

12-31-2010

Overcoming Perceptual Bias in IT Innovation Adoption using Multitrait-Multimethod Analysis

Victor W. Bohórquez Lopez

IE Business School, vwbohorquez.phd2011@alumno.ie.edu

Jose Esteves

IE Business School, jose.esteves@ie.edu

Follow this and additional works at: <http://aisel.aisnet.org/digit2010>

Recommended Citation

Lopez, Victor W. Bohórquez and Esteves, Jose, "Overcoming Perceptual Bias in IT Innovation Adoption using Multitrait-Multimethod Analysis" (2010). *DIGIT 2010 Proceedings*. 6.

<http://aisel.aisnet.org/digit2010/6>

This material is brought to you by the Diffusion Interest Group In Information Technology at AIS Electronic Library (AISeL). It has been accepted for inclusion in DIGIT 2010 Proceedings by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact elibrary@aisnet.org.

Overcoming Perceptual Bias in IT Innovation Adoption using Multitrait–Multimethod Analysis

Victor W. Bohórquez Lopez

IE Business School

vwbohorquez.phd2011@alumno.ie.edu

Jose Esteves

IE Business School

jose.esteves@ie.edu

ABSTRACT

Previous studies in IT innovation adoption have dedicated scant attention to the solution of perceptual bias; which can be defined as a potential bias and error in perceptual measures due to the human tendency to make systematic errors in judgment, knowledge, and reasoning. In IT innovation adoption projects, there are multiple participants belonging different stakeholder groups that are exposed to asymmetric external/internal pressures and influences; hence, assessing different respondents in different groups using perceptual measures could lead to erroneous interpretations if we do not take this situation into account. With this goal in mind, we propose a model to compare stakeholder perceptions on IT Innovation Adoption using confirmatory factor analysis based multitrait–multimethod analysis (CFA-MTMM). The main contribution of this article is to deal with the problem of perceptual bias when researchers have multiple respondents belonging different stakeholder groups. This contribution is relevant because a recent study shows that relatively little attention is being paid to method bias in top IS journals (King et al. 2007).

Keywords

IT innovation Adoption, perceptual measures, MTMM Analysis.

INTRODUCTION

During almost the last three decades of IS research, a rich and diverse body of theoretical and empirical work has been written on the adoption and diffusion of IT-based innovations (Jeyaraj et al. 2006). These studies have defined a dominant research paradigm typified by the desire to explain innovation using economic-rationalistic models, whereby organizations that have greater innovation-related needs and abilities are expected to exhibit a greater quantity of innovation (i.e. greater frequency, earliness, or extent of adoption) Fichman (2004: pp. 315). However, this approach does not take into account the complexity inherent to innovation and simplifies the three possible intertwined angles of analysis: innovation itself, individual, and organizational level.

According to Jeyaraj et al. (2006), previous research in this topic show not only theoretical biases but also methodological biases in the dominant research paradigm. The theoretical biases include the pro-innovation bias, in which all adoptions are considered good a priori; and the rational bias, in which adopters are considered to make rational decisions (Rogers 1995, Fichman 2004). In addition, the methodological biases include recall bias, in which self reports are considered unreliable; and pro-adopter bias, in which most of the studies are focused on adopters instead of non-adopters that emerge as an understudied topic (Rogers 1995).

King et al. (2007) assessed a population of 128 survey-based studies published in three top IS journals (MISQ, ISR, JMIS) over a seven-year period (1999-2005) and found that relatively little attention is being paid to method bias, increasing the threat of serious method bias in many of the published studies. Therefore, the goal of this article is to overcome the methodological bias (recall bias) conducting an empirical examination of potential bias and error in self report (perceptual) measures in IT innovation adoption. Ketokivi and Schroeder (2004) have used survey results to show that perceptual measures are contaminated by two factors. First are the effects that are somehow systematic across the informants. The resulting variance is called method variance, which is a systematic variance in the variables that is caused by collecting data using the same informants. The second source of contamination arises from the fact that each response has a unique component that is not in any way systematic across the informants, it is called error variance.

With this goal in mind, we will compare stakeholder perceptions on IT Innovation Adoption using confirmatory factor analysis based multitrait–multimethod analysis (CFA-MTMM). The most important contribution of MTMM analysis is that in addition to being a diagnostic tool, it is a means of controlling the effects of informant bias and random error in examining

substantive relationships (Ketokivi and Schroeder 2004). Therefore, this study is a step forward in an understanding of the contingent factors for IT Innovation Adoption based on different stakeholder perspective.

LITERATURE REVIEW

Previous research has studied IT adoption using a set of different theories applying them at two different levels: individual and organizational (see Table 1). In each level, researchers have proposed different types of independent variables; such as individual, organizational or innovation characteristics. In this article, we are focused on individual characteristics because we are interested in the specific perceptions that each stakeholder has about IT innovation to facilitate or hinder its adoption. Among the main individual characteristics cited by previous studies it is important to highlight: gender and age (e.g. Venkatesh et al. 2003); experience and education (e.g. Igarria 1993); perceived ease of use and perceived usefulness (e.g. Davis 1989); relative advantage, complexity, compatibility, observability and trialability (e.g. Rogers 1995); personal innovativeness (e.g. Agarwal and Prasad 1997); and so on.

Theory	Main author(s)	Used in individual adoption studies	Used in organizational adoption studies
Innovation Diffusion Theory	Rogers (1983, 1995)	X	X
Perceived Characteristics of Innovations	Moore and Benbasat (1991)	X	
Social Cognitive Theory	Bandura (1986)	X	
Technology Acceptance Model	Davis (1989)	X	
Technology Acceptance Model II	Venkatesh et al. (2003)	X	
Theory of Planned Behavior	Ajzen (1991)	X	
Theory of Reasoned Action	Fishbein and Ajzen (1975)	X	
Unified Theory of Acceptance and Use of Technology	Venkatesh et al. (2003)	X	
Diffusion/Implementation Model	Kwon and Zmud (1987)		X
Tri-Core Model	Swanson (1994)		X

Table 1. Theories used in individual/organizational IT adoption research (Jeyaraj et al. 2006)

After an analysis of the relevant literature, we want to focus our argumentation in the contributions made by Moore and Benbasat (1991) and Jeyaraj et al. (2006) because these articles consolidate previous research in this topic and take into account the main individual characteristics in IT innovation adoption, providing useful information to analyze in this article.

Moore and Benbasat (1991) proposed an instrument as a tool for the study of the initial adoption and eventual diffusion of IT innovations within organizations because they consider that no comprehensive instruments have been developed to measure the variety of perceptions of innovations. These authors have focused on the perceived characteristics of innovations because the findings of previous studies related with the primary characteristics of innovations have been inconsistent. Primary attributes are intrinsic to an innovation, independent of the perception of potential adopters. However, different adopters might perceive primary attributes in different ways and their behaviors related with the innovation might differ (Moore and Benbasat 1991), suggesting that the study of interaction among perceived attributes of innovations could help to the establishment of a more general and consistent theory.

Moore and Benbasat (1991) highlighted that Rogers' (1983) definitions are based on perceptions of the innovation itself, and not on perceptions of actually using the innovation. After an extensive literature review, searching previous tests or scales, these authors argued that prior studies failed providing good validity and reliability for their constructs, becoming unlikely to use most of them without modifications. Therefore, these authors reframed previous studies in terms of the potential

adopters' use, and labeled their instrument Perceived Characteristics of Innovation (PCI). They followed a three stage procedure: item creation, to ensure content validity; scale development, to assess construct validity and identify any ambiguous items; and instrument testing, to assess PCI as well as to perform an instrument reduction.

The most important contribution of Moore and Benbasat's study is the creation of an overall instrument to measure various perceptions of using an IT innovation. The creation process also, can be used as a template to develop new instruments because the method of developing the scales provides a high degree of confidence in their content and constructs validity (Moore and Benbasat 2001). However, this study did not take into account the solution for the perceptual bias when researchers deal with multiple respondents belonging different stakeholder groups.

In the same way, Jeyaraj et al. (2006) consolidated previous studies about IT adoption proposing interesting avenues for further research at individual level. For example, use environmental characteristics in individual adoption research, external pressure and influence variables could be highly relevant to an individual's decision to adopt IT; study time and rate at which individuals adopt different IT innovations; analyze the outcomes of the adoption, taking into account the quality of the innovation implementation, performance impacts, and perceived benefits to overcome the pro-innovation bias; increase the study of Actual System Use instead of Perceived System Use to overcome the self-reporting bias, allowing the evaluation of the return on IT investment by organizations; finally, only eight studies (17%) from the 48 individual studies consider adopters and non-adopters, justifying the need to uncover which characteristics influence people to reject the adoption of IT innovation.

Based on previous suggestions, we can argue that external pressure and influence is not the same for every stakeholder; hence assessing different respondents in different groups could lead to erroneous interpretations if we do not consider method variance in the formulation of the instrument. In addition, time and rate at which individuals adopt different IT innovations are contingent to the role of those individuals and must be taken into account. Ketokivi and Schroeder (2004) proposed that MTMM can be used to analyze the source of disagreement among informants (stakeholders) by partitioning the variance into trait, method and error variance, confirming whether the disagreement comes from systematic informant effects (method variance) or random error (error variance). Therefore, it would be appropriate to explain the application of MTMM in previous studies highlighting the contribution of the present paper.

Multitrait-Multimethod (MTMM) Analysis

In a seminal paper, Campbell and Fiske (1959) proposed the original MTMM matrix as the appropriate method for examining trait, method and error variance in measurement instruments. Ketokivi and Schroeder (2004) state that, in MTMM analysis, individual measurement items are affected by three sources of variance:

1. The indicators reflect the theoretical traits of interest (e.g., trait effect).
2. The indicators reflect systematic informant effects (e.g., method variance).
3. The indicators contain variance unique to the indicator (e.g., random error).

However, Malhotra et al. (2006) argue that traditional MTMM procedure has several limitations. First, its results depend heavily on the types of methods employed in a particular study. Second, because the validity of this technique is based on the methods employed, no formal means are available to assess the level of common method variance. Finally, this procedure is restrictive in actual application because it requires measurement of each of the traits using at least two methods. As a result, the traditional MTMM approach does not allow the researcher to systematically account for method biases (Bagozzi 1980).

The Confirmatory Factor Analysis (CFA) based MTMM technique appears to deal with these limitations (Straub et al. 2004, Podsakoff et al. 2003), allowing researchers to model explicitly the variance in a measure as a function of three components: the "true" score variance, the variance due to method effect, and random error (Malhotra et al. 2006). Bagozzi and Yi (1991) underlined that CFA analysis of MTMM data is based on the assumption that measure variation is a linear combination of traits, methods, and error. This assumption is valid when the effects of common methods do not vary by trait; but, there may be situations in which methods and traits can interact in a multiplicative fashion, which would invalidate this assumption (Campbell and O'Connell 1982, 1967). However, in the context of this study, this assumption is not violated as we can see in the next section.

THEORETICAL MODEL

Based on an assessment of previous studies, we have chosen Moore and Benbasat (1991) to use their proposed traits for individual adoption because their items were developed to be as general as possible; hence, they could be easily reworded by

substituting the names used in the study with a different IT innovation, taking into account additional checks for validity and reliability.

According to Ketokivi and Schroeder (2004), there are many ways to conceptualize and examine a method; however, the most relevant in the context of Information Systems is the use of multiple informants as multiple methods. This conceptualization comes from Cyert and March's (1992) behavioral theory of the firm, whose argue that managers are boundedly rational and engage in locally satisficing behavior. Thus, managers answer surveys from their own local and particular view, which may or may not reflect what is going on in the organization as a whole (Dearborn and Simon 1958). In this sense, responses of participants are independent, avoiding the interaction among them and traits, and reinforcing the validity of the assumption for CFA-MTMM.

For that reason, ideal instruments have high trait variance compared to bias and error variance. If multiple traits (e.g., voluntariness, relative advantage, etc.) are measured with multiple methods (e.g., stakeholder 1, stakeholder 2, etc.), it is possible to explicitly estimate the proportion of variance accounted for by the traits, methods and error using CFA-MTMM analysis (Ketokivi and Schroeder 2004). The proposed model is showed in Figures 1.1 and 1.2.

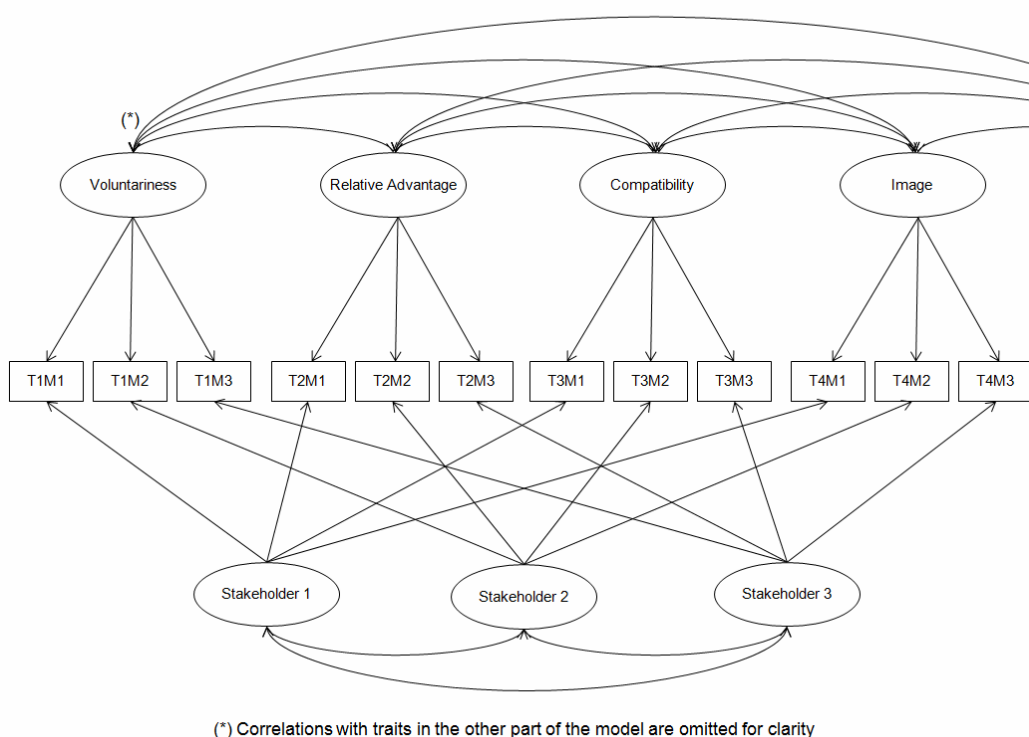


Figure 1.1. MTMM analysis of the first four traits and three methods (error terms are omitted for clarity)

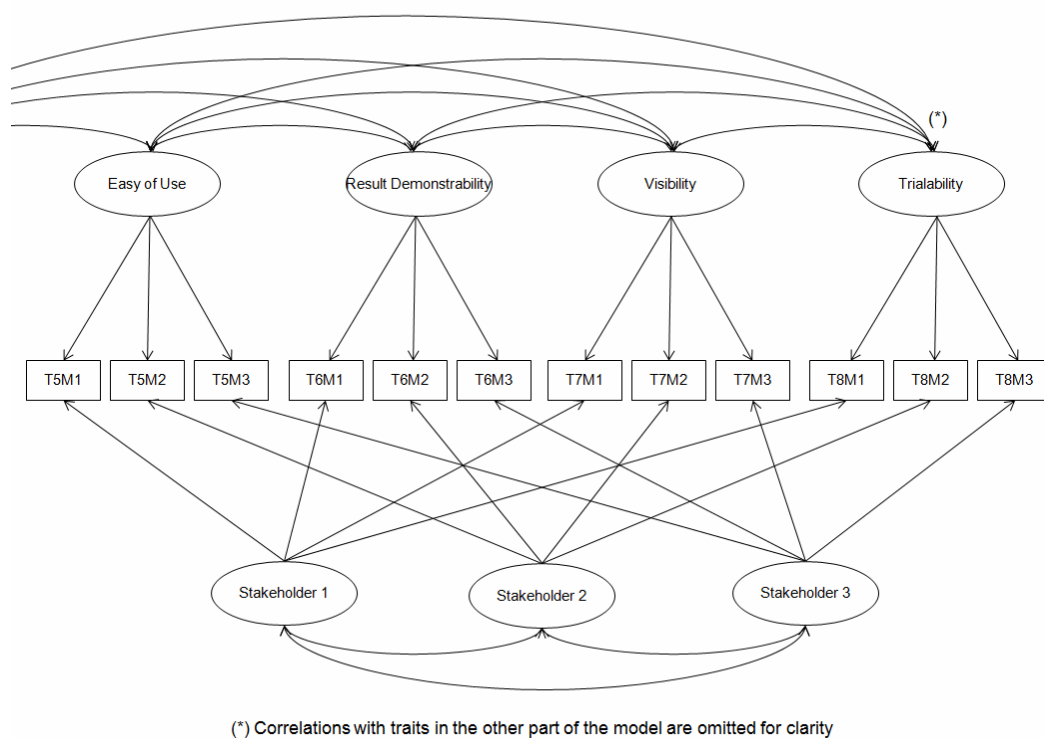


Figure 1.2. MTMM analysis of the last four traits and three methods (error terms are omitted for clarity)

DATA

The data for this study will be collected in small and mid-sized companies in Spain that have implemented Software as a Service (SaaS) applications in the last 12 months. We are planning to include certain demographic variables like size, age, and industry, to account for possible categorical differences. In addition, we will collect information about the adoption of extended-ERP modules like CRM or Business Intelligence that follow the SaaS approach.

Previous studies have been considered ERPs as an IT innovation (e.g., Wang and Ramiller 2009, Wang 2009, Wang 2008). In our particular case, SaaS applications are not only a business innovation but also they are a technological innovation because they are a different paradigm in comparison with the traditional ERP. In addition, this kind of projects makes a good subject of analysis because the community of adopters around it has been large, diverse, and in some cases they have different perceptions of the outcomes of the project that could impact the adoption of the SaaS application.

Despite that we are focused on organizations adopting SaaS applications, it is important to highlight that there are some areas within each organization that are non-adopters of the application. In this sense, we will compare adopters and non-adopters of the IT innovation at the individual level in similar roles inside the organization, considering at least three different stakeholder groups. They will be asked to fulfill a survey based on the eight traits proposed in our model: Voluntariness, Relative Advantage, Compatibility, Image, Easy of Use, Result Demonstrability, Visibility and Trialability.

EXPECTED CONTRIBUTIONS

The main contribution of this article is to deal with the problem of perceptual bias when researchers have multiple respondents belonging different stakeholder groups. The rationale is that assessing different respondents in different groups could lead to erroneous interpretations if we do not consider method variance/bias in the formulation of the instrument. Therefore, method variance/bias must be addressed in some way, for example, using MTMM analysis.

It is quite straightforward to argue that individual difference matters in IT innovation adoption; however, it is difficult to assess where the source of these differences is. A recent study shows that relatively little attention is being paid to method bias in top IS journals (King et al. 2007). Therefore, identify whether the differences come from method or error variance is a step forward for a better understanding of possible incongruence in previous studies and a way to be more accurate when evaluating research models using perceptual measures.

Finally but not least important, Information System researchers must be aware of these possibilities of analysis for further research, especially because this approach can be used in other contexts in which there is not a consensus among previous studies in terms of the obtained results.

REFERENCES

1. Agarwal, R. and Prasad, J. (1997) The Role of Innovation Characteristics and Perceived Voluntariness in the Acceptance of Information Technologies, *Decision Sciences*, 28, 3, 557-582.
2. Ajzen, I. (1991) The Theory of Planned Behavior, *Organizational Behavior & Human Decision Processes*, 50, 2, 179-211.
3. Bagozzi, R. P. and Yi, Y. (1991) Multitrait-Multimethod Matrices in Consumer Research, *Journal of Consumer Research*, 17, 4, 426-439.
4. Bagozzi, R. P. (1980) Causal Models in Marketing, John Wiley and Sons, New York.
5. Bandura, A. (1986) Social Foundations of Thought and Action: A social cognitive theory, Englewood Cliffs, NJ: Prentice-Hall.
6. Campbell, D. T. and O'Connell, E. J. (1982) Methods as Diluting Trait Relationships Rather than Adding Irrelevant Systematic Variance, in D. Brinberg & L. Kidder (Eds.), *Forms of Validity in Research*, pp. 93-111, San Francisco: Jossey-Bass.
7. Campbell, D. T. and O'Connell, E. J. (1967) Methods Factors in Multitrait-Multimethod Matrices: Multiplicative Rather than Additive?, *Multivariate Behavioral Research*, 2, 4, 409-426.
8. Campbell, D. T. and Fiske, D. W. (1959) Convergent and discriminant validation by the multitrait-multimethod matrix, *Psychological Bulletin*, 56, 2, 81-105.
9. Cyert, R. M. and March, J. G. (1992) A behavioral theory of the firm, second ed. Prentice-Hall, Englewood Cliffs, CA.
10. Davis, F.D. (1989) Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology, *MIS Quarterly*, 13, 3, 319-340.
11. Dearborn, D. C. and Simon, H. A. (1958) Selective perception: a note on the departmental identification of the executive, *Sociometry*, 21, 2, 140-144.
12. Fichman, R.G. (2004). Going Beyond the Dominant Paradigm for Information Technology Innovation Research: Emerging concepts and methods, *Journal of the AIS*, 5, 8, 314-355.
13. Fishbein, M. and Ajzen, I. (1975) Belief, Attitude, Intention, and Behavior, Reading, MA: Addison-Wesley.
14. Igbaria, M. (1993) User Acceptance and Microcomputer Technology: An empirical test, *OMEGA*, 21, 1, 73-90.
15. Jeyaraj, A., Rottman, J. W. and Lacity, M. C. (2006) A review of the predictors, linkages, and biases in IT innovation adoption research, *Journal of Information Technology*, 21, 1, 1-23.
16. Ketokivi, M.A. and Schroeder R.G. (2004) Perceptual measures of performance: fact or fiction?, *Journal of Operations Management*, 22, 3, pp. 247-264.
17. King, W. R., Liu, C. Z., Haney, M. H. and He, J. (2007) Method Effects in IS Survey Research: An Assessment and Recommendations, *Communications of the AIS*, 20, 457-482.
18. Kwon, T.H. and Zmud, R.W. (1987) Unifying the Fragmented Models of Information Systems Implementation, in R.J. Boland and R.A. Hirschheim (eds.) *Critical Issues in Information Systems Research*, New York: John Wiley & Sons, pp. 227-251.
19. Malhotra, N. K., Kim, S. S. and Patil, A. (2006) Common Method Variance in IS Research: A Comparison of Alternative Approaches and a Reanalysis of Past Research, *Management Science*, 52, 12, 1865-1883.

20. Moore, G. and Benbasat, I. (1991) Development of an Instrument to Measure perceptions of Adopting an Information Technology Innovation, *Information Systems Research*, 2, 3, 192-222.
21. Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y. and Podsakoff, N. P. (2003) Common method biases in behavioral research: A critical review of the literature and recommended remedies, *Journal of Applied Psychology*, 88, 5, 879-903.
22. Rogers, E.M. (1995) Diffusion of Innovations, New York: The Free Press.
23. Rogers, E.M. (1983) Diffusion of Innovations, New York: The Free Press.
24. Straub, D., Boudreau, M. C. and Gefen, D. (2004) Validation guidelines for IS positivist research, *Communications of the AIS*, 13, pp. 380-427.
25. Swanson, E.B. (1994) Information Systems Innovation among Organizations, *Management Science*, 40, 9, 1069-1092.
26. Venkatesh, V., Morris, M.G., Davis, G.B. and Davis, F.D. (2003) User Acceptance of Information Technology: Toward a Unified View, *MIS Quarterly*, 27, 3, 425-478.
27. Wang, P. and Ramiller, N. C. (2009) Community Learning in Information Technology Innovation, *MIS Quarterly*, 33, 4, 709-734.
28. Wang, P. (2009) Popular Concepts beyond Organizations: Exploring New Dimensions of Information Technology Innovations, *Journal of the AIS*, 10, 1, Article 2. Available at: <http://aisel.aisnet.org/jais/vol10/iss1/2>
29. Wang, P. (2008) Assimilating IT Innovation: The Longitudinal Effects of Institutionalization and Resource Dependence, *ICIS 2008 Proceedings*, Paper 21. <http://aisel.aisnet.org/icis2008/21>