An Empirical Investigation of E-commerce Application Development Effectiveness

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AN EMPIRICAL INVESTIGATION OF E-COMMERCE APPLICATION DEVELOPMENT EFFECTIVENESS

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ABSTRACT

This study reported here examined how system design factors in the online environment influence the effectiveness of e-commerce application development. An alternative model for information requirement definition was proposed. A regression analysis was used to test the effect of this model on the success of e-commerce application development. Results show that reliability, efficiency and privacy related features are important factors for the success of e-commerce application development. Theoretical and managerial implications of the findings are discussed, and future research directions are suggested.

INTRODUCTION

E-commerce application development is a growing aspect of information system management activities within many organizations. Millions of such applications have been developed in the past ten years. Given the growing importance of E-commerce applications, little is known about how those applications should be developed (Huizingh, 2000). In particular, very few studies have focuses on the effectiveness of business to consumer (B2C) e-commerce application development. System development is a complicated and time-intensive process. It consists of defining the information requirement for the proposed application and transforming those requirements into a computer-based information system. Even though information must be gathered from users and other stakeholders throughout the system development process, information requirement definition is considered to be the most important stage for the entire process and is the key for developing a successful information system (Vessey & Conger, 1993).

Since information requirement definition is the first step in the system development process, performing this function ineffectively will significantly impact the outcome of the system under development. Many alternative approaches have been developed for information requirements definition; however, most of them require intensive communications with application users. The users of e-commerce applications are not easily identified and their requirements are even more difficult to define. Researchers and practitioners have also commented that e-commerce applications are different from traditional information systems applications and the traditional systems development methodologies may be inappropriate for e-commerce applications. Therefore, a different systems development approach must be considered in developing e-commerce applications.
The purpose of this study was to propose an alternative model for information requirement definition and to examine its impacts on systems development effectiveness. It is suggested that before web developers can effectively respond to users' requirements, they must understand customers' needs. That is - if Web developers know how customers evaluate a store's service quality, and identify the factors contributing to the evaluation process, then they can design effective e-commerce applications.

This paper first examined the current literature on Web-based system development, a set of design features were derived from previous information systems and marketing literature. E-commerce applications were then collected and analyzed to investigate the effect of design features on system development effectiveness. Finally, this information is summarized with recommendations on how to use this information to develop effective e-commerce applications.

WEB-BASED SYSTEMS DEVELOPMENT METHODOLOGY

With the popularity of Internet, Web developers are finding it more difficult to differentiate their applications solely on the basis of product, price, or promotion in the increasing competitive e-commerce environment. They are forced to evaluate traditional development methods for information requirements definition. However, there are very few information requirement definition methods that are appropriate for the development of e-commerce applications since most of the traditional systems development methodologies focus on the technical and internal issues rather than business and organizational needs. Until recently, information systems and e-commerce researchers are beginning to investigate new Web-based systems development methodologies.

In his study on Web development methodology, Fournier (1998) described the factors involved in the development of client server and Web applications. He proposed the use of Joint Facilitated Sessions to determine user requirements, and his focuses were on internal rather than external stakeholders. Lee (1998) proposed an IDM (Intranet Design Methodology). The IDM consists of ten development stages. The first three stages are related to user requirement analysis. The method uses a meta-information structure to organize information in abstract nodes and an information structure to define the local structure of each node. However, the method focuses on Intranet systems development rather than Internet applications. Howcroft and Carrol (2000) also proposed a Web site development methodology. Their method consists of six tasks: technology analysis, information analysis, skills analysis, user analysis, cost analysis, and risk analysis. Even though it takes an evolutionary view to the development of a Web site and each task is well defined, the method views the users as internal rather than external customers. Recently, Standing (2002) proposed an Internet commerce development methodology (ICDM) as a framework for the development of e-commerce applications. ICDM aims at business to consumer e-commerce applications with focuses on external customers. According to Standing, ICDM is a business analysis methodology as well as systems development methodology. Its components include: Web management structure, strategy and business analysis development phase, meta-development strategy, analysis phase, physical architecture framework, and component implementation and evolution. The user requirement analysis proposed by Standing use two group communication
techniques: brainstorming and group requirement sessions. Brainstorming is used to define alternative ways of using e-commerce in the business, and group requirement session is used to obtain the detailed user requirements. Even though ICDM is a rather comprehensive framework for e-commerce development, it focuses more on management structure and development strategy than user requirement acquisition. A typical e-commerce application might have a large number of users who are not confined by any organizational context. Therefore, group requirement sessions or brainstorming might not be appropriate for most of the business to consumer e-commerce applications.

This paper proposes that in order to meet the needs of e-commerce applications users, information requirement definition must be conducted with a customer focus. Researchers have argued that current e-commerce applications are not user-oriented (Aladwani & Palvia, 2002). In order to understand user requirements in the e-commerce environment, it is important to understand how the individual consumer perceives the store's service quality. If Web developers know how customers evaluate a store's service quality, and identify the factors contribute to the evaluation process, then they can design an effective e-commerce applications. The following section discusses a service quality model that could be used as an alternative for information requirement definition.

**RESEARCH FRAMEWORK: THE E-SQ MODEL**

E-commerce incorporates many of the same characteristics as traditional retail stores. Researchers in the marketing field have studied the effects of store design on retailer's performance. It is generally agreed that the store elements such as color, lighting, style, or music have immediate effects on store's sales, productivity and customer satisfaction (Baker & von Dran, 2001). However, very few studies have examined the effects of store design on e-commerce application effectiveness. Previous studies have provided some design guidelines for Web developers; however, most of them are based on heuristics or rule of thumbs. These studies did not identify design features that contribute to customer satisfaction or service quality expectation.

In order to understand the effects of store design on the effectiveness of information requirement definition, this paper adopted an electronic service quality model for e-commerce information requirement definition. The model is based on the service quality literature in the marketing field (Zeithaml, 2002). In the e-commerce environment, the applications can be regarded as a service and users are customers. In addition to selling goods and services over the Internet, each e-commerce application actually delivers a special service for its customers (Zhang & von Dran, 2001). The quality of this service plays a similar role as the quality of services to consumer in the traditional retail stores. However, without face-to-face human interaction in the online environment, Web developers are facing the challenge of how to design an effective e-commerce application to improve service quality.

The concept of service quality is not new for IS researchers and practitioners. Many IS researchers have applied models in the marketing field to provide information on user satisfaction within the information system functional areas (Kettinger & Lee, 1994; Aladwani & Palvia, 2002). One of the most often used models is the SERVQUAL instrument (Parasuraman, et al., 1988). The
original objective of SERVQUAL was to provide an instrument for service quality measurement that could be used across a broad range of industries with only minor modification. SERVQUAL to date has been applied across a range of private sector organizations and not-for-profit organizations. It is generally recognized that there are five dimensions that consumers evaluate service quality. They are: tangibles, reliability, responsiveness, assurance, and empathy (Parasuraman, et al., 1988).

More recently, Parasuraman and Zeithaml (Zeithaml, 2002) proposed a new e-service quality (e-SQ) concept. They defined e-SQ as "the extent to which a Web site facilitates efficient and effective shopping, purchasing and delivery." The core e-SQ consists of four dimensions: efficiency, fulfillment, reliability, and privacy. Efficiency refers to the ability to help customers find and purchase their desired products with minimal efforts. Fulfillment refers to the ability to deliver ordered products in the promised time. Reliability refers to the technical functioning of the site. Privacy is the ability to keep customer's data safe.

In addition to the core e-SQ dimensions, Zeithaml (2002) also found three dimensions to be important when customer experienced problems or needed to have questions answered. Responsiveness is the ability to provide appropriate information to customers when problems occur. Compensation is the ability to provide customers with satisfaction guarantee. Contact is the ability to provide customers with multiple channel capabilities to contact customer service representatives.

This paper adopted the e-SQ model to the study of e-commerce systems development effectiveness and proposed that an effective e-commerce application could be developed based on the model. The research model is shown in Figure 1. The general research proposition is that the design features derived from the e-SQ dimensions will have positive effects on systems development effectiveness.

Table: Research Proposition

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>The design features derived from the e-SQ dimensions will have positive effects on e-commerce applications development effectiveness.</td>
<td></td>
</tr>
</tbody>
</table>

Figure 1. Research Model
RESEARCH HYPOTHESES

Efficiency

In the context of e-commerce, Web developers should design Web site to allow customer to find their desired products easily. With advanced information technology available today, this task has becoming easier than ever. In fact, information-based products such as music, movie, and software may become more efficient in the online environment where customer can sample or download a trial version of the product. Design attributes to be considered should include: product index, product search, shopping cart, e-account (personal account), and different shopping modes.

Hypothesis 1: Web design with efficiency-related features will have positive effects on systems development effectiveness.

Fulfillment

Fulfillment is the method of providing accuracy of service promised and having products delivered in the promised time. Web designers should use online order tracking features and provide multiple delivery methods to increase customer satisfaction.

Hypothesis 2: Web design with fulfillment-related features will have positive effects on systems development effectiveness.

Reliability

Reliability refers to the store's ability to provide reliable service to its customers. Web designers should incorporate Secure Ordering/Payment System (SSL/SET) features on their Web sites.

Hypothesis 3: Web design with reliability-related features will have positive effects on systems development effectiveness.

Privacy

Privacy refers to the assurances that customers' data and shopping behavior are secured. Web designers should provide confidential guarantee to their customers.

Hypothesis 4: Web design with privacy-related features will have positive effects on systems development effectiveness.
Responsiveness

Web designers should design a site that allows customers to receive adequate service and support adequately. Design features could be used includes well-defined merchandise returned policy and a frequent ask question (FAQ) section.

Hypothesis 5: Web design with responsiveness-related features will have positive effects on systems development effectiveness.

Compensation

When problems occur, the Web site should provide customers with a satisfaction guarantee such as 100% money back guarantee or free restocking fee.

Hypothesis 6: Web design with compensation-related features will have positive effects on systems development effectiveness.

Contact

Web sites should allow customers to speak to a live customer service representative online or over the phone. The design features include telephone support, e-mail support, and 24 hours availability.

Hypothesis 7: Web design with contact-related features will have positive effects on systems development effectiveness.

DATA COLLECTION

A sample pool of 549 online stores was identified from a popular agent Web site. The recent developments of agent-based Web sites are offering online customers an easy shopping environment. Agent Web sites provide customers with comparative prices for a product from multiple online stores. They also invite customers to evaluate stores based on their purchase experience. In the agent Web site we collected data from, customers assigned an overall post-purchase satisfaction rating for the e-tail store based on a five stars scale, with 1 star being the worst and 5 stars being the best. The agent Web site also provides detail store information such as physical address, special store features, return policy, payment methods, and delivery methods. Online stores with less than 30 customer reviews in the agent Web site were eliminated from the study. The final data set consists of 76 e-tail stores. Data was collected from both the agent Web
site and each of the individual store's Web site. The data were coded by the authors and graduate students of the university. Each site was individually examined by two coders using a standardized checklist. The checklist consists of 14 Web design features discussed earlier in the hypotheses section. The data were collected in the spring of 2002.

DATA ANALYSIS

The dependent variable of this research is the effectiveness of systems development. This refers to the effectiveness of a specific e-commerce application. Several surrogate measures have been proposed in the information system literature. User satisfaction is generally recognized as one of the important indicators of success (Doll & Torkzadeh, 1988). In this study, user satisfaction is selected as the surrogate measure for system effectiveness. It was measured by the customer's satisfaction rating on the store. The independent variables of this study are the seven e-SQ dimensions. The 14 Web design features were assigned to each dimension. The averaged score of each dimension is used as the measure for each independent variable. The regression model is as follows:

\[ Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + e \]

where:
- \( Y \) = Web-based Systems Development Effectiveness (measured on the satisfaction score)
- \( X_1 \) = Efficiency (measured on the average design features of product index, product search, shopping modes, shopping cart, and e-account)
- \( X_2 \) = Fulfillment (measured on the average features of online order tracking system and delivery methods)
- \( X_3 \) = Reliability (measured on the use of SSL/SET)
- \( X_4 \) = Privacy (measured on the provision of confidential guarantee)
- \( X_5 \) = Responsiveness (measured on the use of FAQ and merchandise return policy)
- \( X_6 \) = Compensation (measured on the use of 100% satisfaction guarantee feature)
- \( X_7 \) = Contact (measured on the use of phone/e-mail support and 24 hours availability)
- \( e \) = residual term

The main research proposition was tested via regression analysis, with all the 7 e-SQ dimensions entered into the regression equation simultaneously. The analysis indicates that 54% (R^2) of the variance in customer satisfaction was explained by the independent variables, with a significant t-value of 3.960 (p = 0.001). Table 1 shows the descriptive statistics. Table 2 summarizes the regression analysis results. The column title beta shows the beta weights calculated for the main model. The columns t-value and significant show the significance of individual variables in the regression. The F-value and R^2 are shown in the bottom of Table 2. The regression result supports the research proposition that the e-SQ dimensions do have impacts on e-commerce applications development effectiveness.
To test hypotheses 1 - 7, simple regressions were run with customer satisfaction as the dependent variable and each of the seven e-SQ dimensions (efficiency, fulfillment, reliability, privacy, responsiveness, compensation, contact) as independent variables. The results are summarized in Table 3. The column title beta shows the beta weights calculated for each model. The column title significant shows the significance of individual variables in the regression. The variance explained by each variable is shown in the column labeled $R^2$. 

### Table 1: Means and SD for the 7 e-SQ dimensions and Customer Satisfaction

<table>
<thead>
<tr>
<th>e-SQ</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency</td>
<td>3.41</td>
<td>0.80</td>
</tr>
<tr>
<td>Fulfillment</td>
<td>4.67</td>
<td>0.85</td>
</tr>
<tr>
<td>Reliability</td>
<td>0.92</td>
<td>0.27</td>
</tr>
<tr>
<td>Privacy</td>
<td>0.89</td>
<td>0.30</td>
</tr>
<tr>
<td>Responsiveness</td>
<td>1.27</td>
<td>0.65</td>
</tr>
<tr>
<td>Compensation</td>
<td>0.64</td>
<td>0.48</td>
</tr>
<tr>
<td>Contact</td>
<td>1.32</td>
<td>0.50</td>
</tr>
<tr>
<td>Customer Satisfaction</td>
<td>3.36</td>
<td>1.10</td>
</tr>
</tbody>
</table>

### Table 2: Regression results for the main research proposition

(Dependent variable: systems development effectiveness)

<table>
<thead>
<tr>
<th>e-SQ</th>
<th>Beta</th>
<th>t-value</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency</td>
<td>.250</td>
<td>2.169</td>
<td>.034</td>
</tr>
<tr>
<td>Fulfillment</td>
<td>-.126</td>
<td>-1.181</td>
<td>.242</td>
</tr>
<tr>
<td>Reliability</td>
<td>.375</td>
<td>2.982</td>
<td>.004</td>
</tr>
<tr>
<td>Privacy</td>
<td>.103</td>
<td>.715</td>
<td>.477</td>
</tr>
<tr>
<td>Responsiveness</td>
<td>-.047</td>
<td>-.369</td>
<td>.713</td>
</tr>
<tr>
<td>Compensation</td>
<td>.022</td>
<td>.214</td>
<td>.831</td>
</tr>
<tr>
<td>Contact</td>
<td>-.155</td>
<td>-1.468</td>
<td>.147</td>
</tr>
</tbody>
</table>

Notes: $R = .538; R^2 = .290; F = 3.960; p < 0.001$

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Table 3: Results for the seven regression models for e-SQ
(Dependent Variable: Systems development effectiveness)

<table>
<thead>
<tr>
<th>e-SQ</th>
<th>Beta</th>
<th>t-value</th>
<th>F</th>
<th>Significant</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency</td>
<td>.360</td>
<td>3.315</td>
<td>10.991</td>
<td>.001</td>
<td>.129</td>
</tr>
<tr>
<td>Fulfillment</td>
<td>.011</td>
<td>.096</td>
<td>.009</td>
<td>.924</td>
<td>.000</td>
</tr>
<tr>
<td>Reliability</td>
<td>.429</td>
<td>4.080</td>
<td>16.649</td>
<td>.000</td>
<td>.184</td>
</tr>
<tr>
<td>Privacy</td>
<td>.345</td>
<td>3.161</td>
<td>9.993</td>
<td>.002</td>
<td>.119</td>
</tr>
<tr>
<td>Responsiveness</td>
<td>.175</td>
<td>1.531</td>
<td>2.345</td>
<td>.130</td>
<td>.031</td>
</tr>
<tr>
<td>Compensation</td>
<td>.068</td>
<td>.587</td>
<td>.345</td>
<td>.559</td>
<td>.05</td>
</tr>
<tr>
<td>Contact</td>
<td>-.075</td>
<td>-.648</td>
<td>.420</td>
<td>.519</td>
<td>.006</td>
</tr>
</tbody>
</table>

Table 4: Regression results for Customer Satisfaction (with all Web design features)

<table>
<thead>
<tr>
<th>Web Design Features</th>
<th>Beta</th>
<th>t-value</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product index</td>
<td>.327</td>
<td>2.434</td>
<td>.018</td>
</tr>
<tr>
<td>Product Search</td>
<td>.182</td>
<td>1.668</td>
<td>.101</td>
</tr>
<tr>
<td>Shopping Mode</td>
<td>.034</td>
<td>.313</td>
<td>.756</td>
</tr>
<tr>
<td>Shopping Cart</td>
<td>-.135</td>
<td>-1.320</td>
<td>.192</td>
</tr>
<tr>
<td>e-account</td>
<td>.050</td>
<td>.393</td>
<td>.696</td>
</tr>
<tr>
<td>Online Order Tracking</td>
<td>.068</td>
<td>.565</td>
<td>.574</td>
</tr>
<tr>
<td>Delivery Methods</td>
<td>-.137</td>
<td>-1.249</td>
<td>.216</td>
</tr>
<tr>
<td>SSL/SET</td>
<td>.362</td>
<td>2.824</td>
<td>.006</td>
</tr>
<tr>
<td>Confidential Guarantee</td>
<td>.055</td>
<td>.295</td>
<td>.769</td>
</tr>
<tr>
<td>Return Merchandise</td>
<td>-.127</td>
<td>-.845</td>
<td>.402</td>
</tr>
<tr>
<td>FAQ</td>
<td>-.018</td>
<td>-.150</td>
<td>.882</td>
</tr>
<tr>
<td>Satisfaction Guarantee</td>
<td>.092</td>
<td>.873</td>
<td>.386</td>
</tr>
<tr>
<td>Phone/E-mail</td>
<td>-.037</td>
<td>-.332</td>
<td>.741</td>
</tr>
<tr>
<td>24 Hours Support</td>
<td>-.199</td>
<td>-1.845</td>
<td>.070</td>
</tr>
</tbody>
</table>

Notes: R = .638; R² = .407; F = 2.994; p < 0.005
The regression for efficiency yields a positive beta weight of 0.360 and is significant at 0.01. Hypothesis 1 is therefore supported. It suggests that incorporating efficiency-related design features on the Web site does play a significant role in overall customer satisfaction. The fulfillment dimension is found to be positive related to the dependent variable but the coefficient is not significant. The reliability dimension has a positive beta weight of 0.429 and is significant at 0.01. Hypothesis 3 is supported. It suggests that the use of secure order and payment system on the Web site does have significant impact on customer satisfaction. The variable privacy is also significant in the regression model. Hypothesis 4 is also supported. It suggests that the guarantee of customer's data security does have positive impact on customer satisfaction. In addition to the 4 core e-SQ dimensions, responsiveness, compensation, and contact dimensions (hypotheses 5, 6, and 7) were also tested with three regression models. However, all of the three additional dimensions were not significant based on their regression results. The last three hypotheses were not supported.

In addition to the above regression models, a regression analysis was also conducted with all design features as independent variables. The analysis indicates that 64% ($R^2$) of the variance in customer satisfaction was explained by the 14 features, with a significant f-value of 2.994 ($p = 0.002$) (see Table 4). Among the 14 design features, SSL has the strongest effect on customer satisfaction with beta weight of 0.362 and is significant at $P < 0.01$. Product index also has strong effect on customer satisfaction with beta weight of .327 with significant level at $p< 0.05$.

**DISCUSSION**

Three hypotheses are supported in this study. Web sites incorporated efficiency, reliability, and privacy design features have positive impacts on e-commerce application development effectiveness. Customers are more satisfied with their purchase experience when the Web sites have features such as confidential guarantee, secure order and payment system, product index, personal account, and different shopping modes. Web developers should consider those features to develop successful Web sites. The significance result of hypothesis 2 is also consistent with previous studies on information systems user satisfaction (Kettinger & Lee, 1994) and service quality (Zeithaml, 2002). Previous studies also indicated that retailers who convince Web users that online stores are secure environments of retail exchanges are also likely to improve the user's willingness to shop online (Salisbury, etc. 1998). Our results are consistent with previous studies. Customer satisfaction is influenced by their perception on stores' ability to provide reliable and efficient services.

It is interesting to see that the direction of effect for several design features is negative on Table 4. The results are not what we expected. For example, shopping cart, FAQ, phone/e-mail support all have negative effects on customer satisfaction. One possible reason might be the sample size of this study. Future research can collect more data to verify these findings. Another reason might be that design features such as FAQ, shopping cart, and phone/e-mail support have become standard features for most of the Web sites we examined. Customers take those features for granted and don't consider them as special features. This is understandable since e-commerce applications are still in a very early stage compared with other information systems applications. New
e-commerce Web site features are developed almost every month. With advanced multimedia technology, we might have a very different Web interface in the near future. Of course, the Web design features identified in this study needed to be modified constantly as time goes on. We can only conclude that, at the time of this study, reliability and efficiency are important factors for the success of e-commerce Web sites.

IMPLICATIONS AND CONCLUSION

A typical e-commerce application consists of a network of text, graphics, image, etc., each of which should have one or more definitive purpose that are part of the system development strategy. To determine important features that aid in the success of information requirement definition and overall systems development process, it is important to find a theoretical relationship between e-commerce features and the development of e-commerce application. This study has shown the benefit of incorporating constructs from the marketing fields to examine information systems development effectiveness. Specifically, the perceived service quality dimensions are predictors of systems development effectiveness in the e-commerce environment.

With the popularity of Internet, Web developers are finding it more difficult to differentiate their applications solely on the basis of product, price, or promotion in the increasing competitive e-commerce environment. Our findings should provide useful insights into issues that Web developers regularly encountered when designing effective Web sites. In addition, it should help them understand whether the design characteristics influence overall Web site success. These insights should enable managers as well as Web developers to plan for effective Web sites.

Although the results of this study provide some important guidelines for e-commerce development, it is suggested that this initial survey could be advanced by extending the sample size and by more extensive statistical analysis. This research is based on a convenient sample from an agent Web site; therefore a selection bias might have affected our finding. Extensions of this study on other settings and using other data collection methods should provide additional evidence to support our findings. This study also opens doors for future research. It is hoped that this study has gone some way to shedding light into information requirement definition in the online environment. However, much still remain to be done in this area, such as refining the measures and constructs used in this study. Also, we need to investigate the users' demographic, behavior, and experience that are related to e-SQ and customer satisfaction. The results we present here are an important step toward the understanding of the future of e-commerce application development.
REFERENCE


