Chapter 9
Contemporary Reporting Practices Regarding Covariance-Based SEM with a Lens on EQS

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ABSTRACT

Structural Equation Modeling (SEM) continues to grow in use as an important research analysis tool in Information Systems research. While evaluating SEM results and interpreting them depends on a variety of reported details, SEM results continue to be reported in an inconsistent manner. Key reporting elements are discussed with regard to contemporary practices which can serve as a guide for future submissions and reviewing. This chapter contributes to the literature by providing an overview of important considerations in reporting results from covariance-based structural equation modeling execution and analysis. It incorporates models and other examples of EQS, one of the leading SEM software applications. While EQS is increasingly used by IS researchers, exemplars of its code and output have not been well published within the IS community, overly complicating the reviewing process for these papers.

INTRODUCTION

"By the end of the 1990s, [covariance-based] SEM had ascended to the ranks of the most commonly used multivariate techniques within the social sciences," (Hancock and Mueller 2006, p. 2). This interest in structural equation modeling (SEM) extended into the Information Systems discipline, but not without reporting deficiencies. As early as 1998, at the request of the editor-in-chief of MIS Quarterly, Wynne Chin was invited to submit a paper (Chin 1998) relating to the appropriate use of structural equation modeling. While the paper made a few references to Partial Least Squares

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(PLS), the paper itself was focused on what the IS field often refers to as covariance-based SEM. In 2000, Gefen, Straub, and Boudreau (2000) compared PLS, LISREL, and regression techniques, but positioned EQS and AMOS as a different type of analysis method from LISREL (ibid, p. 7). AMOS, EQS, and LISREL all belong to the same family of covariance-based structural equation modeling programs. LISREL (Joreskog and Sorbom 1984) began with the modeling of eight unique matrices. AMOS (Arbuckle 1989) extended this type of computational approach, but added visualization to improve modeling ease of use. While EQS and LISREL have added visualization modeling improvements, EQS (Bentler 1985) architected its SEM computational abilities along the equations-based modeling orientation already utilized by behavioral researchers.

Gefen et al. (2000) continued the no longer valid assumption (Treiblmaier et al. 2010) that covariance-based SEM cannot support formative constructs (ibid, p. 10 & p. 31). We now see formative measures used in a number of contemporary SEM studies (Diamantopoulos and Windlhofer 2001; Edwards and Bagozzi 2000; Kline 2006; Mackenzie et al. 2005; Qureshi and Compeau 2009). Unlike PLS (an analytical alternative to covariance-based SEM), EQS, AMOS, and LISREL share the factor analytic measurement model computation approach versus PLS' principal components computation (Rigdon 1996).

Even in well written and received IS research, omissions from good covariance-based reporting practice can be found. For instance, Gefen et al. (2003) do not report the p-value along with chi-square and degrees of freedom. Additionally, instead of emphasizing the model as a unified hypothesis as recommended for SEM models (Chin 1998; McDonald and Ho 2002), they emphasize the practice of reporting each path as a separate hypothesis, implying that each path can stand alone for support or rejection. Besselier, et al. (2003) utilize a common practice in IS research of omitting the covariance matrix, which constrains the ability to replicate results. While traditional journal articles may desire fewer pages, online journals or those whose practice is to utilize online storage for appendices' access, should not be constraining a practice that allows for one to test the model or even to suggest superior alternative models that could advance theoretical contributions. In Datta et al. (2002), neither the factor loadings nor the chi-square, degrees of freedom, and p-value are reported for the confirmatory factor model utilized with the SEM program, AMOS. Proper reporting practices for covariance-based SEM have been discussed in the SEM literature (Jackson et al. 2009; Brown 2006; McDonald and Ho 2002; Boomsma 2002; Chin 1998); however, these same sources note that proper SEM reporting is often lacking and inconsistent. By limiting the reporting of important SEM detail, submitted papers reduce their probability of acceptance by ineffectively interpreting the papers' findings. It is not apparent that authors have applied the SEM technique incorrectly as was inferred in 1998 (Chin), but it is more likely that they have not submitted sufficient detail of their methodology and results. This paper largely draws on reporting practices and guidelines of SEM methodologists and comments on why more contemporary guidelines should be followed. In doing so, we also draw on theoretical advances in Information Systems. The advances in structural equation modeling are arguably dependent upon the technological advances in SEM software, and contemporary SEM practice in this regard is often quite compatible with theoretical contributions from IS theories.

The purpose of this chapter is to aid the submission process in addressing important elements that authors need to include and that reviewers can verify are included and properly interpreted in SEM research papers. The target audience is for those who use SEM software applications in their research, rather than those who design such applications and the mathematical basis for SEM. The paper also contributes by providing examples