

PLS structural equation modelling for Customer Satisfaction

- Methodological and application issues -

Kai Kristensen, kak@asb.dk
Jacob Kjær Eskildsen, eskildsen@asb.dk
Hans Jørn Juhl, hjj@asb.dk
Peder Østergaard, ps@asb.dk

Center for Corporate Performance, The Aarhus School of Business
Fuglesangsallé 4, 8210 Aarhus V, Denmark.

Abstract:

Initiated by the European Commission (DGIII Industry), and in cooperation with the two large quality organizations in Europe, a technical committee for the development of a National Customer Satisfaction Survey in Europe was formed in 1998. Members of the committee were mainly academics from a number of European universities, but also consultants and government officials were represented. The committee published a technical report in October 1998. In this report a model was proposed together with an estimation procedure. The model was the so-called ECSI model (later renamed EPSI rating) and the proposed estimation procedure was PLS. For a closer description see e.g. Kristensen & Westlund, eds. (2000).

Since 1999 the EPSI Rating framework has been applied in a number of European countries, among others Denmark, Finland, Greece, Portugal, Sweden, Ireland, Iceland and Russia. A few industries have been common to all countries, e.g. banking and telecom. In this study we report on some of the methodological observations that we have made when applying PLS for modelling customer satisfaction in Denmark.

Based on the Danish studies since 1999 we have evaluated the EPSI Rating Framework with respect to a number of statistical criteria. Among these are multicollinearity between the exogenous latent variables, validity and reliability of the manifest constructs, and missing values. Furthermore we have analysed the composite reliability of the latent constructs in the model and we have evaluated various fit statistics, especially R^2 for satisfaction and loyalty.

Among the findings we can mention that there is usually no problem with missing values. On the other hand we have seen that there may be a problem with both the validity and the reliability of the proposed questions in specific industries. Furthermore we see that the distribution of both manifest variables and latent constructs is far from normal and that there is a high degree of multicollinearity between the exogenous latent constructs. In addition our analysis shows that the EPSI Rating Framework requires a different model specification for different industries. This leads to the obvious conclusion that individual models may be subject to specification error. Based on the empirical study we are not able to evaluate the effect of the sample size and the number of manifest indicators (i.e. consistency at large). However we know from a theoretical point of view that both factors play a dominant role for the quality of PLS studies and hence we need a further investigation of this. In the paper we give a detailed description of our empirical findings in addition to a number of proposals for the improvement of future satisfaction studies.

In order to study the implications of our empirical findings in greater detail, and in order to provide some general advice concerning the application of PLS modelling in relation to satisfaction studies, a two stage simulation experiment has been conducted using a simplified version of the EPSI Rating Framework. In the first stage an orthogonal main effect simulation experiment was conducted in order to study the effect of exogenous distribution, multicollinearity, indicator validity, indicator reliability, specification error, sample size and the number of indicators on bias and standard deviation of the latent indices and the parameter estimates. In the first stage a total of 27 runs with 25 replications were carried out. Based on the results from the initial analysis a second stage simulation experiment was conducted. Here a number of factors were held constant (exogenous distribution, indicator validity and specification error) either due to necessity or irrelevance. The remaining factors (multicollinearity, indicator reliability, sample size and number of indicators) were subjected to a full factorial experiment in order to study both main effects and interactions between the factors. In the second stage 54 runs with 25 replications were carried out with a total of 585.000 observations. In the paper we give a detailed account of our simulation results and we provide several rules of thumb that may be helpful for the general design of future satisfaction studies.

References:

Kristensen, K. & Westlund, A. H. (eds.), (2000). Special issue on customer satisfaction. *Total Quality Management*, Vol 11, No7.