Re-examining the measurement models of success for Internet commerce

Jerry Cha-Jan Chang\textsuperscript{a}, Gholamreza Torkzadeh\textsuperscript{a,*}, Gurpreet Dhillon\textsuperscript{b}

\textsuperscript{a}Department of MIS, University of Nevada at Las Vegas, 4505 Maryland Pkwy Box 456034, Las Vegas, NV 89154-6034, USA
\textsuperscript{b}School of Business, Virginia Commonwealth University, Richmond, VA, USA

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Abstract

In an effort to understand the value of Internet commerce, Keeney interviewed over 100 individuals and proposed two sets of variables: means and fundamental objectives for Internet shopping. The first help businesses deliver what is important for customers so that the customers’ objectives are achieved. Fundamental objectives represent ultimate values that customers care about and will influence their overall satisfaction. Using a sample of 620 responses in a two-phase exploratory study, two of the authors previously developed a 5-factor 21-item instrument to measure means objectives and a 4-factor 16-item instrument to measure fundamental objectives. They also proposed a second-order model of the fundamental objectives as a measure of overall customer satisfaction. The new study described here examined the two hypothesized measurement models and the proposed second-order model using a sample of 331 responses. Results confirm factor structures of the two models and suggest a more parsimonious instrument for each; a 5-factor 15-item scale for means objectives and a 4-factor 8-item scale for fundamental objectives. Goodness-of-fit indices for putative models of factor structures and the second-order model are presented.

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1. Introduction

The ultimate question about Internet commerce success closely relates to what the customer believes to be the value of a product and the means of finding, ordering, and receiving it. What the customer values is an important construct for academics and professionals of Internet commerce, since it helps to develop success measures. Keeney [15] suggests that the best way to find out about the value of Internet commerce to customers is to ask them. Using a value-focused approach, an iterative process, he proposed a set of related variables that together help us understand what might influence a consumer to shop online. He also proposed a means–ends network of these variables that can help design and develop Internet commerce systems as well as form efficient processes to search, shop, pay, and receive products.

Based on Keeney’s findings, Torkzadeh and Dhillon [22] developed and recommended two sets of variables for measuring means objectives and fundamental objectives for Internet commerce. They used a sample of 620 people in a two-phase study and proposed five first-order factors—product choice,
online payment, vendor trust, shopping travel, shipping errors—measured by 21 items for means objectives. They also proposed four first-order factors—shopping convenience, Internet ecology, customer relation, product value—measured by 16 items for fundamental objectives. Both studies suggest a second-order factor model for the four first-order factors of fundamental objectives.

No instrument should be used without adequate reliability and validity. The measurement development process includes a confirmatory cycle where the factor structure model proposed during the exploratory phase is confirmed using different data. Confidence in a measurement model is increased when the constructs and their respective measures are confirmed. Widely used instruments in the MIS discipline have several characteristics that promote their use: they are theory based, they are developed using established psychometric methods, they are confirmed for reliability and validity in follow-up studies that use separate samples, they propose constructs that are intuitively appealing, and they are easy to use in a variety of research and practice settings. The proposed measurement models of Torkzadeh and Dhillon are timely as they relate to an important and growing area of MIS: Internet commerce. However, these measures and their factor structures have not been confirmed and the proposed second-order model has not been tested.

Here, we report results of an empirical study that reexamined the two measurement models. A sample of 331 people was used with structural equation modeling to examine the recommended measurement models. The specific goals of this study are to:

(a) confirm the factor structures of means and fundamental objectives,
(b) recommend more parsimonious instruments with high reliability and validity for these constructs, and
(c) test the hypothesized second-order model of fundamental objectives.

2. Internet commerce measurement models

Ideally, one would like to measure Internet success in terms of its outcome and what it does for the customer. Research studies have examined factors that affect consumer’s use of Internet commerce [5,6]. Keeney suggests that the ultimate question about Internet commerce success may be more a function of customers’ belief and perception of the net value of the benefits and costs of both a product and the processes of finding, ordering, and receiving it. In other words, measuring customers’ belief and perception helps us understand factors that influence online shopping and, in turn, help decisions regarding design, development, implementation, and management of e-commerce systems.

Based on what customers experienced or envisioned, Keeney’s study used a ‘value-focused thinking approach’ to capture all the pros and cons of Internet commerce. The intent behind value-focused thinking was to focus on activities that occur prior to a decision problem being solved. As a result, he argued, value-focused thinking helps with the uncovering of hidden objectives. In all, he identified 91 objectives that might influence a consumer to purchase online. He then grouped these objectives into 25 categories, nine of which he termed “fundamental” and the rest “means” objectives. Together, he argued, these two sets of objectives described the bottom line consequences of concern to customers. Means objectives helped Internet commerce businesses deliver what was important to their customers and hence helped in achieving the fundamental objectives. These, on the other hand, represent ultimate values that customers care about, fulfilling the overall objective of customer satisfaction. Keeney did not develop specific measures of these constructs but his proposed means and fundamental objectives provided a useful base for item generation and instrument development.

The exploratory study by Torkzadeh and Dhillon [22] recommended two separate instruments for measuring means and fundamental objectives. They reported high reliability and validity for a 5-factor 21-item instrument of means objectives and a 4-factor 16-item instrument of fundamental objectives. The reliability (Cronbach’s $\alpha$) for each instrument was 0.90. Examples of means objectives included, ‘greater product selection’, ‘ease of comparison shopping’, and ‘vendor legitimacy’. Examples of fundamental objectives included, ‘minimize environmental impact’, ‘provide an easy return process’, and ‘maximize product value’.
They suggested that it is plausible to expect a second-order model of the proposed constructs. However, a close examination of the factors for each construct suggested that a second-order model would be plausible only for the fundamental objective, since the same objective can be expected through different means. Fundamental objectives are the end ones as opposed to the means. Fundamental objectives concern the ends that a decision-maker may value in a given context. On the other hand, means objectives are the methods to achieve the ends. Measures of means and fundamental objectives are presented in Appendix A. A 5-point Likert-type scale was used where 1 = strongly disagree and 5 = strongly agree.

Measurement instruments are not “set in stone”; rather, they evolve through an ever-extending process of development, examination, and refinement [24]. The initial instrument development efforts often involve ambiguity about the appropriate model of underlying data structures [10]. Follow-up studies that use new data are necessary to confirm that a proposed instrument explains and measures the research construct. Confirmatory studies provide more precision for model specification and increase confidence in using recommended measures for decision-making and substantive hypothesis testing. They complete the exploratory–confirmatory research cycle of a measurement development.

3. Methods

In order to confirm the proposed models of means and fundamental objectives for Internet commerce, data were gathered from 337 respondents with experience in online shopping. The data gathering methods were identical to those used in the exploratory study. The instructions for respondents and the Likert-type scale were identical to the original study. The respondents were working students registered in business programs at a university in the southwest region of the US. Respondents worked in sales, banks, government, telecommunications, education, information systems, and other areas and regularly shopped online for books, music, gifts, airline tickets, computers, auto parts, stocks, etc. A few of the responses were discarded due to incompleteness. Data analysis was then based on a sample of 331 responses.

Confirmatory factor analysis involves reexamining the specification and estimation of models that propose a set of factors to account for covariances among a set of observed variables [3,14]. It relies on prior theoretical or empirical work that provides plausible alternative models that can be tested using new data. The study by Torkzadeh and Dhillon provided the first step of measurement development by suggesting appropriate models. The new data in the current study was suitable for confirming and refining these measures.

Fit indices from confirmatory factor analysis indicate the extent the data can be represented by the proposed model. In order to examine the factor structure of the proposed measurements, it was appropriate to first test the new data using exploratory factor analysis. If the proposed factor structure is not supported by the exploratory analysis, there is no point in continuing. On the other hand, if the factor structure is replicated then it is prudent to continue with confirmatory analysis. When the fit indices from confirmatory analyses do not provide strong support, then the researchers may have to refine and purify the measures through specification search [16].

The paradigms for measurement development [7,11,19] suggest an iterative process: examining measurement properties to purify and re-specify scales to develop rigorous measures. To examine the measurement properties, Segars and Grover [21] suggest that each “measured factors be modeled in isolation, then in pairs, and then as a collective network”. This method of analysis would provide the best evidence of measurement efficiency and avoid problems caused by excessive error in the measures [1,2,13,20].

In this study, we used a new data set to first test the convergent validity and unidimensionality of each factor. We then examined discriminant validity followed by construct reliability. Following the paradigm, each factor with more than three items was tested one by one to identify and eliminate items with low loadings. Modification indices were then examined to identify possible error correlations that might improve model fit. Care was taken to ensure that any error correlations added were theoretically sound to avoid making improvements by capitalizing on chance [17]. In testing paired factors, items that cross-load to other factors were identified for elimination, one by
one, to assure unidimensionality of each factor. Cross-loading items were also examined when the full measurement model was tested with all factors included. This procedure established both the convergent validity and unidimensionality of each factor.

Discriminant validity can be established by comparing the model fit of an unconstrained model that estimates the correlation between a pair of factors and a constrained model that fixes the correlation between the factors to unity. Discriminant validity is demonstrated when the unconstrained model has a significantly better fit than the constrained model. The difference in model fit may be evaluated by examining the $\chi^2$ difference between the models. The significance of a $\chi^2$ difference is a $\chi^2$ variate with one degree of freedom.

Construct reliability can be measured by computing composite factor reliability or average variance extracted (AVE) [12]. Composite reliability assesses whether the items are sufficient in representing their respective construct and a common lower threshold of 0.70 is used. AVE indicates the amount of variance that is captured by the construct. Therefore, AVE that is less than 0.50 indicates that the measurement error is larger than the variance captured by the construct.

### 4. Results

Using the new data, we first carried out an exploratory analysis to confirm the factor structure recommended for the measures. These analyses produced a factor structure that was consistent with the original recommendation. Next, confirmatory analyses were conducted for the recommended measurement models using LISREL with the new data. The initial analyses produced fit statistics of $\chi^2 = 1067$, d.f. = 179, $\chi^2$/d.f. = 5.96, RMSEA = 0.123, GFI = 0.76, AGFI = 0.70 for means objectives and $\chi^2 = 726$, d.f. = 98, $\chi^2$/d.f. = 7.40, RMSEA = 0.139, GFI = 0.78, AGFI = 0.70 for fundamental objectives. These results suggest that the recommended measurement model could be improved. Thus, an iterative process of specification search was followed to refine and purify the measures.

Three factors of means objectives and one of fundamental objectives have more than three items. Analyses of these in isolation indicated no item with low loading but suggested several error correlations. A closer look at items measuring these factors indicated that item content might be the reason for the error correlations. For example, the item for ‘greater product choice’ correlated with the item for ‘broad

### Table 1

Parameter estimates, $t$-values, and fit indices for the recommended means objectives$^a$

<table>
<thead>
<tr>
<th>Latent variables</th>
<th>Items</th>
<th>Factor loading</th>
<th>Standard error</th>
<th>$t$-Value</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet product choice</td>
<td>I like having greater product selection</td>
<td>0.82</td>
<td>–</td>
<td>–</td>
<td>0.68</td>
</tr>
<tr>
<td></td>
<td>I like broad choice of products</td>
<td>0.86</td>
<td>0.039</td>
<td>26</td>
<td>0.74</td>
</tr>
<tr>
<td></td>
<td>I like to have maximum range of quality product options</td>
<td>0.91</td>
<td>0.054</td>
<td>21</td>
<td>0.83</td>
</tr>
<tr>
<td></td>
<td>I like having maximum product variety</td>
<td>0.89</td>
<td>0.054</td>
<td>20</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td>I like to have maximum product availability</td>
<td>0.85</td>
<td>0.056</td>
<td>19</td>
<td>0.72</td>
</tr>
<tr>
<td>Online payment</td>
<td>I am worried about who will have access to my credit card number</td>
<td>0.90</td>
<td>–</td>
<td>–</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>I am concerned about unauthorized use of my credit card</td>
<td>0.96</td>
<td>0.025</td>
<td>43</td>
<td>0.92</td>
</tr>
<tr>
<td></td>
<td>I am concerned about misuse of personal information</td>
<td>0.91</td>
<td>0.044</td>
<td>23</td>
<td>0.83</td>
</tr>
<tr>
<td>Internet vendor trust</td>
<td>I am concerned about vendor legitimacy</td>
<td>0.97</td>
<td>–</td>
<td>–</td>
<td>0.95</td>
</tr>
<tr>
<td></td>
<td>I am concerned about how much can I trust the vendor</td>
<td>0.95</td>
<td>0.027</td>
<td>36</td>
<td>0.91</td>
</tr>
<tr>
<td>Shopping travel</td>
<td>I like to travel as little as possible to purchase</td>
<td>0.89</td>
<td>–</td>
<td>–</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td>I like to drive as little as possible to shop</td>
<td>0.97</td>
<td>0.039</td>
<td>28</td>
<td>0.94</td>
</tr>
<tr>
<td></td>
<td>I like to minimize travel for purchase</td>
<td>0.88</td>
<td>0.042</td>
<td>23</td>
<td>0.77</td>
</tr>
<tr>
<td>Internet shipping errors</td>
<td>I worried about receiving wrong products</td>
<td>0.97</td>
<td>–</td>
<td>–</td>
<td>0.94</td>
</tr>
<tr>
<td></td>
<td>I am concerned about shipping errors</td>
<td>0.96</td>
<td>0.031</td>
<td>32</td>
<td>0.92</td>
</tr>
</tbody>
</table>

$^a$ Fit indices: $\chi^2 = 157.32$, d.f. = 78, $P = 0.0000$, $\chi^2$/d.f. = 2.02, RMSEA = 0.056, $P$(RMSEA < 0.05) = 0.22, NFI = 0.97, NNFI = 0.98, CFI = 0.98, RMR = 0.027, GFI = 0.94, AGFI = 0.91.
choice of product’ and the item for ‘access to credit card number’ correlated with the item for ‘unauthorized use of credit card’. These items are similar in meaning, thus we allowed error correlation among them in further analyses. We then analyzed factors in pairs to identify those that cross-loaded on other factors. An iterative process of eliminating one item with significant cross-loading then re-testing the paired factors to identify additional cross-loading items was used to establish unidimensionality for each factor. This procedure resulted in elimination of several items; some of which also had error correlation. The full measurement models with the reduced items were then tested to identify additional cross-loading items. No additional item had cross-loading. Results of this process suggested a 5-factor 15-item measure for means objectives and a 4-factor 8-item measure for fundamental objectives with strong model fits. Fit indices for the full measurement model, as well as information on factors, items, standardized factor loading, standard errors, t-values, and r-squares, are presented in Tables 1 and 2 for means objectives and fundamental objectives, respectively.

To test the discriminant validity of each factor, two $\chi^2$ values for every pair of factors in each model were obtained; one from an unconstrained model that estimated the correlation between the pair and the other from a constrained model where the correlation of the two factors were fixed to one. The difference between the $\chi^2$ values for the free and fixed models for each pair of factors are presented in Tables 3 and 4 for means objectives and fundamental objectives, respectively. The information on composite reliability and AVE for each factor was also included in these tables. All $\chi^2$ differences were significant at $P=0.001$ or less.

Table 2
Parameter estimates, t-values, and fit indices for the recommended fundamental objectives$^a$

<table>
<thead>
<tr>
<th>Latent variables</th>
<th>Items</th>
<th>Factor loading</th>
<th>Standard error</th>
<th>t-Value</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shopping convenience</td>
<td>It is important to make shopping easy</td>
<td>0.85</td>
<td>–</td>
<td>–</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>It is important to minimize queuing time</td>
<td>0.081</td>
<td>0.077</td>
<td>13</td>
<td>0.66</td>
</tr>
<tr>
<td>Internet ecology</td>
<td>It is important to minimize pollution</td>
<td>0.92</td>
<td>–</td>
<td>–</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>It is important to reduce environmental damages</td>
<td>0.96</td>
<td>0.054</td>
<td>19</td>
<td>0.93</td>
</tr>
<tr>
<td>Customer relation</td>
<td>It is important to assure an easy return process</td>
<td>0.89</td>
<td>–</td>
<td>–</td>
<td>0.80</td>
</tr>
<tr>
<td></td>
<td>It is important to provide quality after-sale service</td>
<td>0.89</td>
<td>0.049</td>
<td>20</td>
<td>0.78</td>
</tr>
<tr>
<td>Product value</td>
<td>It is important to minimize tax cost</td>
<td>0.65</td>
<td>–</td>
<td>–</td>
<td>0.42</td>
</tr>
<tr>
<td></td>
<td>It is important to maximize product value</td>
<td>0.82</td>
<td>0.11</td>
<td>11</td>
<td>0.68</td>
</tr>
</tbody>
</table>

$^a$Fit indices: $\chi^2 = 23.25$, d.f. = 14, $P = 0.05629$, $\chi^2$/d.f. = 1.7, RMSEA = 0.045, $P$(RMSEA < 0.05) = 0.57, NFI = 0.99, NNFI = 0.99, CFI = 0.99, RMR = 0.020, GFI = 0.98, AGFI = 0.96.

Table 3
Descriptive statistics, correlations, discriminant validity tests, composite reliability, and AVE for means objectives$^{ab}$

<table>
<thead>
<tr>
<th>Factors</th>
<th>Means</th>
<th>S.D.</th>
<th>M1</th>
<th>M2</th>
<th>M3</th>
<th>M4</th>
<th>M5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet product choice</td>
<td>4.38</td>
<td>0.71</td>
<td>0.94</td>
<td>[0.75]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Online payment</td>
<td>3.97</td>
<td>1.16</td>
<td>–0.037</td>
<td>(78.4'')</td>
<td>0.95</td>
<td>[0.85]</td>
<td></td>
</tr>
<tr>
<td>Internet vendor trust</td>
<td>3.80</td>
<td>1.16</td>
<td>–0.034</td>
<td>(78.6'')</td>
<td>0.66</td>
<td>(13.1')</td>
<td>0.96</td>
</tr>
<tr>
<td>Shopping travel</td>
<td>3.15</td>
<td>1.19</td>
<td>0.165</td>
<td>(69.2')</td>
<td>0.116</td>
<td>(69.1')</td>
<td>0.148</td>
</tr>
<tr>
<td>Internet shipping error</td>
<td>3.37</td>
<td>1.28</td>
<td>0.094</td>
<td>(66.5')</td>
<td>0.529</td>
<td>(23.7')</td>
<td>0.560</td>
</tr>
</tbody>
</table>

$^a$Composite reliabilities are on the diagonal.

$^b$AVE are on the diagonal.

$^c$ fit differences are indicated in parentheses. Differences in $\chi^2$ for one degree of freedom are significant at 0.001.

$^d$Correlation is significant at 0.01.
The composite reliability and AVE values were all above the recommended thresholds. These results supported discriminant validity and reliability for the two models.

The original study suggested a second-order model of fundamental objectives as an overall measure of customer satisfaction with the Internet commerce. Therefore, in addition to refining the original models, a second-order model of fundamental objectives was tested using the four first-order factors. The result of the second-order model analysis for fundamental objectives is presented in Fig. 1. The goodness-of-fit for this second-order model was very strong but not as strong as the first-order model. This may be expected, because the second-order model explains the covariation among the first-order model with less degree of freedom. With two degrees of freedom, the second-order model did not significantly increase $\chi^2$ (the difference between the two models was 4.46). Therefore, the second-order model should be accepted as a “truer” representation of model structure for parsimony.

**Table 4**

Descriptive statistics, correlations, discriminant validity tests, composite reliability, and AVE for fundamental objectives

<table>
<thead>
<tr>
<th>Factors</th>
<th>Means</th>
<th>S.D.</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet shopping convenience</td>
<td>4.13 (2 items)</td>
<td>0.81</td>
<td>0.82 [0.69]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internet ecology</td>
<td>3.97 (2 items)</td>
<td>1.01</td>
<td>0.248* (43.7d)</td>
<td>0.94 [0.88]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internet customer relation</td>
<td>4.40 (2 items)</td>
<td>0.70</td>
<td>0.509* (25.8d)</td>
<td>0.419* (30.7d)</td>
<td>0.88 [0.79]</td>
<td></td>
</tr>
<tr>
<td>Internet product value</td>
<td>4.31 (2 items)</td>
<td>0.73</td>
<td>0.416* (39.8d)</td>
<td>0.400* (36.3d)</td>
<td>0.577* (27.2d)</td>
<td>0.70 [0.55]</td>
</tr>
</tbody>
</table>

* Composite reliabilities are on the diagonal.

** Table 4 continued **

**Fig. 1.** Second-order model for fundamental objectives.
5. Discussion and conclusions

Organizations increasingly invest in Internet technology to enhance delivery of product and services, create competitive advantage, facilitate customer relationship management, reduce cost, etc. Researchers have also devoted significant attention to Internet commerce and its effectiveness. This is quite appropriate. Measuring Internet commerce effectiveness has received particular attention [8,18] and customer values play a significant role in evaluating this effectiveness [23]. IS researchers have long emphasized the importance of developing and using valid measurement instruments [4,9].

Instrument development paradigms require repeated validation and confirmation with different data sets to establish the validity of instruments. This paper reported on a confirmatory assessment and refinement of the Internet commerce success measures developed by Torkzadeh and Dhillon. The results confirmed the original measurement models but indicated the need for improving the scales. Refinement of the measures produced a shorter 5-factor 15-item scale for means objectives and a 4-factor 8-item scale for fundamental objectives. A second-order model of fundamental objectives was also tested and supported. These measures have good psychometric properties, as indicated by the goodness-of-fit indices.

The instruments recommended here are short, easy to use, and reliable. They can evaluate the factors that influence Internet shoppers and help decision-makers of Internet commerce. The instruments can be used with measures of other construct to test hypotheses that involve a priori as well as posterior factors. They can also be used to examine the means–ends relationships.

Appendix A

Means objectives

Internet product choice
I like having greater product selection
I like broad choice of products
I like to have maximum range of quality product options
I like having maximum product variety
I like to have maximum product availability
I like the ease of comparison shopping
I like to have greater product choice

Appendix A. (Continued)

Appendix A. (Continued)

Online payment
I am worried about who will have access to my credit card number
I am concerned about unauthorized use of my credit card
I am concerned about misuse of personal information
I am concerned about misuse of my credit card
I am concerned about my personal information being shared

Internet vendor trust
I am concerned about vendor legitimacy
I am concerned about seller legitimacy
I am concerned about how much I can trust the vendor
I am concerned about security for Internet commerce

Shopping travel
I like to travel as little as possible to purchase
I like to drive as little as possible to shop
I like to minimize travel for purchase

Internet shipping errors
I worry about receiving wrong products
I am concerned about shipping errors

Fundamental objectives

Internet shopping convenience
It is important to make shopping easy
It is important to minimize effort of shopping
It is important to minimize queuing time
It is important to minimize time to select a product
It is important to minimize personal hassle
It is important to minimize payment time
It is important to minimize time pressure when shopping

Internet ecology
It is important to minimize pollution
It is important to minimize environmental impact
It is important to reduce environmental damages

Internet customer relation
It is important to assure an easy return process
It is important to provide an easy return process
It is important to provide quality after-sale service

Internet product value
It is important to minimize tax cost
It is important to minimize product cost
It is important to maximize product value
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Jerry Cha-Jan Chang is Assistant Professor of MIS in the College of Business, University of Nevada, Las Vegas. He received his PhD in MIS and MS in MoIS from University of Pittsburgh, his MBA from Texas A&M University, MS in computer science from Central Michigan University, and BS in oceanography from National Ocean University in Taiwan. His research interest includes performance measurement, IS strategy, management of IS, group support systems, human–computer interaction, organizational learning, and strategic planning. He has published in several major IS conferences and is a member of AIS.

Gholamreza Torkzadeh is Professor and Chair of MIS at the University of Nevada, Las Vegas. He has published on management information systems issues in academic and professional journals including Management Science, Information Systems Research, MIS Quarterly, Communications of the ACM, Decision Sciences, Journal of MIS, Omega, Journal of Operational Research, Information and Management, Journal of Knowledge Engineering, Educational and Psychological Measurement, Behaviour and Information Technology, Long Range Planning, and others. His current research interests include the impact of information technology, measuring e-commerce success, computer self-efficacy, and information systems security. He holds his PhD in operations research from The University of Lancaster, England, and is a member of The Institute for Operations Research and the Management Science, Association for Information Systems, and Decision Sciences Institute.

Gurpreet Dhillon is Associate Professor of MIS in the College of Business, Virginia Commonwealth University. He holds his PhD in information systems from the London School of Economics and Political Science, United Kingdom. He has published in several journals including Information Systems Research, Communications of the ACM, Computers and Security, the European Journal of Information Systems, the Information Systems Journal, the International Journal of Information Management, and others. His research interests include the management of information security, ethical and legal implications of information systems, and aspects of information systems planning and project management.