An Investigation of Factors and Measurements for Successful e-Commerce Websites

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Abstract: Business-to-Consumer (B2C) e-commerce is popular because of its convenience, speed and price. Although there has been intense debate about quality dimensions of e-commerce websites, more research is needed to find a well-established measurement. This empirical study identifies a set of measurements with 10 factors and their corresponding dimensions, including software development attributes based on the literature and the qualitative and quantitative data gathered from four different stakeholders. The survey results suggest that security, smooth transaction processes and smooth shopping processes are the most important concerns for online shoppers. The IS success model checking suggests that the proposed measurements are comprehensive. This work is compared with the customized ISO 9126 quality model.

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1 INTRODUCTION

Business-to-Consumer (B2C) e-commerce is popular because of its convenience, speed and price (Luo et al., 2008). Although there has been debate about quality dimensions of e-commerce websites, however, they are not well-established, and more research is needed to find a measurement of e-commerce website success (Balfagih et al., 2010).

The existing relevant works contain either a broad framework which does not include specific and detailed information for more accurate, effective and practical evaluation of e-commerce websites, or the measurements focus only on certain aspects of the e-commerce websites, or the measurements are applicable to a general information system not specific for e-commerce websites. The existing DeLone & McLean IS Success Model was updated and extended by introducing new metrics for e-commerce system success measurement (DeLone & McLean, 2003). This framework was modified and extended further to be more specific on measuring e-commerce website success (DeLone & McLean, 2004). When these frameworks are applied to a specific website, further interpretations or refinements are required. An empirical study was conducted to develop a set of instruments of B2C e-commerce website quality (Cao et al., 2005). The instruments covered some aspects of service quality, such as responsiveness, information quality, and information accuracy. However, they omitted other aspects, such as page design and shopping process. The 7C framework was developed (Rayport & Jaworski, 2001) to evaluate e-commerce websites; however, it emphasizes the specific role of interface elements as a communication channel between retailers and their customers. The 7Cs evaluates an e-commerce website more from a user interface design perspective than information quality and usability perspectives. The 8C framework was developed based on the 7Cs to cover the Web 2.0 features (Yang et al., 2008). However, the scope of 7Cs was extended for generic web application, and the dimensions were interpreted more from technique implementation perspectives. A B2B e-commerce web application evaluation model was proposed in 2009 (Behkamal et al., 2009), in which a traditional software quality model, ISO 9126, was customised by identifying the B2B quality characteristics and adding the necessary attributes. The customisation was carried out in five steps. A numeric value was assigned to each of the quality characteristics from both the B2B application users' and developers' viewpoints. So the result emphasizes the user and development issues.

The long-term success is determined by their ability to generate positive net revenues (DeLone & McLean, 2004). Attracting Internet users, encouraging customer loyalty and improving service are aiming to increase profits ultimately (Bezes,

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2009). These suggest that the ultimate measurement for e-commerce website success is profit. To help the business owners improve the quality of their e-commerce websites, there is a need to identify the factors that critically influence the quality of the websites and the measurements which can reflect the profit closely.

This empirical study focuses on B2C e-commerce websites that support shopping functionalities. It aims to find a set of comprehensive, specific and objective measurements based on the information possibly obtained from different sources for successful e-commerce websites. It uses the existing research findings as a starting point and captures the critical factors that contribute to the success of an e-commerce website from design, content, shopping process, security, management and technique perspectives. Ten important factors and their dimensions were identified initially (Lian, 2012). To verify and refine these factors, data were collected from an online survey of e-commerce website users, interviews of relevant professionals and online tool testing. The data were interpreted and analyzed with the help of two simple quantitative instruments: mean and standard deviation; and the factors as well as their dimensions were refined. The refined factors were examined against the six dimensions of the updated DeLone and McLean (2004) information systems success model. The refined factors were also examined against the conceptual model proposed by Ghandour group (Ghandour et al., 2008).

In the following sections, the initial measurements are described first, that is, followed by the data analysis and the measurement refinement, the proposed measurements are validated, and finally the result is discussed and the paper is summarized.

2 INITIAL FACTORS

On the basis of a study of the existing publications, this research identifies 10 factors that may contribute to the success of e-commerce websites. The detailed dimensions for each factor were also identified at the same time. Following are the 10 factors, their dimensions, their literature sources and their codes which will be referred to in the rest of this paper:

- ***Factor 1. Site Popularity (F1)*** *(Ghandour et al., 2008)*: Keeping high daily reach (F1D1), A large number of unique users (F1D2), A larger number of visitors (F1D3);
- ***Factor 2. Website Profit (F2)*** *(Carney, 2005; Barnes, 2002)*;
- ***Factor 3. Usability and Performance (F3)*** *(Haenlein, 2004; Kuballa, 2007; May, 2000; Chen, 2005)*: Speed of site load (F3D1), Website consistence for the leading browsers (F3D2), The home page is well-organized and easy to read and understand (F3D3); Logical and clear navigation choices with consistence and availability (F3D4); Easy to use navigation (F3D5); Easy to use search boxes (F3D6); Functionality (F3D7); Error message resolution (F3D8);
- ***Factor 4. Security and Privacy (F4)*** *(Gehling & Stankard, 2005)*: Escrow service (F4D1); Personal information privacy (F4D2); Secure server (F4D3); Secure payment mechanism (F4D4); Antivirus software (F4D5); Firewall (F4D6); Authentication (F4D7);
- ***Factor 5. Website Design (F5)*** *(Lau, 2007; Blanchard & Fabrycky, 1990)*: Use of animated gifts and ticker tapes (F5D1); A balance between design and functionality (F5D2); Page fitness for scrolling entire page (F5D3); Simple and logical web layout (F5D4); Use of colors (F5D5); Expression of company image (F5D6); Easy to understand product categories (F5D7); Appropriate typefaces and font sizes (F5D8); Ease in finding checkout button (F5D9); Shopping cart location (F5D10);
- ***Factor 6. Website Content (F6)*** *(Leea & Kozar, 2006)*: Quality information (F6D1); Good service (F6D2); Easy to understand (F6D3); Catalog information organized logically (F6D4);
- ***Factor 7. Transaction Process and Volume (F7)*** *(John, 2004)*: The site supports secure credit card transactions (F7D1); Different payment methods available (F7D2); User-friendly rules and policy for sellers and buyers (F7D3); Good trade volumes (F7D4);
- ***Factor 8. Shopping Process (F8)*** *(Spiekermann et al., 2001)*: Reliable delivery process (F8D1); Easy to obtain refunds (F8D2); Easy to use the shopping cart (F8D3); Easy to add or delete items from the shopping cart (F8D4); Easy to view the contents of the shopping cart (F8D5); An obvious click path to the cash register (F8D6); Accessible product inventory and availability of information (F8D7); Customer rating/recording system (F8D8);

- ***Factor 9. Technical Support (F9)*** *(Citera & Beauregard, 2005)*: Availability of site map (F9D1); Customer online help (F9D2); Discussion board (F9D3); User guide (F9D4); FAQs (F9D5); Contact details (F9D6);
- ***Factor 10. System Development (F10)*** *(Anil et al., 2003)*.

3 THE DATA AND ANALYSIS

Customer experience could influence customers' perceptions of value and service quality, therefore, affecting customer loyalty. This is critical for the success of an e-commerce website. An online survey (Lian, 2012) was used to solicit customers' opinions on most of the proposed factors, except F2 and F10, which are more appropriate for professionals' opinions. 52 e-commerce website users from a local technology institute participated in the survey, of which the majority are aged between 18 and 30 (Lian, 2012). These young tertiary students are active on the internet and have good computer skills. The results of the survey may reflect this situation. Eight selected professionals participated in the interviews. The chosen participants needed to understand and have an interest in the research area, as well as have certain knowledge of e-commerce websites. In addition, the participants needed to have the ability and insight to perceive critical success factors for e-commerce websites with a technical and business focus. Two academic researchers, three business managers and three e-commerce website developers were interviewed. The authors believe that they possessed the required characteristics and experiences.

3.1 Online Survey Data

The participants were asked to choose which particular factors are critical for e-commerce website success and how they weight each of the dimensions of a particular factor (Lian, 2012). The questions were presented using a five-point Likert-type scale, 5 being the most desirable, and 1 being the least. A dimension score is the average of all the scores for that dimension from all the participants. A factor score is the average of all the scores for that factor from all the participants. Table 1 is a summary of the results.

The standard deviation of the dimension scores for a factor was calculated to check the diversity of the dimensions in the participants' opinions. A small standard deviation may indicate that the dimensions proposed for that particular factor are highly correlated; a large one may indicate that certain dimensions are inappropriate.

Table 1: Online survey results.

Factors	Dimensions	Dimension Score	STDEV	Factor Score
F1	F1D1	3.79	0.093	4.21
	F1D2	3.84		
	F1D3	3.97		
F3	F3D1	4.03	0.139	4.22
	F3D2	3.94		
	F3D3	4.14		
	F3D4	4.09		
	F3D5	4.14		
	F3D6	4.39		
	F3D7	4.14		
	F3D8	3.97		
F4	F4D1	3.69	0.359	4.34
	F4D2	4.29		
	F4D3	4.26		
	F4D4	4.54		
	F4D5	4.23		
	F4D6	4.09		
	F4D7	4.37		
F5	F5D1	3.00	0.359	4.22
	F5D2	4.00		
	F5D3	3.57		
	F5D4	3.91		
	F5D5	3.56		
	F5D6	3.43		
	F5D7	4.17		
	F5D8	3.71		
	F5D9	4.00		
	F5D10	3.78		
F6	F6D1	3.97	0.075	4.29
	F6D2	4.11		
	F6D3	3.97		
	F6D4	4.09		
F7	F7D1	4.20	0.109	4.32
	F7D2	4.20		
	F7D3	4.14		
	F7D4	3.97		
F8	F8D1	4.09	0.135	4.29
	F8D2	4.40		
	F8D3	4.00		
	F8D4	4.23		
	F8D5	4.14		
	F8D6	4.11		
	F8D7	4.31		
	F8D8	4.06		
F9	F9D1	3.44	0.278	4.17
	F9D2	3.85		
	F9D3	3.56		
	F9D4	3.56		
	F9D5	3.71		
	F9D6	4.21		

The survey results show that F4 and F7 got the highest factor scores of 4.34 and 4.32, respectively. This suggests that security and smooth transaction processes are the two most important concerns for online shoppers.

System security becomes a more significant system-quality issue as e-commerce is typically conducted over the Internet (DeLone & McLean. 2004). Good protection on confidential information should help to gain the consumer's trust (Yazdanifard et al., 2011). An e-commerce website must provide a secure user interface system and an easy-to-use transaction process. F9 got the lowest score of 4.17, suggesting that customers prefer a convenient and easy-to-use shopping system than using a help system. This may also reflect that the survey samples are highly computing skilled. F8 scored 4.29 which is higher than F5 at 4.22. This suggests that the shopping process and functionality is more important to the customers than the site's visual appearance.

Table 2: The difference between the dimension average of a factor and its factor score.

Factors	Dimension Average	Factor Score	Difference
F1	3.87	4.21	0.34
F3	4.11	4.22	0.11
F4	4.21	4.34	0.13
F5	3.71	4.22	0.51
F6	4.04	4.29	0.25
F7	4.13	4.32	0.19
F8	4.17	4.29	0.12
F9	3.72	4.17	0.45

The scores of all the dimensions of a particular factor were averaged to compare with that factor's score to gauge the validity of the dimensions for that particular factor. Table 2 shows the dimension averages and the differences between the dimension average of a factor and its factor score. A large difference may indicate the omission of certain dimensions for that factor. For example, the largest difference between the two scores is 0.51 for F5, which suggests that the identified dimensions for this factor may not be suitable or complete.

Customization defined in the 7Cs (Rayport & Jaworski, 2001) was missed out in the dimensions of F5. With customization, a user is provided with functions that enable him/her to enter personal details or customize the look of a banner. So, the dimension "Be able to customize the look of the user interface" with code F5D11 is added to F5. F3 got a small average score difference of 0.11 and a relatively small standard deviation of 0.139, which suggests that the dimensions for this factor are well defined. For example, "Search facility" was highlighted in (Cao et al., 2005) and it was included in F3D6. The difference for F9 is 0.45, which is the second largest. There may be serious omissions for this factor. Service quality can be measured by the effectiveness of on-line support capabilities, such as answers to frequently asked questions or responsiveness in the e-commerce environment (DeLone & McLean, 2004). This is confirmed by (Cao et al., 2005), where responsiveness is a construct with 5 items. So "Responsive to customers' inquiries" with code F9D7 is added to F9. The difference for F6, 0.251, is large as well. This suggests omissions. The small standard deviation 0.075 suggests that the proposed dimensions may only focus on certain aspects of this factor. The dimensions for F6 show that some popular dimensions like "use video demonstration" (Cao et al., 2005) are missing, thus, it is added to code F6D5, and, similarly, "use customer testimonial" with F6D6 is added. For F7, the average score of F7D4 is much lower than the others, suggesting that F7D4 may not belong to this factor. Removing F7D4 from the factor reduces the difference to 0.14, which is more appropriate. The name of F7 has been changed, therefore, to ***Transaction Process.***

3.2 Interview Data

Each group of professionals was given a slightly different set of questions to reflect their expertise (Lian, 2012). While they shared some opinions with the online survey participants, there were a few differences that need to be highlighted.

Only the professionals' opinions were solicited for F2 and F10. For F2, six out of eight professionals thought that website profit is a success factor and no meaningful comments were given. On the other hand, Transaction Volume was fully supported with strongly supportive comments, such as, "there must be a problem if the trading volume is too small", "transaction volume and website success are positively correlated", and "transaction volume reflects the commercial value of a website". In many cases, commercial transaction volume is positively related to commercial profit. It is reasonable to add "Good transaction volume" with code F2D1 as a dimension of F2.

F10 received full support as well, with many meaningful comments. The comments added desirable attributes for e-commerce websites from a software development perspective. Here is a

summary of the comments, which define the dimensions for this factor: System Requirements-Reliability (F10D1); System Requirements-Usability (F10D2); System Requirements-Data Integrity (F10D3); Resources-Technologies and Tools (F10D4); Resources-Network & Internet Access (F10D5); Resources-Relevant Knowledge (F10D6); Process-Back up (F10D7); Process-Documentation (F10D8); Process-Methodology (F10D9).

3.3 Online Testing Data

The online testing tool Alexa was used to test 30 e-commerce websites, including three very successful sites, TaoBao, eBay and Amazon (Lian, 2012). The results showed that TaoBao, eBay and Amazon got a much higher Alexa Traffic Rank than the others. They scored 15, 24 and 17, respectively, while the highest rank for the others was 387. It is reasonable to use Alexa Traffic Rank (Global) as a quantitative measurement for e-commerce website success. The average score difference for F1 is quite large, 0.34, with a small standard deviation, 0.093. This suggests omissions again. So "Traffic rank" with code F1D4 is added to F1. Table 3 is a summary of the revised factors and their dimensions.

Table 3: Revised factors and their dimensions.

Factors	Dimensions
F1	F1D1, F1D2, F1D3, F1D4
F2	F2D1
F3	F3D1, F3D2, F3D3, F3D4, F3D5, F3D6, F3D7, F3D8
F4	F4D1, F4D2, F4D3, F4D4, F4D5, F4D6, F4D7
F5	F5D1, F5D2, F5D3, F5D4, F5D5, F5D6, F5D7, F5D8, F5D9, F5D10, F5D11
F6	F6D1, F6D2, F6D3, F6D4, F6D5, F6D6
F7	F7D1, F7D2, F7D3
F8	F8D1, F8D2, F8D3, F8D4, F8D5, F8D6, F8D7, F8D8
F9	F9D1, F9D2, F9D3, F9D4, F9D5, F9D6, F9D7
F10	F10D1, F10D2, F10D3, F10D4, F10D5, F10D6, F10D7, F10D8, F10D9

4 INFORMATION SYSTEM SUCCESS MODEL

According to DeLone and McLean (2004), all of the proposed measures for e-commerce website could be classified under six dimensions. To validate the proposed measurements in Table 3, it is helpful to check them against the six dimensions of the DeLone & McLean Model. Table 4 shows detailed information for each dimension.

For B2C e-commerce websites that support shopping functions, the main stakeholders are the customers and the business owners. For the net benefits, we should consider the benefits for both of them. When the customers find the site convenient or are happy with the quality/price of the products they purchase, so the website can make a profit. Website Profit (F2) can be used to measure this. Site Popularity (F1) can be used to measure customer satisfaction.

Table 4 shows the proposed factors' classification in the DeLone & McLean Model. The factors are distributed into all six dimensions, so they should be comprehensive; however, they are not necessarily accurate. For example, F1 can reflect customers' satisfaction to a certain extent, however, possibly not completely.

Table 4: Checking with DeLone & McLean Model.

Dimensions	Measures	Factors
System quality	Measures the desired characteristics such as usability and response time	F3, F10
Information quality	Captures the content issue such as personalization, complete, relevant, easy to understand and secure	F4, F5, F6
Service quality	The overall support delivered	F9
Usage	Measures everything from a visit to a website and navigation to information retrieval	F7, F8
User satisfaction	Measures customers' opinions	F1
Net benefits	Captures the balance of the positive and negative impacts	F2

In the DeLone & McLean Model, the role of computing was not strongly suggested nor recommended. This was considered in an extended model proposed by Ghandour et al. (2008), where there were three main phases of e-commerce website success: development, use and consequences of the website. This study categorized the factors proposed in Table 3 by collaborating with the interviewed professionals. They were asked to classify the ten factors in the three given categories (Lian, 2012). The results showed that 6 factors (F3, F4, F5, F6, F9 and F10) belong to the development; 2 factors (F7 and F8) belong to the use; and 2 factors (F1 and F2) belong to the impact. Each category got more than half of the experts' support. So the proposed

measurements fit in the extended model. It also provided empirical evidence support for the extended model.

5 DISCUSSION AND SUMMARY

A set of measurements with 10 factors and their corresponding dimensions was identified in Table 3 based on the literature and the qualitative and quantitative data gathered from four different e-commerce website stakeholders. It is the combination of these factors that measures the success of an e-commerce website rather than an individual factor. The survey results suggested that security, smooth transaction processes and smooth shopping processes are the most important concerns for online shoppers. Good protection on confidential information should help to gain the consumer's trust (Yazdanifard et al., 2011) and maintain customer loyalty. The IS success model (DeLone & McLean, 2004) checking suggested that the proposed measurements are comprehensive; however, they are not necessarily accurate. The proposed measurements fit in the extended model (Ghandour et al., 2008), which also provides empirical evidence support for this model. To refine the measurements further, empirical tests involving a set of e-commerce websites and their customers/owners are required.

Comparing the proposed measurements with the existing work, the customized ISO 9126 quality model (Behkamal et al., 2009) seems the closest. They both define the quality factors in a hierarchical structure and assign numerical values to the quality factors. However, one is for B2B e-commerce websites and the other is for B2C. In terms of quality attributes, the customized ISO 9126 quality model emphasizes the user and development factors, such as “Functionality”, “Reliability” and “Usability”; the proposed measurements emphasize the customer and business-related factors more, such as “Website Design”, “Website Content”, “Shopping Process” and “Transaction Process and Volume”. In terms of process, five steps were defined in the customized ISO 9126 quality model, particularly in step 4, a widely-used method, analytical hierarchy process (AHP) is carefully followed. This systematic approach makes it easy to generalise the five steps for other types of e-commerce websites such as B2C. However, the factors should be revised to include more customer-related features. On the other hand, this work used the scores given by the users and adjusts the quality factors by means of simpe statistics instruments. These were further improved by considering the opinions of the other stakeholders. In terms of data, only users’ viewpoints and developers’ viewpoints were considered in the customized ISO 9126 quality model; in the proposed measurements, users’, developers’, business owners’ and researchers’ viewpoints were considered, therefore, the resulting quality factors should be more complete.

The small sample size of the online survey limited the use of rigorous statistics in the data analysis, instead, a mixed approach using combined qualitative and quantitative analysis was used on these data. A large sample with a more general population should improve the accuracy of the results.

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