Three Reasons We May Shun the Research Practice That Employs Formative Measurement in the Endogenous Position

Gimun Kim* · Bongsik Shin** · Kijoo Kim***

Abstract

When the formative construct is placed in the endogenous position, there are clear theoretical, mathematical, and empirical issues in model estimation. Nonetheless, scholars who have adopted structural equation modeling for empirical research and those who are engaged in debates on the viability of formative modeling fail to recognize the fundamental problems of employing formative measurement in the endogenous position. This manuscript is intended to set a corrective path by discussing three reasons why this frequented practice may be avoided in both theoretical and empirical research.

Keywords : Structural Equation Modeling, Formative Construct, Endogenous Variable, Formative Measurement

Received : 2013. 09. 03. Revised : 2013. 09. 24. Final Acceptance : 2013. 09. 25.

* First Author, Department of Business Administration, Chungnam National University Daejeon, Korea, e-mail : gmkim12@cnu.ac.kr
** Second Author, Information and Decision Systems, San Diego State University San Diego, CA 92182, USA, e-mail: bshin@mail.sdsu.edu
*** Corresponding Author, Global Business College, Konyang University Nonsan, Korea, e-mail : kjkim@konyang.ac.kr

1. Introduction

In the wake of much debate regarding the integrity of formative measurement, behavioral researchers including IS scholars are facing growing uncertainties in its usage. Many scholars are engaged in the debate in an attempt to find convergence on the merits and demerits of adopting formative modeling in academic research [e.g., Howell et al., 2007; Bollen, 2007; Bagozzi, 2007; Wilcox et al., 2008; Franke et al., 2008; Hardin et al., 2008; Cenfetelli and Bassellier, 2009; Kim et al., 2010; Bagozzi, 2011; McKenzie et al., 2011; Bollen, 2011; Diamantopoulos, 2011; Edwards, 2011; Treiblmaier et al., 2011; Hardin and Marcoulides, 2011; Hardin et al., 2011; Shin and Kim, 2011; Aguirre-Urreta and Marakas, 2012; Petter et al., 2012; Jarvis et al., 2012]. Despite the heated theoretical discussions on the viability of formative modeling, its usage in empirical research has been steady [Diamantopoulos et al., 2008; Diamantopoulos 2011]. For instance, from the literature review of the two premier IS journals, Information Systems Research and MIS Quarterly, we found 90 formatively defined constructs in 47 research articles since 2000 (see <Table 1> and <Table 2>). The information systems field not only has actively employed formative modeling for empirical research but also has become the epic center of the ongoing and constructive discourse on its theoretical viability [Hardin and Marcoulides, 2011].

In this manuscript, we bring to the attention that scholars who have adopted formative measurement for empirical research and those who are engaged in the debates on formative modeling failed to recognize the fundamental problems of having the formative construct in the endogenous position of a structural equation model. In other words, the formatively-defined endogenous construct results in estimation bias in empirical analysis and also flawed arguments in theoretical debates. As summarized in <Table 1>, empirical researchers have employed the first-order, second- order, and even third-order [e.g., Bassellier and Benbasat, 2004; Sun, 2012] formative constructs in both exogenous and endogenous positions. Also, a group of methodologists debate about the potential bias in parameter estimates as a result of measurement model misspecification of the formative construct placed in the exogenous and endogenous positions [e.g., Aguirre-Urreta and Marakas, 2012; Petter et al., 2012; Jarvis et al., 2012; Jarvis et al., 2003; MacKenzie et al., 2005; Petter et al., 2007]. However, if the theoretical debates are grounded on the formative model structure whose estimation integrity itself becomes questionable, they could convey erroneous messages to readers. By pointing out the risks associated with formative measurement in the endogenous position, we would like to caution current empirical and theoretical research practices.

〈Table 1〉 Articles with Formative Construct(s) (Sources : ISR and MISQ)

	Positions of formative construct	
	Exogenous	Endogenous
First-order	• Security education, training, and awareness programs [D'Arcy et al., 2009; ISR] • User awareness of security policies [D'Arcy et al., 2009; ISR] • Computer monitoring [D'Arcy et al., 2009; ISR] • Perceived performance [Kim et al., 2009; ISR] • Virtual copresence [Ma and Agarwal, 2007; ISR] • Self-presentation [Ma and Agarwal, 2007; ISR] • Psychological contract violation with an individual seller [Pavlou and Gefen, 2005; ISR] • Demographic similarity [Preston and Karahanna, 2009; ISR] • Experiential similarity [Preston and Karahanna, 2009; ISR] • Equitable Work Performance Fulfillment [Au et al., 2008; MISQ] • Equitable Relatedness Fulfillment [Au et al., 2008, MISQ] • Equitable Self-Development Fulfillment [Au et al., 2008; MISQ] • Knowledge diversity [Carlo et al., 2012; MISQ] • Knowledge depth [Carlo et al., 2012; MISQ] • Knowledge linkages [Carlo et al., 2012; MISQ] • IT support for knowledge management Practices [Choi et al., 2010; MISQ] • Web Experience [Choudhury and Karahanna, 2008; MISQ] • Web Use [Choudhury and Karahanna, 2008; MISQ] • Differentiation [Gattiker and Goodhue, 2005; MISQ] • Influence of family, relatives, friends, and peers [Hsieh et al., 2008; MISQ] • Project size [Iacovou et al., 2009; MISQ] • Social influence [Johnston and Warkentin, 2010; MISQ] • User participation [Spears and Barki, 2010; MISQ] • Social norms [Srite and Karahanna, 2006; MISQ] • Champion [Wixom and Watson, 2001; MISQ] • Resources [Wixom and Watson, 2001; MISQ] • User Participation [Wixom and Watson, 2001; MISQ] • Team Skills [Wixom and Watson, 2001; MISQ] • Source Systems [Wixom and Watson, 2001; MISQ]	• Product development cost [Banker et al., 2006; ISR] • Product design cycle time [Banker et al., 2006; ISR] • Perceived risk [Kim et al., 2009; ISR] • Perceived benefit [Kim et al., 2009; ISR] • Structural systems of knowing [Preston and Karahanna, 2009; ISR] • Task performance [Yi and Davis, 2003; ISR] • Declarative knowledge [Yi and Davis, 2003; ISR] • Team performance [Choi et al., 2010; MISQ] • Optimistic biasing [Iacovou et al., 2009; MISQ] • Pessimistic biasing [Iacovou et al., 2009; MISQ] • Relationship-specific performance [Klein and Rai, 2009; MISQ] • Strategic information flows [Klein and Rai, 2009; MISQ] • Software team response extensiveness [Lee and Xia, 2010; MISQ] • Software team response efficiency [Lee and Xia, 2010; MISQ] • ERP assimilation [Liang et al., 2007; MISQ] • IS continuance usage [Limayem et al., 2007] • Management infrastructure sophistication [Ravichandran and Rai, 2000; MISQ] • Process management efficacy [Ravichandran and Rai, 2000; MISQ] • Stakeholder participation [Ravichandran and Rai, 2000; MISQ] • Quality performance [Ravichandran and Rai, 2000; MISQ] • Intention to Use [Titah and Barki, 2009; MISQ] • Self-reported use [Venkatesh and Ramesh, 2006, MISQ] • Use [Venkatesh et al., 2012; MISQ]

Higher-order	• IS use-related activity [Barki et al., 2007; ISR] • System usage [Burton-Jones and Straub, 2006; ISR] • Service quality [Cenfetelli et al., 2008; ISR] • Supporting services functionality [Cenfetelli et al., 2008; ISR] • External pressure [Chwelos et al., 2001; ISR] • Readiness [Chwelos et al., 2001; ISR] • IT leveraging competence [Pavlou and El Sawy, 2006; ISR] • IT architecture modularity [Tiwana and Konsynski, 2010; ISR] • IT governance decentralization [Tiwana and Konsynski, 2010; ISR] • Business Competence [Bassellier and Benbasat, 2004; MISQ] • Organizational climate [Bock et al., 2005; MISQ] • Top Management Championship [Chatterjee et al., 2002; MISQ] • SLA Characteristics [Goo et al., 2009; MISQ] • Task-oriented communication [Kanawattanachai and Yoo 2007, MISQ] • Trusting beliefs [Klein and Rai, 2009; MISQ; Sia et al., 2009; MISQ] • User familiarity [Nadkami and Gupta, 2007; MISQ] • Habit [Polites and Karahanna, 2012; MISQ] • Propensity to resist change [Polites and Karahanna, 2012; MISQ] • IT Infrastructure Integration for SCM [Rai et al., 2006; MISQ] • Neutralization [Siponen and Vance, 2010; MISQ] • Novel Situations [Sun, 2012; MISQ] • Mimetic pressures [Teo et al., 2003; MISQ] • Coercive Pressures [Teo et al., 2003; MISQ] • Normative Pressures [Teo et al., 2003; MISQ] • Website quality [Wells et al., 2011; MISQ] • Network effects [Zhu et al., 2006; MISQ] • Adoption costs [Zhu et al., 2006; MISQ]	• NPD functional competencies [Pavlou and El Sawy, 2006; ISR] • NPD dynamic competencies [Pavlou and El Sawy, 2006; ISR] • Perceived Effectiveness of IT-Enabled Institutional Structures [Pavlou and Gefen, 2005; ISR] • Observational learning processes [Yi and Davis, 2003; ISR] • Perceived website complexity [Nadkami and Gupta, 2007; MISQ] • Perceived behavioral control [Pavlou and Fygenson, 2006; MISQ] • Inertia [Polites and Karahanna, 2012; MISQ] • Supply Chain Process Integration [Rai et al., 2006; MISQ] • Firm Performance [Rai et al., 2006; MISQ] • Trusting beliefs [Sia et al., 2009; MISQ] • Adaptive System Use [Sun, 2012; MISQ]

〈Table 2〉 Summary of Formative Construct Usage Since 2000 (Sources : ISR and MISQ)

Order of construct		Positions of formative construct		
		Exogenous position	Endogenous position	Total
First-Order Construct	ISR	9	7	16
	MISQ	20	16	36
	Sub-total	29	23	52
Higher-Order Construct	ISR	9	4	13
	MISQ	18	7	25
	Sub-total	27	11	38
Total		56	34	90

2. Three Reasons for Caution

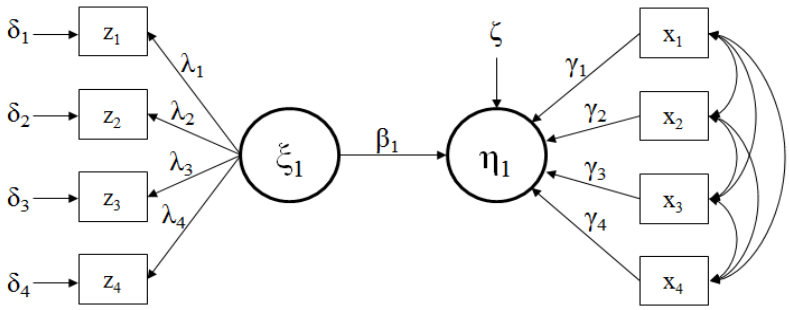
To theoretically substantiate that a formative construct may be avoided in the endogenous position, the conceptual model appeared in Jarvis et al. [2003] and Petter et al. [2007] is used. The model is composed of five constructs and was introduced as a Correctly Specified Model by the authors. For brevity in demonstration, a subset of the full model is shown in <Figure 1> which contains one reflective exogenous (ξ_1) and one formative endogenous (η_1) constructs. Three other constructs (all dependent variables of the two constructs) of the Correctly Specified Model are not shown in <Figure 1>. In the full model of 5 constructs, the endogenous formative construct (η_1) is associated with two reflectively designed dependent constructs and thus there is no difficulty in identifying coefficients of formative measures.

2.1 Conceptual Ambiguity of the Formative Construct (η_1)

The total variation of a formative construct is explained by the combination of variation explained by indicators included in the model and variation unexplained by missing indicators (i.e., measurement residual variance) [Bagozzi, 2007]. When a formative construct is placed in the exogenous position, the theoretical explanation regarding the sources of total variation remains valid. When it becomes an endogenous variable as in <Figure 1>, however, there is an additional force that affects its total variation (i.e., an antecedent construct). The following regression equation demonstrates the three different sources of variation in the endogenous formative construct (η_1) :

$$\eta_1 = \gamma_1 x_1 + \gamma_2 x_2 + \gamma_3 x_3 + \gamma_4 x_4 + \beta_1 \xi_1 + \zeta \qquad (1)$$

The function indicates that the meaning (or value) of the formatively-defined endogenous construct (η_1) is influenced by both its indicators and the antecedent construct (ξ_1). This violates the fundamental principle that the meaning of a formative construct should be a function of its indicators [Edwards and Bagozzi, 2000]. When the meaning is not entirely up to the indicators, the formative construct (η_1) becomes conceptually ambiguous.



〈Figure 1〉 A Partial View of the Correctly Specified Model with a Formative Construct in the Endogenous Position (Adapted from Jarvis et al., 2003 and Petter et al., 2007)

2.2 Conceptual Ambiguity of the Disturbance Term (ζ)

The measurement residual variance of a formative construct represents the influence of indicators not captured in the model. Also, the structural residual variance of an endogenous construct reflects the influence of missing antecedents not included in the structural model. Cognizant of their distinctiveness, employing a formative construct in the endogenous position raises a theoretical question regarding the nature of its disturbance term (ζ). In <Figure 1>, does the disturbance term (ζ) reflect measurement residual variance or structural residual variance? If the error term represents only one of the two sources of variation, where do we find the residual variance of the other source? If the magnitude of the disturbance term (ζ) is decided by both residual sources, what is their respective contribution? We may take an interpretational position on the fundamental questions, but will never be able to prove its integrity. After all, the theoretical ambiguity of the disturbance term becomes another confounding source in determining the meaning of the formative construct as an endogenous variable.

2.3 Bias in Measurement Weights and Path Coefficient

Having a formative construct in the endogenous position raises the chance of bias in both measurement weights and structural path coefficients. This risk has been proved by previous researchers [e.g., James et al., 1983; Mauro, 1990] through regression analysis. According to the studies, such bias takes place when a research model fails to include an antecedent variable that significantly affects the dependent variable of interest AND when the variable is correlated with other antecedent variable(s) already included in the model. By excluding the significant predictor from the research model, existing model predictors and the disturbance term co-vary and subsequently coefficients of the remaining predictors experience estimation bias.

The findings become an indication that when a research model includes a formative construct only in the exogenous position, there is a chance of bias in measurement weights due to the correlation between formative indicators included in the model and the disturbance term (reflecting missing indicators). However, if the formative construct is placed in the endogenous position, there are more sources of bias resulting from the failure of excluding a significant indicator (s). For example, if the disturbance term of <Figure 1> is correlated with the indicators of the formative construct, it is an indication of bias in the weights of formative indicators. Meanwhile, if the disturbance term is correlated with the antecedent construct (ξ_1), this spells bias in the structural path coefficient (β_1). If the disturbance term (ζ) of <Figure 1> is correlated with both formative indicators and the antecedent construct, this implies the presence of bias in both measurement weights and the structural path coefficient.

3. Conclusion

Through the three theoretical lenses, we demonstrated that using the formative construct in the endogenous position is theoretically, mathematically, and empirically a highly risky practice. Facing such threats to research validity, scholars may exercise restraints in incorporating the formatively defined construct into the endogenous position of a research model for empirical testing. Also, we would like to highlight that the theoretical debates of having formative construct in the endogenous position are without merits as this can mislead other researchers. This leads us to suggest that the debates regarding the integrity of formative measurement be limited to its adoption in the exogenous position. As for the use of the formative construct as an exogenous variable, heated debates are underway between two camps who support the modeling method and who are against it. In sum, researchers may avoid having formative measurement in the endogenous position of a structural equation model and its employment in the exogenous position may be approached with caution until methodologists reach an acceptable level of agreements in terms of its reliability. A limitation of the study may be to find an empirical evidence that supports our arguments although it may be an impossible task.

References

[1] Aguirre-Urreta, M. I and Marakas, G. M., "Revisiting Bias Due to Construct Misspecification : Different Results from Considering Coefficients in Standardized Form", *MIS Quarterly*, Vol. 36, No. 1, 2012, pp. 123-138.

[2] Bagozzi, R. P., "On the Meaning Formative Measurement and How It Differs From Reflective Measurement : Comment on Howell, Breivik, and Wilcox(2007)", *Psychological Methods*, Vol. 12, No. 2, 2007, pp. 229-237.

[3] Bagozzi, R. P., "Measurement and Meaning in Information Systems and Organizational Research : Methodological and Philosophical Foundations", *MIS Quarterly*, Vol. 35, No. 2, 2011, pp. 261-292.

[4] Bollen, K. A., "Evaluating Effect, Composite, and Causal Indicators in Structural Equation Models", *MIS Quarterly,* Vol. 35, No. 2, 2011, pp. 359-372.

[5] Bollen, K. A., "Interpretational Confounding Is Due to Misspecification, Not to Type of Indicator : Comment on Howell, Breivik, and Wilcox (2007)", *Psychological Methods*, Vol. 12, No. 2, 2007, pp. 219-228.

[6] Cenfetelli, R. T. and Bassellier, G., "Interpretation of Formative Measurement in Information Systems Research", *MIS Quarterly*, Vol. 33, No. 4, 2009, pp. 689-707.

[7] Diamantopoulos, A., "Incorporating Formative Measures into Covariance-Based Structural Equation Models", *MIS Quarterly*, Vol. 35, No. 2, 2011, pp. 335-358.

[8] Diamantopoulos, A. and Riefler, R., "Using Formative Measures in International Marketing Models : A Cautionary Tale Using Consumer Animosity as an Example", Marko Sarstedt, Manfred Schwaiger, Charles R.

Taylor, in (ed.) Measurement and Research Methods in International Marketing (Advances in International Marketing, Vol. 22), Emerald Group Publishing Limited, 2011, pp. 11-30.

[9] Diamantopoulos A., Riefler, P., and Roth, K. P., "Advancing Formative Measurement Models", *Journal of Business Research*, Vol. 61, No. 12, 2008, pp. 1203-1218.

[10] Edwards, J. R., "The Fallacy of Formative Measurement", *Organizational Research Methods*, Vol. 14, No. 2, 2011, pp. 370-388.

[11] Franke, G. R., Preacher, K. J., and Rigdon, E. E., "Proportional Structural Effects of Formative Indicators", *Journal of Business Research*, Vol. 61, 2008, pp. 1229-1237.

[12] Hardin, A. M., Chang, J. C., Fuller, M. A., and Torkzadeh, G., "Formative Measurement and Academic Research : In Search of Measurement Theory", *Educational and Psychological Measurement*, Vol. 71, No. 2, 2011, pp. 281-305.

[13] Hardin, A. M. and Marcoulides, G. A., "A Commentary on the Use of Formative Measurement", *Educational and Psychological Measurement*, Vol. 71, No. 5, 2011, pp. 753-764.

[14] Howell, R. D., Breivik, E., and Wilcox, J. B., "Reconsidering Formative Measurement", *Psychological Methods*, Vol. 12, No. 2, 2007, pp. 205-218.

[15] James, L., Mulaik, S., and Brett, J., *Causal Analysis : Assumptions, Models, and Data*. Beverly Hills, CA : Sage Publications, Inc. 1983.

[16] Jarvis, C. B., MacKenzie, S. B., and Podsakoff, P. M., "A Critical Review of Construct Indicators and Measurement Model Misspecification in Marketing and Consumer Research", *Journal of Consumer Research*, Vol. 30, No. 2, 2003, pp. 199-218.

[17] Jarvis, C. B., MacKenzie, S. B., and Podsakoff, P. M., "The Negative Consequences of Measurement Model Misspecification : A Response to Aguirre-Urreta and Marakas", *MIS Quarterly*, Vol. 36, No. 1, 2012, pp. 139-146.

[18] Kim, G., Shin, B., and Grover, V., "Investigating Two Contradictory Views of Formative Measurement in Information Systems Research", *MIS Quarterly*, Vol. 34, No. 2, 2010, pp. 345-365.

[19] MacKenzie, S. B., Podsakoff, P. M. and Podsakoff, N. P., "Construct Measurement and Validation Procedures in MIS and Behavioral Research : Integrating New and Existing Techniques", *MIS Quarterly*, Vol. 35, No. 2, 2011, pp. 293-334.

[20] Mackenzie, S. B., Podsakoff, P. M., and Jarvis, C. B., "The Problem of Measurement Model Misspecification in Behavioral and Organizational Research and Some Recommended Solutions", *Journal of Applied Psychology*, Vol. 90, No. 4, 2005, pp. 710-730.

[21] Mauro, R., Understanding L.O.V.E (Left Out Variables Error) : A Method for Estimating the Effects of Omitted Variables, *Psychological Bulletin*, Vol. 108, No. 2, 1990, pp. 314-329.

[22] Petter, S., Rai, A., and Straub, D., "The Critical Importance of Construct Measure-

ment Specification : A Respone to Aguirre-Urreta and Marakas", *MIS Quarterly*, Vol. 36, No. 1, 2012, pp. 147-155.

[23] Petter, S., Straub, D., and Rai, A., "Specifying Formative Constructs in Information Systems Research", *MIS Quarterly*, Vol. 31, No. 4, 2007, pp. 623-656.

[24] Shin, B. and Kim, G., "Investigating the Reliability of Second-Order Formative Measurement in Information Systems Research", *European Journal of Information Systems*, Vol. 20, No. 5, 2011, pp. 608-623.

[25] Schumacker, R. E. and Lomax, R. G., *A Beginner's Guide to Structural Equation Modeling (2nd ed.)*, New York : Taylor and Francis Group, 2004.

[26] Treiblmaier, H., Bentler, P. M., and Mair, P., "Formative Constructs Implemented via Common Factors", *Structural Equation Modeling*, Vol. 18, No. 1, 2010, pp. 1-17.

[27] Wilcox, J. B., Howell, R. D., and Breivik, E., "Questions About Formative Measurement", *Journal of Business Research*, Vol. 61, No. 12, 2008, pp. 1219-1228.

References for Table 1

[1] Au, N. and Ngai, E. W. T., "Extending the Understanding of End User Information Systems Satisfaction Formation : An Equitable Needs Fulfillment Model Approach", *MIS Quarterly*, Vol. 32, No. 1, 2008, pp. 43-66.

[2] Banker, R. D., Bardhan, I., and Asdemir, O., "Understanding the Impact of Collaboration Software on Product Design and Development", *Information Systems Research*, Vol. 17, No. 4, 2006, pp. 352-373.

[3] Barki, H., Titah, R., and Boffo, C., "Information System Use - Related Activity : An Expanded Behavioral Conceptualization of Individual-Level Information System Use", *Information Systems Research*, Vol. 18. No 2, 2007, pp. 173-192.

[4] Bassellier, G. and Benbasat, I., "Business Competence of Information Technology Professionals : Conceptual Development and Influence on IT-Business Partnerships", *MIS Quarterly*, Vol. 28, No. 4, 2004, pp. 673-694.

[5] Bock, G.-W., Zmud, R. W., Kim, Y.-G., and Lee, J.-N., "Behavioral Intention Formation in Knowledge Sharing : Examining the Roles of Extrinsic Motivators, Social-Psychological Forces, and Organizational Climate", *MIS Quarterly*, Vol. 29, No. 1, 2005, pp. 87-111.

[6] Burton-Jones, A. and Straub, D. W., "Reconceptualizing System Usage : An Approach and Empirical Test", *Information Systems Research*, Vol. 17, No. 3, 2006, pp. 228-246.

[7] Carlo, J. L., Lyytinen, K., and Rose, G. M., "A Knowledge-Based Model of Radical Innovation in Small Software Firms", *MIS Quarterly*, Vol. 36, No. 3, 2012, pp. 865-895.

[8] Cenfetelli, R. T., Benbasat, I., and Al-Natour, S., "Addressing the What and How of Online Services : Positioning Supporting-Services Functionality and Service Quality for Business-to-Consumer Success", *Information Systems Research*, Vol. 19, No. 2, 2008, pp. 161-181.

[9] Chatterjee, D., Grewal, R., and Sambamurthy, V., "Shaping up for E-Commerce : Institutional Enablers of the Organizational Assimilation of Web Technologies", *MIS Quarterly*, Vol. 26, No. 2, 2002, pp. 65-89.

[10] Choi, S. Y., Lee, H., and Yoo, Y., "The Impact of Information Technology and Transactive Memory Systems on Knowledge Sharing, Application, and Team Performance : A Field Study", *MIS Quarterly*, Vol. 34, No. 4, 2010, pp. 855-870.

[11] Choudhury, V. and Karahanna, E., "The Relative Advantage of Electronic Channels : A Multidimensional View", *MIS Quarterly*, Vol. 32, No. 1, 2008, pp. 179-200.

[12] Chwelos, P., Benbasat, I., and Dexter, A. S. "Empirical Test of an EDI Adoption Model", *Information Systems Research*, Vol. 12, No. 3, 2001, pp. 304-321.

[13] D'Arcy, J., Hovav, A., and Galletta, D., "User Awareness of Security Countermeasures and Its Impact on Information Systems Misuse : A Deterrence Approach", *Information Systems Research*, Vol. 20, No. 1, 2009, pp. 79-98.

[14] Gattiker, T. F. and Goodhue, D. L., "What Happens After ERP Implementation : Understanding the Impact of Interdependence and Differentiation on Plant-Level Outcomes", *MIS Quarterly*, Vol. 29, No. 3, 2005, pp. 559-585.

[15] Goo, J., Kishore, R., Rao, H. R., and Nam, K., "The Role of Service Level Agreements in Relational Management of Information Technology Outsourcing : An Empirical Study", *MIS Quarterly*, Vol. 33, No. 1, 2009, pp. 119-145.

[16] Hsieh, J. J., Rai, A., and Keil, M., "Understanding Digital Inequality : Comparing Continued Use Behavioral Models of The Socio-Economically Advantaged and Disadvantaged", *MIS Quarterly*, Vol. 32, No. 1, 2008, pp. 97-126.

[17] Iacovou, C. L., Thompson, R. L., and Smith, H. J., "Selective Status Reporting in Information Systems Projects : A Dyadic-Level Investigation", *MIS Quarterly*, Vol. 33, No. 4, 2009, pp. 785-810.

[18] Johnston, A. C. and Warkentin, M., "Fear Appeals and Information Security Behaviors : An Empirical Study", *MIS Quarterly*, Vol. 34, No. 3, 2010, pp. 549-566.

[19] Kanawattanachai, P. and Yoo, Y., "The Impact of Knowledge Coordination on Virtual Team Performance over Time", *MIS Quarterly*, Vol. 31, No. 4, 2007, pp. 783-808.

[20] Kim, D. J., Ferrin, D. L., and Rao, H. R., "Trust and Satisfaction, Two Stepping Stones for Successful E-Commerce Relationships : A Longitudinal Exploration", *Information Systems Research*, Vol. 20, No. 2, 2009, pp. 237-257.

[21] Klein, R. and Rai, A., "Interfirm Strategic Information Flows in Logistics Supply Chain Relationships", *MIS Quarterly*, Vol. 33, No. 4, 2009, pp. 735-762.

[22] Lee, G. and Xia, W., "Toward Agile : An Integrated Analysis of Quantitative and Qualitative Field Data", *MIS Quarterly*, Vol. 34, No. 1, 2010, pp. 87-114.

[23] Liang, H., Saraf, N., Hu, Q., and Xue, Y., "Assimilation of Enterprise Systems : The

Effect of Institutional Pressures and the Mediating Role of Top Management", *MIS Quarterly*, Vol. 31, No. 1, 2007, pp. 59-87.

[24] Limayem, M., Hirt, S. G., and Cheung, C. M. K., "How Habit Limits the Predictive Power of Intention : The Case of Information Systems Continuance", *MIS Quarterly*, Vol. 31, No. 4, 2007, pp. 705-737.

[25] Ma, M. and Agarwal, R., "Through a Glass Darkly : Information Technology Design, Identity Verification, and Knowledge Contribution in Online Communities", *Information Systems Research*, Vol. 18, No. 1, 2007, pp. 42-67.

[26] Nadkarni, S. and Gupta, R., "A Task-Based Model of Perceived Website Complexity", *MIS Quarterly*, Vol. 31, No. 3, 2007, pp. 501-524.

[27] Pavlou, P. A. and El-Sawy, O. A., "From IT Leveraging Competence to Competitive Advantage in Turbulent Environments : The Case of New Product Development", *Information Systems Research*, Vol. 17, No. 3, 2006, pp. 198-227.

[28] Pavlou, P. A. and Fygenson, M., "Understanding and Predicting Electronic Commerce Adoption : An Extension of the Theory of Planned Behavior", *MIS Quarterly*, Vol. 30, No. 1, 2006, pp. 115-143.

[29] Pavlou, P. A. and Gefen, D., "Psychological Contract Violation in Online Marketplaces : Antecedents, Consequences, and Moderating Role", *Information Systems Research*, Vol. 16, No. 4, 2005, pp. 372-399.

[30] Polites, G. L. and Karahanna, E., "Shackled to the Status Quo : The Inhibiting Effects of Incumbent System Habit, Switching Costs, and Inertia on New System Acceptance", *MIS Quarterly*, Vol. 36, No. 1, 2012, pp. 21-42.

[31] Preston, D. S. and Karahanna, E., "Antecedents of IS Strategic Alignment : A Nomological Network", *Information Systems Research*, Vol. 20, No. 2, 2009, pp. 159-179.

[32] Rai, A., Patnayakuni, R., and Seth, N., "Firm Performance Impacts of Digitally Enabled Supply Chain Integration Capabilities", *MIS Quarterly*, Vol. 30, No. 2, 2006, pp. 225-246.

[33] Ravichandran, T. and Rai, A., "Quality Management in Systems Development : An Organizational System Perspective", *MIS Quarterly*, Vol. 24, No. 3, 2000, pp. 381-415.

[34] Sia, C. L., Lim, K. H., Leung, K., and Lee, M. K. O., "Web Strategies to Promote Internet Shopping : Is Cultural-Customization Needed?" *MIS Quarterly*, Vol. 33, No. 3, 2009, pp. 491-512.

[35] Siponen, M. and Vance, A., "Neutralization : New Insights into the Problem of Employee Information Systems Security Policy Violations", *MIS Quarterly*, Vol. 34, No. 3, 2010, pp. 487-502.

[36] Spears, J. L. and Barki, H., "User Participation in Information Systems Security Risk Management", *MIS Quarterly*, Vol. 34, No. 3, 2010, pp. 503-522.

[37] Srite, M. and Karahanna, E., "The Role of Espoused National Cultural Values in Technology Acceptance", *MIS Quarterly*, Vol. 30, No. 3, 2006, pp. 679-704.

[38] Sun, H., "Understanding User Revisions When Using Information System Features :

Adaptive System Use and Triggers", *MIS Quarterly*, Vol. 36, No. 2, 2012, pp. 453-478.

[39] Teo, H. H., Wei, K. K., and Benbasat, I., "Predicting Intention to Adopt Interorganizational Linkages : An Institutional Perspective", *MIS Quarterly*, Vol. 27, No. 1, 2003, pp. 19-49.

[40] Titah, R. and Barki, H., "Nonlinearities between Attitude and Subjective Norms in Information Technology Acceptance : A Negative Synergy", *MIS Quarterly*, Vol. 33, No. 4, 2009, pp. 827-844.

[41] Tiwana, A. and Konsynski, B., "Complementarities Between Organizational IT Architecture and Governance Structure", *Information Systems Research*, Vol. 21, No. 2, pp. 288-304.

[42] Venkatesh, V. and Ramesh, V., "Web and Wireless Site Usability : Understanding Differences and Modeling Use", *MIS Quarterly*, Vol. 30, No. 1, 2012, pp. 181-206.

[43] Venkatesh, V., Thong, J. Y. L., and Xu, X., "Consumer Acceptance and Use of Information Technology : Extending the Unified Theory of Acceptance and Use of Technology", *MIS Quarterly*, Vol. 36, No. 1, 2012, pp. 157-178.

[44] Wells, J. D., Valacich, J. S., and Hess, T. J., "What Signal are You Sending? How Website Quality Influences Perceptions of Product Quality and Purchase Intentions", *MIS Quarterly*, Vol. 35, No. 2, 2011, pp. 373-396.

[45] Wixom, B. H. and Watson, H. J., "An Empirical Investigation of the Factors Affecting Data Warehousing Success", *MIS Quarterly*, Vol. 25, No. 1, 2001, pp. 17-38.

[46] Yi, M. Y. and Davis, F. D., "Developing and Validating an Observational Learning Model of Computer Software Training and Skill Acquisition", *Information Systems Research*, Vol. 14, No. 2, 2003, pp. 146-169.

[47] Zhu, K., Kraemer, K. L., Gurbaxani, V., and Xu, S. X., "Migration to Open-Standard Interorganizational Systems : Network Effects, Switching Costs, and Path Dependency", *MIS Quarterly*, Vol. 30 : Special Issue, 2006, pp. 515-539.

Author Profile

Gimun Kim

Gimun Kim is an associate professor of information systems at the School of Business Administration, Chungnam National University in Korea. He received his Ph.D. from Yonsei University in Korea and M.S. from Georgia State University. His research interests are in the business value of information technology capabilities, user behavior in electronic commerce, and research methodology. He has published in journals such as *MIS Quarterly, Journal of the Association for Information Systems, Journal of Management Information Systems, European Journal of Information Systems, Information Systems Journal, and Information and Management.*

Bongsik Shin

Bongsik Shin is a professor of MIS at San DiegoState University. He earned a Ph.D. from the University of Arizona and taught at the University of Nebraska at Omaha before joining San Diego State University. He has taught data communications and network security, introductory and advanced electronic commerce, IT management and strategy, business intelligence (data warehousing and statistics), operating systems, and principles of MIS. His research interests include IT management and strategy, IT sustainability, research methodology, and trust issues in e-business. His academic activities have been funded by fifteen different grants since 1997. He was the chair of San Diego International Systems Conference in 2005 and 2006.His research has appeared in such journals as *MIS Quarterly, IEEE Transactions (Engineering Mgt and SMC), Journal of AIS, European Journal of IS, Journal of MIS, Information Systems Journal, Communications of the ACM, Information and Management, and Decision Support Systems*. He wrote a book 'Principles of Data Communications and Network Security : Practice Orientation.'

Kijoo Kim

Kijoo Kim is a professor at the Global Business College in Konyang University. He studied his PH.D. Courses at the University of Nebraska-Lincoln and received the MBA degree from Bowling Green State University at Ohio and the Bachelor's degree from Hankuk University of Foreign Studies. His research interests include ERP system, Business Process Management, SCM, Information Systems Strategy, and IT service Management. He has published in journals such as *Production and Inventory Management Journal, International Journal of Educational Management, The Journal of American Academy of Business, Cambridge, Journal of Information Technology Application and Management*, and *Journal of the Korea Industrial Information Systems Research*. He wrote many books related to the national qualification test about ERP.