a nonzero loading on its designated factors and zero loadings on other factors; and (4) the measurement error terms associated with the observed variables were uncorrelated.

The model exhibited an excellent model fit, with a ratio of Chi-square to degree of freedom of 3.55, RMSEA of 0.05, CFI of 0.94, GFI of 0.95, NNFI of 0.93, and SRMR of 0.04. All five first-order factors loaded on the second-order factor strongly (>0.67) and

Table 2
Confirmatory factor analysis

Factor and item	Loading	CR	AVE
Usability			
Customized search functions	0.65	0.87	0.54
Search facilities	0.68		
Well-organized hyperlinks	0.65		
Customized information presentation	0.69		
Confidentiality for customer information	0.49		
Adequacy of security features	0.47		
Usefulness of content			
Relevant information to the customer	0.62	0.84	0.57
Up-to-date information	0.77		
Valuable tips on products/services	0.80		
Unique content	0.63		
Adequacy of information			
Complete product/service description	0.68	0.89	0.62
Information comprehensiveness relative to other portals	0.59		
Complete content	0.74		
Sufficiency of information	0.67		
Detailed contact information	0.64		
Accessibility			
Accessibility of the portal	0.67	0.77	0.63
High speed of page loading	0.79		
Interaction			
Follow-up services to customers	0.61	0.66	0.50
Message board forum	0.52		

Model Fit Indices: $\chi^2/\text{d.f.} = 3.58$; RMSEA = 0.05; GFI = 0.95; CFI = 0.95, NNFI = 0.93; SRMR = 0.04. *Note*: CR, composite reliability; AVE, average variance extracted.

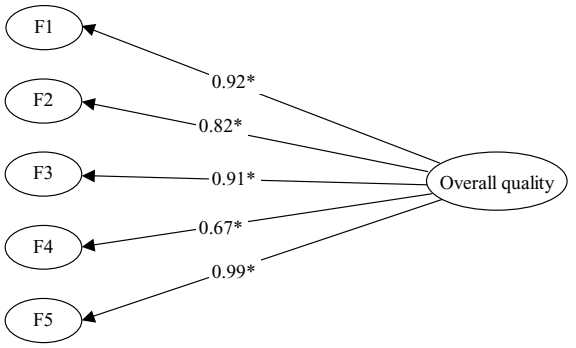

Fig. 3. The second-order measurement model. Chi-square = 518.10; $P = 0.00$; CFI = 0.94; RMSEA = 0.05. *Notes*: F1: usability; F2: usefulness of content; F3: adequacy of information; F4: accessibility; F5: interaction. $^{*}P < 0.001$.

significantly. This result confirmed that a second-order factor of overall portal quality existed.

5.3. Reliability and validity tests

The reliability of a measure is the extent to which it is free from random error. To estimate the reliability of the instrument, we employed composite reliability tests which examined the internal consistency of the indicators that measured each CFA factor. It had advantages over Cronbach's alpha when the measures were not Tau-equivalent. The composite reliability for each factor was computed by using the EQS output. They were: 0.87, 0.84, 0.89, 0.77, and 0.66, respectively (see Table 2). Thus, the reliability of the scales was deemed acceptable [3].

Next, we assessed convergent, discriminant, criterion-related, and nomological validity of the scales. Among them, the convergent and discriminant validity were required to establish construct validity, referring to the degree to which a scale measures what it is intended to measure. The criterion-related and nomological validity tests were critical in determining whether a scale behaved as expected in terms of its relationships with other theoretically related outcome variables and constructs.

First, convergent validity implies that evidence from different sources gathered in different ways all indicated the same or similar meaning of a construct [28]. To test the convergent validity of the five factors for the first-order measurement model, we calculated average variances extracted (AVE) for each construct. They were: 0.54, 0.57, 0.62, 0.63, and 0.50, respectively. All met the recommended minimum level of 0.5 [21], thus supporting the convergent validity for the first-order measurement model. Moreover, in the second-order measurement model, all the five first-order factors loaded significantly on the second-order factor, with the standardized loadings larger than 0.67. As in the case of the first-order measurement model, one could interpret this result as an indication of convergent validity for the second-order measurement model.

Second, discriminant validity implies that one can empirically differentiate a construct from other constructs that may be similar, and can determine what is unrelated to the construct. To test discriminant validity of the factors, we took a nested model confirmatory analysis approach. For each pair of factors, we first constructed a constrained model in which the covariance between them was fixed to unity. This assumed that there was no discriminant validity between the factors. Then, we constructed an unconstrained model by freeing the covariance between the factors. For each pair of factors, there existed significant difference in the Chi-square between the constrained and unconstrained models with one degree of freedom. The results indicated the discriminant validity among the five factors.

Third, criterion validity refers to the extent to which the factors measured are related to pre-specified criteria. To assess the criterion validity of the derived dimensions, a regression analysis was performed for the dependent variable (user evaluation of overall service quality). This was measured by the item ''Overall, the services provided by the portal have excellent quality''. The mean of the five derived factors were entered as independent variables. The overall model fit for the regression equation was assessed by F statistics. The regression model was significant at $P < 0.001$. All the five dimensions were significant and had positive relationships with the overall service quality, thus confirming the criterion-related validity. As shown in Table 3, user evaluation of the portal's service quality was most strongly affected by usability and usefulness of content, followed by adequacy of information, interaction, and accessibility.

Finally, we examined the instrument in terms of its nomological validity. This determines whether an

Table 3
Regression analysis results between overall service quality and five quality dimensions

Independent variables	Standardized coefficients beta	*t*-value	*P*-value
Usability	0.37	10.54	0.000
Usefulness of content	0.25	7.98	0.000
Adequacy of information	0.08	2.22	0.026
Accessibility	0.05	1.97	0.049
Interaction	0.07	2.27	0.023

$F = 168.86$, $P < 0.000$, $R = 0.678$, $R^2 = 0.46$, adjusted $R^2 = 0.46$.

instrument behaved as expected with respect to other constructs to which it is theoretically related. Previous studies have suggested that if users receive high quality service, they are likely to be satisfied [12,15]. Therefore, we tested a structural model that related overall portal quality to user overall satisfaction (see Fig. 4). This was measured by two items: (1) "All in all, I am very satisfied with the portal's services," and (2) "I am satisfied with the property information provided in the portal." The structural model showed a good model fit, with a ratio of Chi-square to degree of freedom of 3.5, RMSEA of 0.05, CFI of 0.94, GFI = 0.94, NNFI of 0.93, and SRMR of 0.04. Moreover, as predicted, it showed that the overall portal quality had a positive, significant influence on user satisfaction (parameter estimate: 0.92). Therefore, the nomological validity of this instrument was demonstrated.

6. Discussion

6.1. The five-factor instrument

The study has determined that there are five service quality dimensions perceived by users of an IP Web portal: usability, usefulness of content, adequacy of information, accessibility, and interaction. These were consistent with our original factors except for the security/privacy factor. Initially, this was viewed as a distinct dimension. However, our results indicated that it was linked to usability; so it was merged into this factor. One primary explanation lies in users' difficulty in making a sound independent assessment of security and privacy. Instead, it was typically evidenced by other factors related to a Web site. As Wolfinbarger and Gilly [52] pointed out:

> [O]nline consumers suggested that they had difficulty judging the privacy and security of a site, even after checking that the site was secure when making transactions and after reading a statement of privacy that in their minds was legalistic. It appears that initially consumers judge security/privacy based on elements such as the professional look and feel of the Web site, as well as functionality of a Web site, and company reputation.

The five factors significantly affected users' overall service quality evaluation, which in turn influenced user satisfaction. The factors addressed the essential aspects of IP Web portal service quality: information

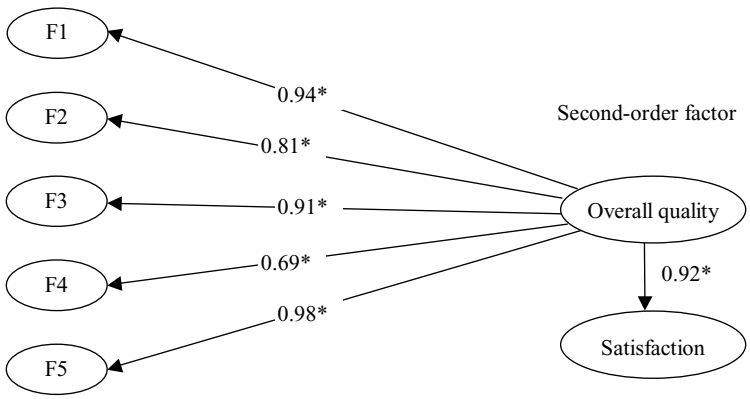

Fig. 4. The nomological model. Chi-square = 852.40; $P = 0.00$; CFI = 0.91; RMSEA = 0.06. *Notes*: F1: usability; F2: usefulness of content; F3: adequacy of information; F4: accessibility; F5: interaction. $^{*}P < 0.001$.

retrieval and delivery, information quality and quantity, and interaction.

6.2. Efficient information retrieval and delivery

Our study identified two major aspects of efficient information retrieval and delivery systems: usability and accessibility. This dimension was found to be the one that most significantly influences users' overall service quality perceptions. Managers of an IP Web portal should design a user friendly Web site, with appealing Web page appearance and visual design, intuitive layout and classification, high readability, and simple and easy-to-use search and navigation directions. To a user, it is important to be able to locate the needed information without difficulty. Thus, managers may consider using "personalization software" with a self-learning engine to evaluate users' real-time behaviors ("what a visitor is looking at") and to offer relevant information and suggestions to users who are not frequent visitors. Based on regular user's browsing behavior and input, customized recommendations can promptly be provided.

Although users usually do not conduct online transactions, portals still need to protect users' personal, sensitive information from hackers, and its avoid abuse for marketing purposes. Accordingly, IP Web portals need strict security policies and to use advanced security technologies.

It should be noted that improving IP Web portal usability is a continuous process. Managers need to make use of feedback, including online surveys, emails, online communities, and bulletin boards. From a technical perspective, enhanced software that provides integrated access to data systems, documents, and other e-commerce functionality is effective in increasing usability.

Accessibility means that users expect to access IP Web portals anytime and view its content quickly. Slow downloading will frustrate users and may force them to turn to other portals.

6.3. Information quality and quantity

Users demand unique, reliable, valuable, and up-to-date information from portals. To provide them with this, a formal policy of content development and information selection should be set. Therefore, a sound content management system to track, edit, and update contents is essential. Yahoo regularly provides relevant lists of content linkages through manual editing. Finally, managing information flow between internal departments is critical and challengeable for the purpose of information consistency and update.

The information quantity dimension indicated that users desire in-depth and comprehensive information. IP Web portals should provide sufficient information for all customers, including company background, goods and product information, payment policy, and after sales service.

Some participants mentioned that if an IP Web portal lacks "completeness," users would find it difficult to get a "broad and relevant" picture; others suggested that "too much" information could stop users finding what they want. A balance therefore has to be made.

6.4. Interaction as an advantage of an IP Web portal

Our results indicate that an IP Web portal should satisfy user information needs in terms of two interaction aspects: users often want to make inquiries with respect to the organization (in addition, accessible and knowledgeable spokespersons are needed) also as users seek guidance, suggestions, and testimonies from peer users, they may require interaction with someone directly via the IP Web portal. Facilities may include user chat rooms, message board, customer reviews, reputation systems, and customer ratings [43,50].

7. Conclusions

This study employed a rigorous scale development procedure to establish an instrument that measures users' perceived service quality of IP Web portals. Each of the five identified and verified factors had a significant impact on overall service quality. Through understanding the service quality dimensions for IP Web portals, an organization will stand a much better chance of gaining more business and serving its stakeholders. For managers, the 19 items across five factors can serve a useful diagnostic purpose. The managers can use the validated scale to measure and improve service. Furthermore, the five-dimension measurement scale adds to extant literature by establishing a basis for further theoretical

advances on service quality related to on-line user retention and loyalty.

The study has its limitations. Our data were collected from users of a single property developer portal in Hong Kong. Generalization of our five-dimension scale still needs to be viewed with caution.

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Appendix A. Initial measurement dimensions and items of Web portal site quality

The following measurement items were generated from personal interviews except as otherwise specified.

(1) Usefulness/quality of information (Items 1–4 were adapted from Liu and Arnett [33])
   1. Relevant information to the customer
   2. Accurate information*
   3. Up-to-date information
   4. Customized information presentation
   5. Valuable tips on products/services
   6. Reliable professional opinions*
   7. In-depth market analysis*
   8. Unique content

(2) Ease of navigation/use
   1. Clear and well-organized content*
   2. Well-organized hyperlinks
   3. Customized search functions
   4. Appropriate proportion of advertising*
   5. Ease of finding desired information*
   6. Logical layout*
   7. Search facilities

(3) Completeness/adequacy/quantity of information
   1. Complete product/service description
   2. Complete content
   3. Detailed market daily news*
   4. Sufficient information for potential and existing customers
   5. Relatively comprehensive information compared to other portals
   6. Diversified content*
   7. Rich linkages relevant to the content*
   8. Detailed contact information

(4) Interactive communication/customization (Items 1–4 were adapted from Liu and Arnett [33])
   1. Quick responsiveness to customers*
   2. Empathy to customer problems*
   3. Follow-up services to customers
   4. Message board forum for customer-to-customer/company
   5. Interactive feedback between customers and the company*
   6. Assurance to solve customers' problems*

(5) Technical adequacy 5 (Item 1 was adapted from Liu and Arnett [33], Items 2–7 were adapted from Aladwania and Palvia [2])
   1. High speed of accessing the Web*
   2. High speed of page loading
   3. Proper use of fonts*
   4. Proper use of colors*
   5. Proper use of multimedia*
   6. Proper use of graphics*
   7. Valid links*
   8. Accessibility of the site
   9. Strong technical support*

(6) Privacy and security
   1. Confidentiality for customer information
   2. Adequacy of security features
   3. Reputation of the company*
   4. Proper use of personal information*

Overall service quality

1. Overall, the services provided by the portal have excellent quality
2. The service quality provided by this portal matches my expectations
3. This portal's service offerings are very competitive

Overall Satisfaction

1. All in all, I am very satisfied with the portal's services
2. The portal can largely fulfill my needs at this stage

Note: (*) items were deleted from later analyses.

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