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User Satisfaction: An Evaluation of a Carbon Credit Information System

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Abstract

This paper presents the analysis of user satisfaction with a web-based system that enables users to calculate the value of carbon credits for landholdings based on user-defined parameters including size of landholding, monoculture species, site quality, management & perpetration etc. For the purposes of this project, User Satisfaction was evaluated using questions based on the User Information Satisfaction (UIS) surveys demonstrated to validate the DeLone and McLean (1992, 2003) model of information systems success. The items in the survey used to test the UIS for this study were modified to suit the nature of the system under investigation, that is, a public, web-based information system. This differs from most previous UIS surveys which have been primarily used to examine proprietary, in-house applications. The paper reports the structural validity of the instrument using exploratory factor analysis (EFA) and structural equation modelling (SEM).

Keywords

User Information Satisfaction (UIS), Carbon Credits, Structural Equation Modelling (SEM), Exploratory Factor Analysis (EFA)

Introduction

The issue of carbon credit trading and greenhouse emissions is a major issue world wide and receiving increasing attention from all levels of government nationally (N.S.W. Parliament, 2002; A.C.T. Parliament, 2004; Baker and McKenzie, 2005) and internationally (U.N.F.C.C.C., 1997; E.C. Parliament, 2003). In fact, the federal government has just recently announced their intention to establish a national carbon credit trading system (Murphy, 2007).

The system examined in this study was developed by the authors with the support of an environmental industry partner 'Australian Forest Corporation' (AFC) based in Lismore, Northern NSW. The 'CO_2 Calculator' is accessible from the AFC website at the following address:

http://www.australianforestcorporation.com.au/CO2calc/

The system was developed with the aim of providing information to landholders who wished to investigate the value of using land reserves as carbon sinks. That is, using their land to sequester carbon and earn carbon credits with the aim of trading the carbon credits as an income producing venture. Additionally the site was developed to demonstrate timber plantations, with appropriate management could earn carbon credits as an additional income stream.

Theoretical Foundations of the Research

The DeLone and McLean (1992, 2003) model of information system success was chosen as the measure of 'user satisfaction' for the study reported in this paper. It was chosen in preference to other models such as TAM and TAM2 (Davis, 1989; Venkatesh and Davis, 2000) as it was felt it better captured users' perceptions of the application rather than measuring users' acceptance of the technology.

The technology acceptance model and derivatives of this model were not selected for one main reason; the technology being used is familiar to users. The CO_2 calculator is an information system that is entirely web-based and as such, users are not required to accept any sort of new technology. Browsing and web-submission forms are commonly accepted methods of seeking information on the World Wide Web. As carbon credit trading is a topical issue it was felt that most users would be accepting of the technology (the Internet) and that it was more important to capture users' perceptions of the success of the application in meeting their expectations related to carbon credit valuation.

Several survey instruments used to validate the DeLone and McLean model of information systems success were examined to design the UIS survey used to measure the success of the 'CO_2 Calculator'.

Following is a subset of the survey instruments examined:

- Bailey and Pearson (1983)
- Miller and Doyle (1987)
- Nelson and Cheney (1987)
- Seddon and Kiew (1994)
- Teng and Calhoun (1996)
- Igbaria and Tan (1997)
- Torkzadeh and Doll (1999)
- Wixom and Watson (2001)

However, it needs to be recognised that some of the survey items from the UIS were changed to reflect the nature of the application and the fact that it was publicly accessible on the web and was not a proprietary, organisationally-focussed information system. Additional questions, which do not impact on the subject of this study, were added to the survey to gauge user attitudes towards privacy, global warming, carbon credits and responsible use of land. The key constructs and the scales used to measure the information system's success are shown in Table 1. These were also the constructs and observed variables tested.

Table 1: Latent and Observed Variables

Latent Variable	Question	Observed Variable
System Quality	1	System is easy to use
	2	System is user friendly
	3	System is easy to learn
Information Quality	4	Information I got from the system is clear
	5	System is accurate
	6	The system provided me with sufficient information
	7	The system provided me with reports that seemed to be just what I needed
	8	The information content meets my needs
	9	The system provided the precise information I needed
Service Quality	10	The system provides up-to-date information
	11	System provided me timely information
	12	The response time of the system was good
	13	The systems output is presented in a useful format
	14	The output from the system was accurate
Overall Satisfaction	16	Overall, how successful is the system
	17	Overall, how satisfied with the system were you
	18	To what extent do you feel the system assisted your land management planning process
Intended Use	19	Using the system improves the planning process
	20	Using the system saves planning time
	21	I will use the system in the future
	22	I would recommend the system to others

The CO_2 calculator could be described as an e-commerce system as it has been provided by the Australian Forest Corporation as a tool to convince land holders of the benefits of the carbon trading and the accreditation services provided by the company. However, the CO_2 calculator could also be described as a decision support system, in that users have the ability to calculate what value of carbon credits their land holdings are capable of returning, and whether that is a desirable use of their land.

In both cases; e-commerce and decision support, the DeLone and McLean I/S success model is ideal to benchmark the CO_2 calculator's success. The DeLone and McLean model has been used as a measure of success for many information systems since it was proposed in 1992.

The key differentiating characteristic of this study is that it uses the DeLone and MacLean I/S success model to examine user satisfaction with a publicly available, web-based application that is non-proprietary or organisationally focussed. This means that users could be using the system as per any publicly available web-based information site. Thus respondent's views are not based on any organisational context and they may not even realise any personal benefits from use of the system. As a result it is expected that users will be providing their views of the information appropriateness regardless of whether there are benefits to them or not.

In the conceptual model used for this study a covariate path is shown between the variables *Intended Use/Use* and *Overall Satisfaction*. The updated DeLone and McLean IS success model has a covariate relationship between *Use/Intention to Use* and *User Satisfaction* which could have been labelled *Overall Satisfaction*. The current study used scales examining 'intended use' rather than 'use' *per se*. This was done because theoretically there is a distinction between intention to use and actual use. Actual use could realistically affect satisfaction as a user would know what the system is capable of providing, whereas, if it was only an intention to use, then the user may not have actually used the system and hence have an unrealistic view of its capability.

As well, the variable *Net Benefits* from the DeLone and McLean model was omitted from the conceptual model used in this study. The information from the 'CO_2 calculator' is a summary of data and can be used for planning processes, the net benefits of which would not be realised until a plantation had been established and appropriate carbon credit management processes implemented. Effectively this could require a minimum of 15 years from a user obtaining information from the CO2 calculator through to initial harvesting of timber from a plantation.

The conceptual model used for this study is displayed in Figure 1.

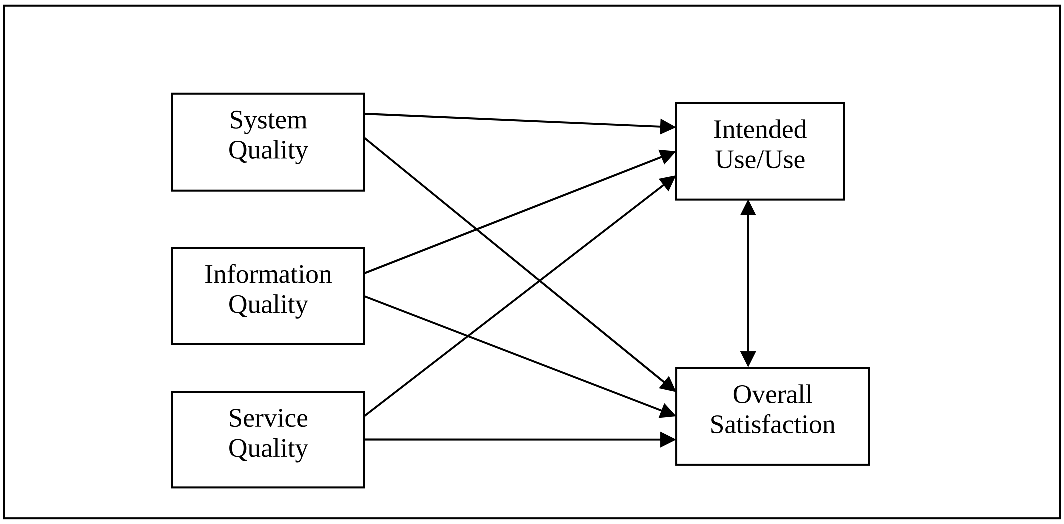

Figure 1: Conceptual Model

The hypotheses tested in the model are derived directly from the associations shown on the conceptual model. Given that the analysis of the model relies on the transitive relationships the authors have not listed the individual hypotheses. This is because each of the relationships that were tested in the complete model would have an affect on any single relationship. Therefore no single hypothesis in the model is disproved or proved as an individual hypothesis as each relationship can mediate the affect of the other relationships in the model.

Data Collection

Users of the system had to register and supply contact details before being permitted to view the advanced output from the analysis. They were required to enter an email address which was used as a contact point to solicit their input to the survey. Each user that indicated they were willing to be part of the survey was sent an email with the survey on a Microsoft Excel spreadsheet.

The reasons a spreadsheet was used were:

- to prevent data transcription errors – data was collated into the final data set using a macro;

- enable users to complete the survey electronically;
- enable users to complete the form in their own time rather then immediately as is the case with most internet based surveys;
- provide users with time to consider their responses; and
- to minimise data entry by the researchers.

There were 260 surveys returned at the date the analysis presented in this paper was prepared. More surveys are expected as part of the final analysis. A pre-test of the survey was conducted and responses from 45 users collected. As a result of the pilot study and the preliminary statistical analyses, the current survey instrument was derived.

Data Analysis

SPSS version 14.0.0 was used for the descriptive, correlation and exploratory factor analysis and Amos version 7.0 was used to test the structural model. The data analysis proceeded in four stages. Firstly, general descriptive analyses were undertaken to perform basic checks on outliers, invalid cases and distributions. Given that the data was collected using spreadsheets to ensure minimisation of data transcription errors, it was not expected that there would be any problems resulting from outliers or data transcription. This was in fact found to be the case and the data set needed no housekeeping prior to proceeding to the next stages of the analysis.

The main analysis proceeded in three separate stages as follows:

- Examination of correlations among the observed variables to check for collinear relationships and the significance of the relationships between latent variables that were expected;
- Check that the observed variables did reflect underlying relationships among the latent variables using exploratory factor analysis (EFA); and
- Examine the relationships among the latent variables as per the conceptual model based on the DeLone and McLean information systems success model.

Correlation Analysis

Pearson bivariate correlations were run on all variables in the study. This was undertaken to check that significant relationships did exist among the items as expected but also to check for items that could be collinear. These items would need to be examined closely in the EFA to ensure that respondents did not see individual items as measuring the same thing. All items in the correlation matrix with relationships significant at the 99% confidence interval ($p < .01$) were desk checked for collinearity. Any items with a correlation coefficient greater than 0.80, were carefully checked to determine how they would be treated in the EFA. Items that are collinear can be combined or not used in the analysis dependent on the nature of the collinear items. In this study there were a number of collinear items where one of the variables was removed during the EFA. The decision on which of the items was retained was based on the wording of the variable in the original survey. In general the item that was retained was the one that the researchers felt had the clearest most unambiguous wording and best reflected the measurement item that the research was attempting to capture.

Exploratory Factor Analysis

Exploratory factor analysis was used to check that the variables did in fact reflect underlying structures in the data set. Factor analysis is a useful tool for examining these constructs and can be used to reduce the data to be taken forward in subsequent analyses. In this case however, EFA was used simply to establish that there were underlying structures. The structures that emerged from this analysis resulted in 4 factors. Both maximum likelihood and principal axis factoring methods with direct Oblimin rotations of the solutions were used to examine the data. There were minor variations in the items that loaded onto the factors. However in the main the items loaded consistently into 4 factor solutions in both analyses.

It must be noted that the items did not load on the factors as expected and according to the structure developed and reflected in the survey. This could be explained by the fact that the UIS is an instrument to assess user satisfaction with information systems *per se*, whereas, this study is examining user satisfaction with a web-based application that is non-proprietary or an organisationally focussed system. This means that users are accessing the site with the aim of obtaining information not directly related to activities and tasks associated with their jobs as would be expected in most organisational information systems. The researchers did cater for this fact when developing the variables in their survey and is reflected in the wording of the items.

As a result of these differences, the researchers decided to approach the next phase of testing in 2 stages. The first stage was to assess a model using all items as per the structure reflected in the survey and model, the scales as observed variables on each of the expected latent traits. The second stage involved reordering the items to reflect their loading on items as per the outcomes of the EFA. Comparisons of the models' fit would then reveal the importance of the item variations and allow the researchers to determine if the variations in these items from the expected relationships were in fact significant. It was expected that a model tested with the hypothesised variables would not have the same 'fit' as the model used with the scales derived from the EFA.

This resulted in a number of changes to the variables that were taken forward into the later stages of the analysis. The model in Figure 2 shows only 3 variables from the conceptual model shown and the variables *Intended Use* and *Service Quality* being omitted. However, the variables *Ease of Use* and *System Usefulness* were introduced to the model. While it could be said that these variables are a re-labelling of the variables that were discarded, they are in fact variables derived from the EFA with observed variables that were expected to load on other latent scales. This then led to modification of the relationships in the model. The researchers examined the questions used to measure the scales that loaded on each of the two new variables and named them *Ease of Use* and *System Usefulness* respectively to reflect their characteristics.

The pattern matrix from the EFA is shown in Table 2 below. It should be noted that the items measuring *Service Quality* were not included in this iteration of the EFA and the findings reported in this section, as they were found to load inconsistently on a number of the factors. The EFA was used primarily to confirm that there were existing structures underlying the data that were commensurate with the findings of previous studies.

Table 2: Pattern Matrix (a)

INFORMATION QUALITY				
8. The information content meets my needs	.941	-.021	.074	-.066
9. The system provided the precise information I needed	.911	.031	.054	-.050
7. The system provided me with reports that seemed to be just what I needed	.721	.169	.120	-.056
6. The system provided me with sufficient information	.665	.071	.087	.127
5. The system is accurate	***.642***	.033	-.013	***.247***
14. The output from the system was accurate	***.520***	-.120	.051	***.487***
16. Overall, how successful was the system	.475	.269	.157	.079
EASE-OF-USE				
2. The system is user friendly	.005	.938	-.017	.026
3. The system is easy to learn	-.071	.832	.075	.015
1. The system is easy to use	.131	.772	-.036	.049
4. Information I got from the system is clear	***.318***	***.385***	.088	.111
SYSTEM USEFULNESS				
20. Using the system saves planning time	-.018	-.097	.960	.050
19. Using the system improves the planning process	.054	-.062	.929	.033
18. How well do you feel the system assisted your land management process	.260	.214	.462	-.001
21. I will use the system in the future	.000	.098	.423	-.022
22. I would recommend the system to others	.179	.119	.379	.142

SYSTEM QUALITY				
11. The system provided me with timely information	.087	.206	-.027	.669
10. The system provides up-to-date information	.344	.049	-.040	.571
12. The response time of the system was good	-.091	.017	.099	.542
13. The systems output is presented in a useful format	.113	.105	.240	.461

Extraction Method: **Principal Axis Factoring**. Rotation Method: Oblimin with Kaiser Normalization.
A Rotation converged in 8 iterations.

As shown in the pattern matrix in Table 2 there were four factors identified. Close examination of the items that loaded on each factor led to the names of some of the factors being changed from those originally identified on the conceptual model. As well, some items loaded onto factors differently from the original study. This is believed to have occurred because respondents were evaluating a web-based system rather than a proprietary, in-house system directly associated with a respondent's work. Therefore it would be expected that 'overall success of the system' and 'overall satisfaction with the system' would be directly associated with scales more definitely aimed at measuring information quality. As well, the output from the system is the main criteria by which respondents are evaluating the system as it is not designed to make them more efficient in their normal work-related activities.

Structural Equation Modelling

SEM is ideally suited to testing multiple hypotheses simultaneously. However, it needs to be recognised that testing these hypotheses simultaneously may reveal different results to testing them individually. This arises due to the transitive nature of the relationships in the model and that the effects of relationships may be moderated by other relationships that would not be evident if the hypotheses were tested individually. Therefore it is also valuable to disassemble certain hypotheses and test them individually without the mediating or transitive affects of other relationships in the model.

Of the four factors identified from the EFA there was no factor whose scales indicated a measure of overall satisfaction as originally hypothesised. In fact, some of the items hypothesised as measuring overall satisfaction with the system loaded on two separate factors. These items are highlighted in italics in Table 2 above. As SEM requires an endogenous variable, it was decided that the 3 scales that were originally hypothesised as measuring overall satisfaction would be included in the model as a latent variable. This meant that these scales were not included in the factors derived from the EFA and as shown above.

This then resulted in the initial structural model that was tested having five latent variables. Given the differences in the systems that underpin the focus of the research it is reasonable to adjust variables in the manner described. It should also be noted that in the initial stages of testing the variables measuring *Service Quality* was not included (and nor was it included in the EFA for the reasons discussed above). *Service Quality* has been introduced into the model for this study to assess users' trust in the system. Given that the system is in the public domain and publicly available on the web, it was felt necessary to attempt to measure users' perceptions of the validity of both the output from the system and the use of the web as the access domain.

A number of modifications were suggested during the analysis of the structural model that resulted in changes to variables included in the model. The first change resulted in the scale measuring '*How well do you feel the system assisted your land management practices*' being omitted as an observed variable of *Overall Satisfaction*. The modification indices suggested that this variable have a covariance with *System Usefulness*.

However, inclusion of this path did significantly alter model fit and resulted in further suggested modifications. This is indicative of a variable that is potentially covariate with other scales and could be reasonably omitted as the dimension it sought to measure is being adequately measured through other variables in the model. A closer examination of the correlation matrix did show significant relationships between the affected variables although the relationship was not collinear. For the sake of model parsimony it was removed resulting in significantly improved model fit and thereby further justifying its omission.

The second change was the omission of the scale '*the output from the system was accurate*' from the latent variable *Information Quality*. The correlation matrix showed this variable was collinear with the item '*the system is accurate*'. As the modification indices suggested a pathway between this scale and *System Quality* the decision was made to omit it from the model as the intended dimension of 'accuracy' was measured in an alternative scale.

The final changes recommended were to include paths from *System Quality* to *System Usefulness* and from *Information Quality* to *Ease of Use*. The addition of these two additional paths further improved overall model fit.

Additional changes made to the model prior to presenting it as shown in Figure 2 were the result of testing it with paths from *System Quality* to *Information Quality* and *Information Quality* to *System Quality* at the same time (2 paths present) and individually (1 path only present each time). Evaluation of the fit indices showed that best fit was achieved with the singular path drawn from *Information Quality* to *System Quality*. This was the relationship retained for the final presented below.

Running the model with the changes described above resulted in all paths being significant other than the path from *System Usefulness* to *Overall Satisfaction*. This path was subsequently removed resulting in the model shown in Figure 2. The removal of this path from the model did result in very minor improvements to three of the fit indices thereby justifying its omission. While the path could well have been retained in the model due to minor changes to fit, it showed that it was having little affect, therefore, could be removed without compromising the model.

Theoretically it also shows that *System Usefulness* does not influence users' *Overall Satisfaction* with web based systems. This could reasonably be expected given that many web users simply browse the web looking for sites of interest or relevance and their overall satisfaction with the site is not necessarily related to the site's usefulness. In fact the model in figure 2 shows that users' *Overall Satisfaction* with a web based application is determined directly by *Ease of Use*, *System Quality* and *Information Quality*. Therefore, the model is showing that user' do not equate *Overall Satisfaction* with a web based information system with its usefulness (*System Usefulness*).

Hair et al. (1995) and Kline (1998) state there are numerous statistical tests that can be used to describe the 'fit' of a SEM. However, there is no single statistical test that describes the strength of SEM (Hair et al., 1995). The 'fit' indices effectively assess the congruence between the hypothetical model and the data set. Therefore, researchers should report multiple 'fit' indices, as the various fit indices each measure different aspects of the model. As a general rule-of-thumb, the more criteria that a model satisfies, the better is its fit.

However, fit indices alone are not an adequate measure of model validity as 'good' fit can be derived for models which are not conceptually sound and which have poor conceptual associations between the model constructs (Kline, 1998). Thus the associations between the model variables must also be conceptually valid. Table 3 provides a summary of several of the most common fit indices. These indices represent measures of the key aspects of SEM model validation.

Table 3: Summary of Goodness-of-fit and Model Evaluation Indices

Measurement Indices	**Recommended Value**	**Value Range**	**Model Indices**
Root Mean Square Error of Approximation (RMSEA)	< 0.05 (ideal) < 0.08 (acceptable)		.052
Goodness-of-Fit Index (GFI)	≥ 0.95 (Good) ≥ 0.90 (Adequate)	0 to 1	.944
Adjusted Goodness-of-Fit Index (AGFI)	≥ 0.95 (Good) ≥ 0.90 (Adequate)	Upper limit 1	.915
Normed Fit Index (NFI)	Close to 1 (unity)	≤ 1 (unity)	.967
(Same as TLI – see below)	Close to 1 (unity)	≤ 1 (unity)	.980
Minimum Sample Discrepancy Function (CMIN/DF)	< 2.0 (Good) < 3.0 (Adequate)		1.837

Table 3 above shows the output from analysis of the model and measures derived for each of the key fit indices. The analysis was undertaken using Maximum Likelihoods as the discrepancy function.

As well, the lowest critical ratios of all items on the model was 2.954, meaning that all critical ratio values for all items exceeded the suggested minimal value of +/-1.96. Further testing was conducted with the items measuring *Service Quality* included in the model. This resulted in degraded model fit and consequently this variable is not included on the final model.

However, it is intended in future research that these scales will be examined using hierarchical regression analysis to see if there are relationships supported that are not part of the final model shown in Figure 2. This will be undertaken as part of further research and is not reported in this paper.

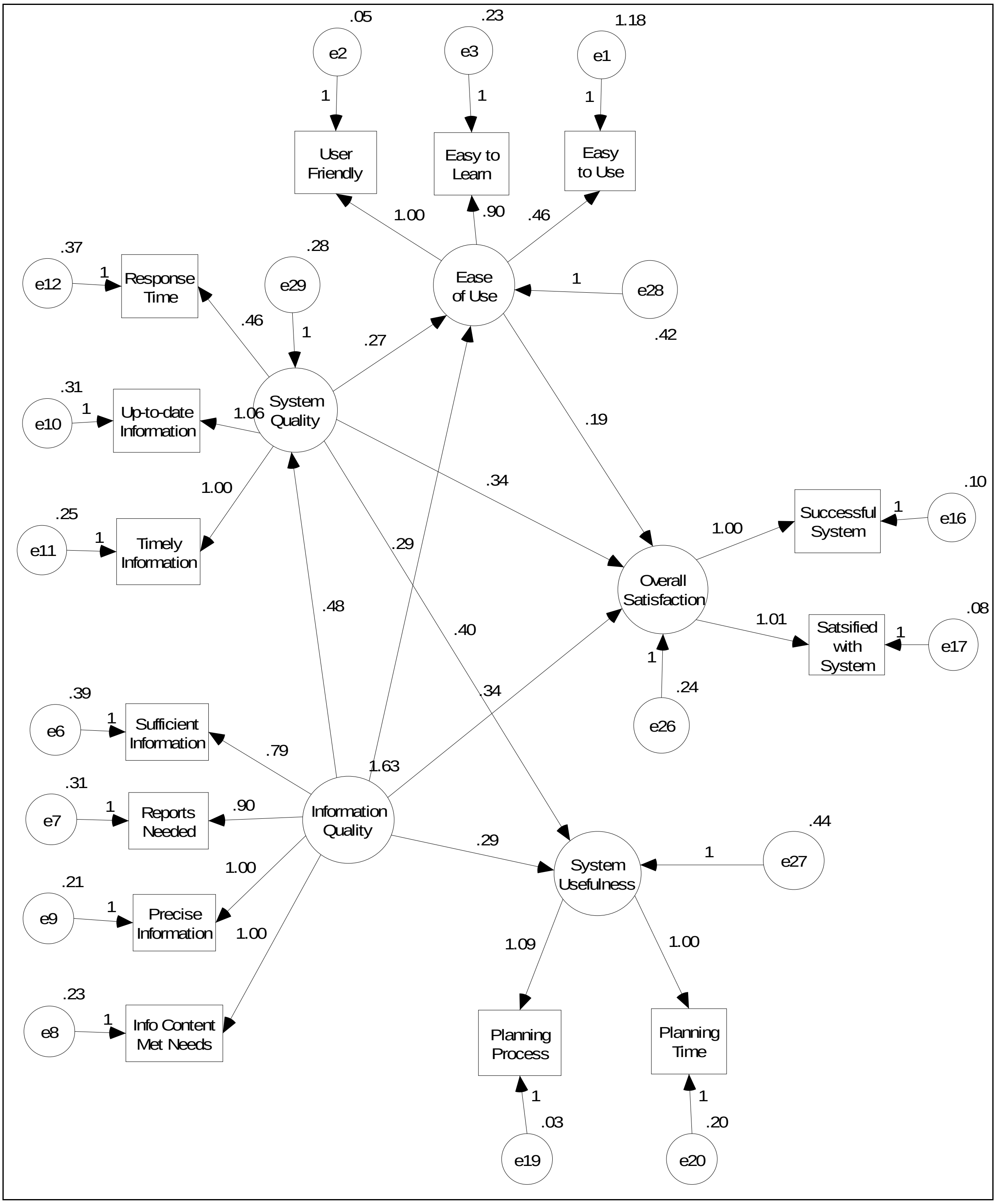

Figure 2: Structural Model

Conclusion

The model shown in Figure 2 explains 72.2% of the variance in *Overall Satisfaction* which is the explanatory variable used to measure user's satisfaction with the system based on the traits measured by the other variables. The model also explained 57.3% of the variance in *System Quality*, 42.0% in *Ease of Use*, and 49.4% of the variance in *System Usefulness*. Quite clearly, the variables used in the study are effective in measuring the traits that contribute to user's satisfaction with a web-based application that has no specific proprietary roles or a specific organisational context.

Given the analysis resulted in different variables to the conceptual model there were also changes to the relationships in the final model. Key relationship differences that should be noted are *Information Quality* predicting System Quality. As well, there is no relationship between Overall Satisfaction and System Usefulness. This is felt to result from the nature of the system being investigated in that it is a publicly available, web-based application. Therefore, user satisfaction with a web-based system is not dependent on its usefulness. This may be indicative of web-browsing behaviour in that users may find sites of interest that are of little or no use to them either personally and/or professionally, yet that they feel is of importance generally. In essence, it is felt that they are happy to see a system that provides information that is of benefit to the environment but is not information that is not of immediate advantage to them.

It is important to recognise that the variance explained by the model results from the measures and relationships among all the variables. Therefore, as explained earlier, there could well be valid relationships among other variables explored in this study that need to be investigated further. Further, the research is not trying to say that these variables are the variables that should be used when investigating user satisfaction with web based applications. The value of the study lies in its identification of scales and traits, that when examined simultaneously, do account for a large percentage of user satisfaction with the system investigated. The size of the sample means that the results cannot be reliably extrapolated to a whole-of-population. However, it is a valuable starting point for future researchers wishing to examine user satisfaction with web based applications.

As pointed out above, a number of relationships in the model differ from those identified in the foundation research undertaken by DeLone and McLean. These changes can be explained by the differences in the systems investigated – web-based publicly available applications versus proprietary in-house applications supporting specific business functions.

Further analysis aims to use the demographic variables to see if they moderate the structural paths in the model. However this testing is dependent on there being sufficient responses from each demographic grouping to enable the analysis to proceed (minimum observations suggested for SEM is 100). Even this number of observations per moderating variable could only be considered to be on the 'small' side and is not really sufficient to reliably extrapolate the results.

Hierarchical regression tests will also be used to further examine the relationships among the predictor variables and also to ensure that the mediating effects of testing in the model did not preclude relationships that could reliably be used outside of the structural model testing reported in this paper.

References

A.C.T. Parliament 2004, "Electricity (Greenhouse Gas Emissions)", Act 2004-71

Bailey, J.E. and Pearson, S.W. 1983, "Development of a Tool for Measuring and Analyzing Computer User Satisfaction", *Management Science*, vol. 29, no. 5, pp. 530-545.

Baker & McKenzie 2005, *National Emissions Trading Scheme Comunique*, Baker & McKenzie, Sydney.

Comrey, A.L. 1973, *A First Course in Factor Analysis*, Academic Press, New York.

Davis, F. D. 1989, "Perceived usefulness, perceived ease of use, and user acceptance of information technology", *MIS Quarterly*, vol.13, no. 3, pp. 319-339.

DeLone, W.H. and McLean, E.R. 1992, "Information Systems Success: The Quest for the Dependent Variable", *Information Systems Research*, vol. 3 no. 1, pp. 60-95.

DeLone, W.H. and McLean, E.R. 2003, "The DeLone and McLean Model of Information Systems Success: A Ten-Year Update", *Journal of Management Information Systems*, vol. 19, no. 4, pp. 9–30.

EC (European Commission) Parliament 2003, "European Union Greenhouse Gas Emission Trading Scheme" Directive 2003/87/EC.

Fornell, C. and Larcker, D.F. 1980, "The Use of Canonical Correlation Analysis in Accounting Research", *Journal of Business Finance and Accounting*, vol. 7, no. 3, pp. 455-473.

Gorsuch R.L. 1974, *Factor Analysis*, W.B. Saunders Company, Philadelphia.

Hair J.F., Anderson R.E., Tatham R.L. and Black W.C. 1995, "*Multivariate Data Analysis with Readings*", 4th Edition, Prentice Hall Publishers, New Jersey.

Igbaria, M., and Tan, M. 1997, "The Consequences of Information Technology Acceptance on Subsequent Individual Performance", *Information and Management*, vol.32, no. 3, pp.113-121.

Kline, R.B. 1998, "*Principles and Practice of Structural Equation Modelling*", Guilford Press, New York.

Loehlin, J.C. 1987, *Latent Variable Models: An Introduction to Factor, Path and Structural Analysis*, Lawrence Erlbauin Associates, Hillsdale, New Jersey.

Miller, J. and Doyle B. A. 1987, “Measuring Effectiveness of Computer Based Information Systems in the Financial Services Sector”, *MIS Quarterly*, vol. 11, no. 1, pp. 107-124.

Murphy, K. 2007, “Carbon Trading by 2012: Taskforce”, *The Age*, 1 June, viewed 17 June 2007, <http://www.theage.com.au/news/national/carbon-trading-by-2012/2007/05/31/1180205427795.html >.

Nelson, R.R. and. Cheney, P.H. 1987, “Training End Users: An Exploratory Study”, *MIS Quarterly*, vol. 11, no. 4, pp. 547-559.

Nunnally, J. C. 1967, *Introduction to Psychological Measurement*. McGraw Hill, New York.

Nunnally, J.C. and Bernstein, I.H. 1994, *Psychometric Theory*, 3rd Edition, McGraw Hill, New York.

N.S.W. Parliament 2002, "Electricity Supply Amendment (Greenhouse Gas Emission Reduction)", Act 2002-122.

Seddon, P.B. and Kiew, M.Y. 1994, “A Partial Test and Development of the DeLone and McLean Model of IS Success”, *Proceedings of the International Conference on Information Systems,* Vancouver, Canada, pp. 99-110.

Teng, J., and Calhoun, K. 1996,"Organizational computing as a facilitator of operational and managerial decision making: An exploratory study of managers’ perceptions" *Decision Sciences*, vol. 27, no. 4, pp. 673–710.

Torkzadeh, G. and Doll, W.J. 1999, "The Development of a Tool for Measuring the Perceived Impact of Information Technology on Work", *Omega*, vol. 27, no. 3, pp. 327-339.

UNFCCC (United Nations Framework Convention on Climate Change), COP3 (Conferences of the Parties) 1997. *Kyoto Protocol*, Kyoto, Japan.

Venkatesh, V. and Davis, F. D. 2000, “A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies”, *Management Science*, vol. 46, no. 2, pp. 186-204.

Wixom, B.H., and Watson, H.J. 2001, "An empirical investigation of the factors affecting data warehousing success", *MIS Quarterly*, vol. 25, no. 1, pp. 17–41.

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