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Survey design: Insights from a public sector-ERP success study

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Abstract
Research on the impact of Information Systems (IS) reported in both academic literature and popular press has reported confounding results. Some studies have reported encouraging results of IS, while others have reported nil or detrimental results. The contradictory results of these research studies can be partially attributed to the weaknesses in survey instruments. In an attempt to increase the validity of conclusions of IS assessment studies, survey instrument design should follow a rigorous and scientific procedure. This paper illustrates key validity and reliability issues in measuring Information Systems performance, using examples from a study designed to assess Enterprise Resource Planning systems success. The article emphasizes on the importance of the survey method and the theoretical considerations of item derivation, scale development and item evaluation. Examples are provided from the ERP assessment study to supplement the readers understanding of the theoretical concepts of survey design.

Keywords: Survey research, Enterprise Resource Planning Systems, IS success, IS impact

Introduction

Information System (IS) investments are under increasing scrutiny and pressure to justify their contribution to productivity, quality and competitiveness of organisations. Assessing the success of IS has been listed as one of the key 'issues' by organisational executives around the world (Ball and Harris, 1982; Brancheu and Wetherbe, 1987; Dickson, Leitheiser, Nechis, Wetherbe, 1984). The most commonly used research methodology for empirically assessing the success of IS (as explained in the Survey Research section below) is survey study. However, results from these survey studies have been mixed. Some have shown positive impacts of IS in organizations (e.g. Barua and Lee, 1997; Barua et al., 1991; Brynjolfsson and Hitt, 1996; Lehr and Lichtenberg, 1999; Mukherjee, 2001), while others have shown nil or detrimental impacts (e.g. Brynjolfsson and Yang, 1996; Cameron and Quinn and Rohrbaugh, 1983; Wilson, 1993). These perplexing results of IS success studies can be partially attributed to the weaknesses in survey instruments employed and failure to adhere to fundamental guidelines in conducting survey research. In order to yield dependable, consistent results a survey should be conducted in a systematic manner and the question items should represent the constructs utilized in the study (Hinkin, 1995; Hunter, Schmidt and Jackson, 1983; Schoenfeldt, 1984).

This paper provides guidelines for survey instrument design and validation in Information Systems measurement studies. It does so by providing examples and insights from a recent research on the measurement of Enterprise Resource Planning (ERP) system success in 27 public sector organisations in Queensland, Australia. The instrument design and validation procedure described herewith is kept generic so that it can be easily adopted for similar research in IS. Examples specific to the research study, however, are also provided to give a context for understanding the theoretical and practical considerations in information systems measurement research. The structure of the paper is as follows. First, a brief, general description about the survey method is provided to illustrate advantages of the survey method in the context of this study. The next section discusses the theoretical considerations of survey design. In particularly, it emphasizes on construct/sub-construct derivation, item and scale development and administration of surveys and evaluation of the survey outcomes. The final section provides some insights and examples from the research study. For a common reference of the terminology used in this study, Appendix A graphically illustrates the relationships (and differences) between *the concept*, *constructs, sub-constructs* and *items*.

Survey Research

Survey research is one of the most widely used methodologies in the field of Management Information Systems (MIS). This is so for several reasons. Firstly, Attwell and Rule (1991) state that survey research can be usefully employed in documenting the norm accurately, identifying extreme outcomes and delineating associations between variables in the sample. Secondly, survey research also provides the ability to analyze data both at aggregate and at individual levels. Thirdly, survey research facilitates more rigorous hypothesis testing and generalization by giving more cases (samples) and more systematic data than, for example case studies (Ishman, 1996; Danziger and Kreamer, 1991). Fourthly, survey research has the potential to add to the inventory of previously well-developed research instruments (Ishman, 1996). Benbasat (1989) states that such an inventory of instruments allows the MIS field to be more proactive and research activities can be expedited without re-inventing instruments. However, these advantages could only be realized in a survey research only if its instrument has been validated. Indeed, Starub (1989) states that instrument validation is inadequately addressed in the MIS research and provides an excellent overview of general methodologies that should be followed for conducting empirical research in the field. Survey instrument validation is also critical as it helps to provide researchers with greater clarity to research findings and afford in-depth analysis (Bagozzi, 1980; Straub, 1989). Hunter et al., (1983) state that validated instruments provide greater corporative research in the field of MIS. Validated instruments would also allow other researchers to conduct follow-up research and using the same survey instrument in heterogeneous environments would help researchers to triangulate findings.

Construct Identification – *Theoretical Constituents*

As mentioned earlier, a survey instrument has been developed as part of our research on measuring ERP success. IS research has concluded that there exists no single overarching measure to evaluate the multi-dimensional IS success in organisations. Prior research in IS suggests that the employment of a single construct or a subset of constructs may contribute to mis-measurement (Carlson & McNurlin, 1992; Hartwick & Barki, 1989). Furthermore, one needs to validate measurement constructs and sub-constructs for the context of the study, before employing them in a survey instrument.

Hinkin (1995) specifies two approaches of identifying appropriate constructs for a research study: (1) the inductive and (2) the deductive approach. In the *inductive* approach, the researcher has to determine the *domain* and/or *dimensions* of a construct. Here, the researcher can gather qualitative data, such as interviews/case studies, and categorize the content of qualitative data in order to generate appropriate constructs and sub-constructs. The *deductive* approach is a theory-driven approach where the research is focused on deriving at sub/constructs following the propositions of an existing theory, model, framework or taxonomy. In both circumstances constructs and sub-constructs should represent the measurement phenomenon adequately with no extraneous variables.

Survey item derivation - *Theoretical Constituents*

Once the constructs and their sub-constructs have been identified and individually qualified for the context of the study, the survey items (i.e. *questions*) for each of the sub-constructs can be derived. It is important that each of the sub-constructs is well represented by one or more items and that the items are appropriate for the research domain. This criterion is referred to as *content validity*. Cronbach (1971) and Kerlinger (1964) suggest that an instrument is valid in the content, if that (*instrument*) (i) has drawn representative questions from a universal pool, and (ii) subjected to a thorough reviewing process of the items by experts until a formal consensus is reached.

Number of items

Cronbach and Meehl (1955) suggest that the number of items to measure a construct should adequately sample the domain of interest, but be as parsimonious as possible. Obtaining the 'optimal' number of respondents is an important decision that one has to make in instrument derivation process. Surveys with too many items can induce response pattern bias (Anastasi, 1976); however, if too few are used, then the content and construct validity are at risk (Kenny, 1976; Nunnally, 1976). Hinkin and Schriescheim (1989) state that scales with *one item* per *construct* are at greater danger in under-specifying a construct. On the other hand, for practical purposes, Ives, Hamilton, and Davis (1983) and Bailey and Pearson (1983) propose that each sub-construct should be measured by a single instead of multiple items in IS measurement studies.

Negatively worded questions

Negatively worded items, when used in conjunction with other items that measure the same sub-construct, are mainly used to eliminate response pattern bias. Some researchers (Schriesheim and Hill, 1981; Jackson, Wall, Martin & Davis, 1993), however, suggest that reversed scored items, if not phrased appropriately, may induce systematic error and will reduce the validity of the items. Indeed, Hinkin (1995) has found that the loadings of a factor analysis of negatively worded items were lower that the ones that are positively worded.

Scale development

Using the appropriate scale is another important consideration in the instrument design process. This refers to the choices a respondent has on answering each item. The most frequently used scale in perceptions gathering surveys is likert-type scale, where a respondent has to choose a response from a scale of values (for example, from 1 to 7, where 1 represents an extreme negative response, 7 an extreme positive response, and middle value represent a neutral response). One important decision regarding the scale selection is pertained to the length of the scale (e.g. 1 to 5; 1 to 7) and usually it is up to the researcher to select the length of a scale. A 'good' scale should accommodate sufficient variability among the respondents. According to Lissitz and Green (1975), reliability of a scale increases with the increments of the number of choices up to *five* and levels off beyond. Once the preliminary item derivation is completed, it should be pilot tested with a selected sample of respondents. If a survey is to be administered to different cohorts of respondents (for example, respondents from different organizational levels), care should be taken to ensure that the survey is pilot tested by at least a respondent from each of the cohorts.

Administration and item evaluation - *Theoretical Constituents*

Once the survey items are finalized, the survey instrument is administered to the target respondents. The target respondents that one selects to administer the instrument should be a representative sample of the population (if not the entire population). As responding to survey is often a voluntary exercise, strategies should be in place to increase the likelihood of response from the target respondents. A larger sample of responses would help researchers to check the validity and reliability of the items employed in the survey instrument. When conducting factor analysis to establish underlying structure of a construct, results may be vulnerable to the size of the sample (Hinkin, 1995). Researchers have set forth different arguments about the size of the required sample for a detailed data analysis. Rummel (1970) recommend an item-to-sample response ratio of 1:4 while Schwab (1980) recommends an item-to-sample ratio of 1:10. Guadognoli and Velicar (1988) suggest a sample of 150 to obtain an accurate exploratory factor analysis regardless of the items employed in the survey, provided that internal reliability of the measures is strong. Bryant and Yarnold (1995) suggest a minimum of 1:5 item-to-sample ratio in order to conduct an exploratory factor analysis.

The common procedure for validating if a construct has been measured appropriately by its sub-constructs is often achieved through exploratory factor analysis (Ford, MacCullum & Tait, 1986). Factor analysis identify the items that 'load' into a relevant construct and the weights of those items. One should discard or revise items that do not load to the assigned constructs and/or has a loading below 0.4 (Hinkin, 1995).

Further criteria such as criterion and construct validity should be applied where appropriate. Criterion validity provides an indicator that reflects whether the scores on a measure are related to the criterion. Construct validity is a mechanism to check whether the selected constructs are true depicters that describe the event, not merely artifacts (Cronbach, 1971l Campbell & Fiske, 1959). Construct validity of an instrument can be assessed through multitrait-multimethod (MTMM) techniques (Campbell and Fiske, 1959) or techniques such as confirmatory or principal component factor analysis (Long, 1983; Nunnally, 1967)[1]. Construct validity includes face, content, criterion, concurrent and discriminant validity as well as internal consistency.

Finally, a test of the *internal reliability* of a measure should also be conducted. Internal Reliability is particularly important in connection with multiple-item scales. It raises the question of whether each scale is measuring a single idea and hence whether the items that make up the scales are internally consistent. The most widely used *Cronbach's alpha* is suggested here to determine the internal reliability of the measurement items.

The next section of this paper discusses the systematic process of designing a survey instrument in a study conducted to measure the success of ERP in the public sector as an example. It first describes the study, followed by the theoretical guidelines of construct (*and sub-constructs*) identification and scale development. Finally, a discussion on instrument validation will be provided.

The ERP success measurement research study

The main objective of the study was to identify and empirically assess ERP success in the public sector environment. The study was conducted across 27 state government departments in Australia that had implemented SAP (*the market leading ERP solution*) in the second half of 1990. The data collection process had two important phases: (1) exploratory survey and (2) confirmatory survey, which together covered the full research cycle proposed by Mackenzie and House (1979). The purpose of the exploratory survey was to identify and validate constructs and sub-constructs that are relevant to the study context and it is discussed in detail in the following section. In the exploratory phase, respondents were asked to specify impacts associated with the SAP system in their organisation.[2] The purpose of the confirmatory survey was to test the *a priori* model that was derived from the exploratory survey. The confirmatory survey employed five constructs and 42 sub-constructs, similar to ones that of the Delone and McLean IS success model (1992). The exploratory survey received hundred and thirty-seven responses and the confirmatory survey received three hundred and ten responses.

Construct Identification – *Examples from the study*[3]

This study employed a deductive approach to derive at constructs for measuring the success of ERP systems on the public sector organisations. There is considerable literature offering recommendations and methodologies for IS impact assessment. More prominent of these include: the Delone and McLean IS success model (1992), the

[1] Concurrent and predictive validity are generally considered to be subsumed in the construct validity and thus will not be discussed in this paper.

[2] It should be highlighted that the word "impacts" in the exploratory survey round was used in the broadest sense, to encompass impacts on individuals, the organization, information, the system, etc.

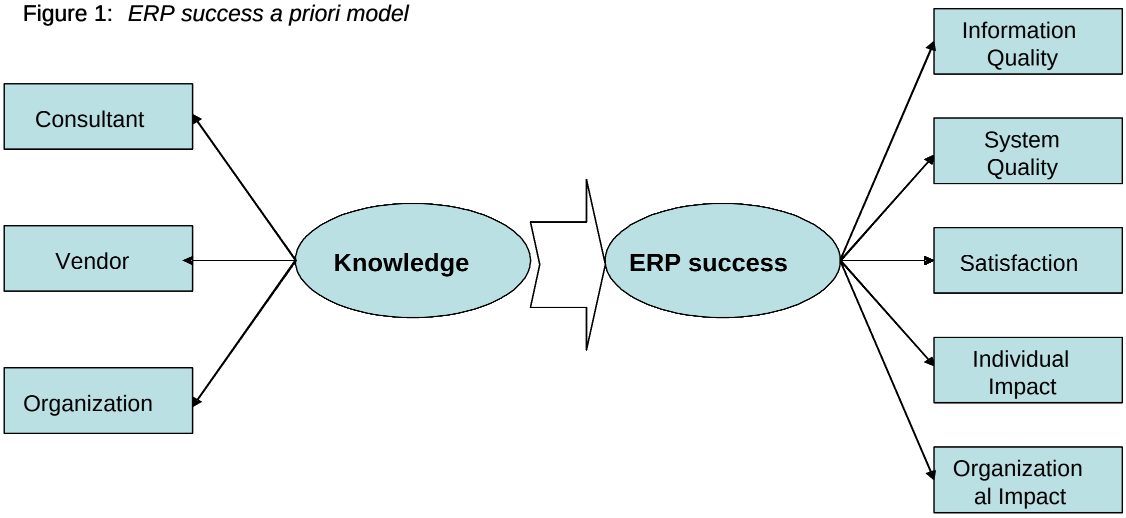
[3] Study findings are reported in Sedera et al., 2000; Sedera et al., 2001; Sedera et al., 2002; Sedera et al., 2003 *forthcoming (a)*; Sedera et al., 2003 *forthcoming (b);* Sedera et al., 2003 *forthcoming (c)*

Saunders and Jones IS function performance evaluation framework (1992), the IS assessment selection model (Myers, Kappelman, Prybutok, 1997), MIT 90s IT impacts framework (Scott-Morton, 1990; Allen and Scott-Morton, 1992), and Balanced Scorecard (Kaplan and Norton, 1992, 1996, 2000). Shang and Seddon (2000) present one of few ERP specific benefits frameworks.

As depicted in Appendix B, prior studies relevant to instrument design were adequately analyzed and some items were based on prior validated instruments. To comply with the second aspect of content validity, a series of expert workshops (*with leading academics and industry representatives in the study domain*) were conducted and amendments were made to the instrument items[4]. The literature review failed to identify any validated instruments that could be used entirety to fulfill the purpose of this study. However, the comprehensive literature review helped to identify items from prior validated survey instruments, which contributed to the design of the current instrument. A majority of these, questions, however, had to be amended to represent the *ERP* context in the *public sector*.

The DeLone and McLean (1992) IS success model is one of the most comprehensive and widely cited (Heo and Han, 2002; Myers et al., 1997) and provided the basis for construct identification in this study. Delone and McLean, based on the work of Shannon and Weaver (1949) and Mason (1978), proposed an interrelated set of six constructs of IS measurement; (1) System Quality, (2) Information Quality, (3) Use, (4) User Satisfaction, (5) Individual Impact, and (6) Organisational Impact and a list of sub-constructs. Unlike the DeLone and McLean's model, the *a priori model* illustrated in Figure 1[5], is a *measurement* model for measuring ERP success using *FIVE* independent dimensions; System Quality, Information Quality, Satisfaction, Individual Impact and Organisational Impact. These dimensions are posited to be correlated and additive measures of the same multidimensional phenomenon, namely ERP success.

Figure 1: *ERP success a priori model*



[4] Detailed outcomes of the expert workshops can be obtained from the contact author.
[5] SQ – System Quality, IQ – Information Quality, U – User Satisfaction, US – User Satisfaction, II – Individual Impact, OI – Organisational Impact

DeLone and McLean (1992) suggest that the *constructs* and *sub-constructs* of their model should be systematically selected and validated in order to develop a comprehensive measurement instruments. With the intention of validating the constructs and sub-constructs of the Delone and McLean (1992) IS success model to the unique nature of this study (i.e. ERP in the public sector) an exploratory survey was conducted.

The emphasis of the exploratory survey was to 'qualify' the sub/constructs proposed in the Delone and McLean IS model and to identify any new constructs and/or sub-constructs that are specific to the context of the study. The exploratory survey was non-anonymous and had three sections. The first section requested demographic details of the respondent and asked for a brief description of their involvement with the SAP system. The second section sought to identify specific impacts associated with their SAP system. In the third section respondents were asked to list any past, present and future initiatives for increasing positive impacts from the SAP system. A total of 485 impacts were received at the end of the exploratory round yielding a mean of 3.6 impacts per respondent. Impacts cited (485) were then codified and were mapped to the sub-constructs (within constructs) of the Delone and McLean IS success model. Using the employment descriptions provided, respondents were classified into distinctive employment cohorts to understand diversity of impacts across different employment cohorts within each of the agencies. Five individuals (three academics and two senior business analysts from Queensland Government) carried out the mapping exercise to avoid any individual judgmental errors (for the details of the mapping exercise see Sedera, Gable, Palmer, 2002; Sedera, Gable, Chan, *forthcoming*). The analysis of the exploratory survey responses resulted in a list of 'validated' constructs and sub-constructs for this unique study environment. Table 1 briefly portrays the rational for in/excluding constructs and sub-constructs for the study.

Table 1A: Rational for constructs in/exclusion
▪ Use (a.k.a. usage) construct was removed. [6] ▪ 'User Satisfaction' was changed to 's*atisfaction'* to accommodate views of senior managers, who do not *use* the SAP system per se. ▪ No differences were made on the remaining four constructs.

[6] As Delone and McLean (1992) point out "usage, either perceived or actual is only pertinent when such use is not mandatory" (p 68). When use of a system is mandatory, the number of hours a system is used conveys little information about the impact of such a system. Seddon and Kiew (1994) argue that the underlying construct IS researchers have been trying to gauge is *Usefulness*, not *Usage*. The ERP system under investigation is mandatory for all users, and thus changes advocated by Seddon and Kiew (1994) are acknowledged. However, we argue that the *Usefulness* of a system derives from such factors as, the quality of the system, quality of information, and satisfaction of users. We therefore argue that *Usefulness* is not an independent construct, but rather a surrogate measure of system quality, information quality and satisfaction. On the basis of this argument, *Usefulness* is excluded from the *a priori model*.

Table 1B: rational for sub-construct in/exclusion
▪ When a sub-construct seems inappropriate for the public sector ERP environment, they were removed before the exploratory mapping exercise. For example some of the organisational measures (i.e. Return On Asset and Return On Investment) deemed inappropriate for the context of the study. ▪ A sub-construct was considered unsuitable to include as an item in the survey instrument, if it was not populated in the exploratory mapping exercise. ▪ Similarly, new sub-constructs were created and added, when the citations could not be mapped into the existing list of sub-constructs. ▪ Sub-constructs were eliminated, if the required information (or perceptions) can be usefully gathered from other sources (e.g. executive interviews, organisational documentation, etc.). ▪ When there are overlaps between sub-constructs, only the most appropriate sub-construct was listed to create survey items. Some sub-constructs listed in the Delone and McLean (1992) and related studies, did not occur individually, but occurred simultaneously. In such instances, sub-constructs were grouped into logical categories to represent impacts of ERP systems.

Survey item derivation - *Examples from the study*

Following the guidelines of Bailey and Pearson (1983) and Ives et al., (1983), it was decided to represent each sub-construct with a single question. This resulted in a survey instrument that measure ERP success through five constructs and 42 sub-constructs in Queensland Government agencies. The 42 sub-constructs are listed in Table 1 of Appendix A. Respondents' perceptions were gathered using a seven point likert type scale with the end values (1) strongly disagree and (7) strongly agree, with a middle value of (4) neutral. In order to articulate the meaning (rather than for checking for response bias), three out of forty-two questions were negatively worded in the survey.

Once the preliminary item derivation is completed, it was pilot tested in a selected sample. Feedback from the pilot round respondents resulted minor modifications to survey items.

Administration and item evaluation - *Examples from the study*

This research targeted all SAP users in all Queensland Government agencies with live SAP systems. A total of 310 valid responses were received which adequately fulfills all requirements of the sample size. Twenty-seven Queensland Government agencies with live SAP systems participated in the survey. To refine the survey instrument and thus to establish construct validity, a factor analysis was conducted. The final factor solution of items is shown in Table 1 in Appendix C with values below 0.3 suppressed. The factor analysis used a principal component extraction using orthogonal (varimax) rotation. As mentioned earlier, there were no missing values as respondents answered all the questions. Factor loadings explained 64.022% of variance of the model. In compliance with the a priori dimensions, Information Quality, Individual Impact and Organisational Impact loaded as predicted. However, System Quality dimensions and Satisfaction dimensions loaded together, yielding a new factor named System quality satisfaction. Items loaded less than the cut-off weight of 0.4 were analyzed further before being dropped from the survey instrument. Table 2 in Appendix C shows the number of items dropped from each construct. Further analysis of the discarded items revealed possible overlaps between system quality and information quality items may have perplexed respondents.

The notion of reliability of a measure is measured using the most widely used *Cronbach's alpha* and results are shown in Table 3 in Appendix C.

In addition to the theoretical aspects of survey design and development, the current study engaged in a number of supplementary activities, including (1) obtaining senior management support and endorsement for the survey, (2) web survey facility to increase accessibility and (3) incentives for the respondents.

The study was first introduced to the Queensland State Government agencies in August 2001 in a special benefits realization interest group gathering. Queensland Treasury - the lead agency in SAP related activities in Queensland Government - appointed a senior business analyst to provide support and guidance to the research study. A memorandum of understanding (MOU) was signed between the State of Queensland and the University outlining the deliverables, the timeline and commitments from both parties. A director of the lead agency endorsed both survey instruments (i.e. exploratory and confirmatory) and all directors of corporate services were contacted in seeking their support for the research project. The Financial Management Branch (FMB) – a subsidiary of Queensland Treasury – provided a contact database of Government employees who have participated in SAP related activities supplemented the data collection.

The exploratory round was mainly conducted through electronic mail. However, we accommodated traditional mediums such as fax and mail, which yield a small number of responses. The number of responses in the confirmatory survey was critical for the data analysis and the dissemination of the survey instrument to potential respondents was seen as an important aspect to increase the response rate. Dissemination of the confirmatory survey instrument was completed through (i) a Web survey facility, and (ii) MS Word instrument attached to email. As an incentive to complete the survey, all respondents had the option of receiving a research report of SAP impacts in Queensland Government. No other incentives were allowed due to the restrictions of public sector regulations in the state of Queensland.

Conclusion

This paper discussed important theoretical concerns in survey instrument design for Information Systems measurement studies in sub/construct derivation, item generation and survey evaluation. It provided step-by-step guidelines of the appropriate statistical measures to be used in a survey design process, which could be adopted for any survey research and provided examples from a study designed to measure Enterprise Resource Planning success. The instrument design and validation process is an arduous and time consuming task, but cannot be compromised in an empirical research study. Statistical measures and in-depth analysis will be of little or no importance, if the data is collected with measures that are unreliable and invalid.

References

Allen, T., Scott Morton, M. S. (1992) “Information Technology and the corporation of the 1990’s”, New York, Oxford Press.

Amoli, E. J., Farhoomand, A. F. (1996) "A structural equation model of end user computing satisfaction and user performance", Information & Management, 30, 65-73

Bailey, J. E., Pearson, S. W. (1983) "Development of a tool for measuring and analysing computer user satisfaction", Management Science, 29(5), 530-545

Ball, L., Harris, R. (1982) "SMIS members: a membership analysis", MIS Quarterly, 6(1), 19-38

Barua, A., Kriebel, C., Mukhopadhyay, T. (1995) “Information Technologies and business value: an analytic and empirical investigation”, Information systems research, 6, 1, pp3-50.

Barua, A., Lee, B. (1997) “The information technology productivity paradox revisited: a theoretical and empirical investigation in the manufacturing sector”, International journal of flexible manufacturing systems, 9, 2, pp 145-166.

Brancheau, J., Whetherb, J. (1987) "Key issues in Information Technology management", MIS Quarterly, 11(1), 23-45

Brynjolfsson, E. (1993) "The productivity paradox of Information Technology", Communications of the ACM, 36(12), 67-77

Brynjolfsson, E., Hitt, L. (1996) “Paradox lost? Firm level evidence on the return of information systems spending”, Management Science, 42, 4, pp 541-558.

Brynjolfsson, E., Yang, S. (1996) “Information Technology and Productivity: a review of literature”, Advances in Computers, 43, pp 170-214

Cameron, K. S., Quinn, R. E. (1988) “Organizational paradox and transformation”, Paradox of transformation: Toward a theory of change in organization and management, Cambridge, MA: Ballinger, pp 1-18

Carr, H. H. (1992) "Factors that effect user friendliness in interactive computer programs", Information & Management, 137-149

Cronbach, L.J. (1971) "Test Validation in Educational measurement", 2nd Edition, R. L. Thorndike (ed.), American Council of Education, Washington, D.C. 443-507

Davis, F. D. (1989) "Perceived usefulness, perceived ease of use, and user acceptance of Information Technology", MIS Quarterly, September, 319-340

DeLone , W. H., McLean, E. R. (1992) “Information Systems success: The quest for the dependent variable”, Information Systems Research, 3, 1, pp 60-95.

Dickson, G., Leitheiser, R. L., Nechis, M., Wetherbe, J. (1984) "Key Information Systems issues for the 1980's" MIS Quarterly, 8(3), 135-159

Doll, W. J., Torkzadeh, G. (1988) "The measurement of end-user computing satisfaction", MIS Quarterly, June, 259-274

Doll, W. J., Xia, W., Torkzadeh, G. (1994) "A confirmatory factor analysis of the end-user information satisfaction instrument", MIS Quarterly, December 18(4), 453-461

Du Plessis, A. L. (1993) "A method for CASE evaluation", Information & Management, 93-102

Franz, C. R., Robey, D, (1986) "Organisational context, user involvement, and the usefulness of information system", Decision Science, 17, 329-356

Gelderman, M. (1998) "The relation between user satisfaction, usage of information systems and performance", Information & Management, 34, 11-18

Goodhue, D. L., Thompson, R. L. (1995) “Task Technology fit and individual performance”, MIS Quarterly, June, pp 213-235

Hartwick, J., Barki, H. (1994) "Explaining the role of user participation in Information systems use", Management Science, 40(4), 440-465

Heo, J., Han, I. (2002) “Performance measures of Information Systems (IS) in evolving computing environments: an empirical investigation”, Information & Management, 1(14), 1-14

Hong, K. K., Kim, Y. G. (2001) "The critical success factors for ERP implementation: an organisational fit perspective", Information & Management, 1-16

Igbaria, M., Zinatelli, N., Cavaye, A. L. M. (1998) "Analysis of information technology success in small firms in New Zealand", International Journal of Information Management, 18(2), 103-119

Ishman, M. D. (1996) "Measuring information success at the individual level in cross-culture environments", Information resource management journal, fall, 16-28

Ives, B. (1982) "Graphical user interface for business information systems", MIS Quarterly, special issue, 15-47

Kaplan, R., Norton, D., P. (2000) “Having trouble with your strategy? Then map it”, Harvard Business Review, September-October.

Kaplan, R., S., Norton, D., P. (1992) “The Balanced Scorecard - Measures that drive performance”, Harvard Business Review, January-February.

Kaplan, R., S., Norton, D., P. (1996) “Translating Strategy in to action: The Balanced Scorecard”, Harvard Business School Press, Boston, Massachusetts.

Kerlinger, F. N. (1964) "Foundations of behavioral research", Holt, Rinehart and Winston, New York, NY

Kraemer, K. L., Danziger, J. N., Dunkle, D. E., King, J. L. (1993) "The usefulness of computer based information to public managers", MIS Quarterly, 129-148

Lehr, B., Lichtenberg, F. (1999) “Information Technology and its impact on productivity: Firm level evidence from Government and private data sources 1977-1993”, Canadian Journal of Economics, 32, 2, pp 335-362.

Long, J. S. (1983) "Confirmatory Factor analysis", Sage, Beverly Hills, CA

Mason, R. O. (1978) "Measuring Information output: A communication systems approach", Information & Management, 1(5), 219-234

Miller, J., Doyle, B. A. (1987) "Measuring the effectiveness of computer based information systems in the financial services sector", MIS Quarterly, 11(1), 107-124

Mukherjee, K. (2001) “Productivity growth in large US commercial banks: the initial post regulation experience”, Journal of Banking and finance, 25, 5, pp 913.

Myers, B. L., Kappelman, L. A., Prybutok, V. R. (1998) “A comprehensive model for assessing the quality and productivity of the information systems function: toward a theory for information systems assessment”, Idea group publishing, Hershey.

Naumann and Palvia (1982) “A selection model for systems development Tools”, MIS Quarterly, March, p.39-45

Nunnally, J. C. (1967) "Psychomatric Theory", McGraw-Hill, New York, NY

Palvia (1996) “A model and instrument for measuring small business user satisfaction with information technology”, Information an Management, Vol 31, p.151-163 (Expanded)

Post, G. V., Kagan, A., Keim, R. T. (1999) "A structural equation evaluation of CASE tool attributes", Journal of management information systems, 15(4), 215-234

Queensland Treasury, (1998) “QGFMS Lead Agency Strategic Plan 1988-2003”, The Office of Financial Management Systems and Training.

Queensland Treasury, (2000a) “QGFMS Benefits Realization Guidelines: Translating Strategy in to performance benefits and initiatives", The Office of Financial Management Systems and Training.

Queensland Treasury, (2000b) “Understanding Managing For Outcomes”, The Office of Financial Management Systems and Training.

Queensland Treasury, (2000c), “QGFMS Lead Agency Strategic Plan”, The Office of Financial Management Systems and Training.

Quinn, R. E., Rohrbaugh, J. (1983) “A spatial model of effectiveness criteria: Towards a competing values approach to organisational analysis”, Management Science, 29, 3, pp 363-377

Rainer, K. R., Watson, H. J. (1995) "The keys to Executive Information System Success", Journal of Management Information Systems, 12(2), 83-98

Saarinen, T. (1996) "An expanded instrument for evaluating information system success", Information & Management, 31, 103-118

Saunders, C. S., Jones, J. W., (1992), “Measuring the performance of the information systems function”, Journal of Management Information Systems, 8, 4, pp 63-82

Scott Morton, M. S., (Editor) (1990), “The corporations of the 1990’s”, New York, Oxford University Press.

Seddon, P. B. , Kiew, K. Y. (1994) "A partial test and development of the DeLone and McLeans model of IS success", proceedings of the international conference on Information Systems, Vancouver, Canada

Seddon, P. B., Yip, S. K. (1992) "AN empirical evaluation of user information satisfaction UIS, measures for use with general ledger software", Journal of information systems, 75-92

Sedera, D., Gable, G., Palmer, A. (2002) “Enterprise Resource Planning systems impacts: a Delphi study of Australian public sector organisations” in proceedings of the Pacific Asian Conference on Information Systems (PACIS ’02), Tokyo, Japan, September 3-5.

Sedera, D., Gable, G., Rosemann, M., (2001b)“A Balanced Scorecard Approach to Enterprise Systems Performance Measurement” in proceedings of the 12th Australasian Conference on Information Systems (ACIS ’01), Coffs Habour, NSW, Australia, December 5-7.

Sedera, D., Rosemann, M., Gable, G., (2001a) "Using Performance Measurement Models for Benefit Realization with Enterprise Systems- The Queensland Government Approach", in proceedings of the 9th European Conference on Information Systems (ECIS '01), Bled, Slovenia.

Sethi, V., King, W. R. (1996) "Development of a measures to assess the extent to which an Information Technology application provides competitive advantage", Management Science, 40(12), 1601-1627

Shang S. and Seddon, P. B. (2000) "A Comprehensive Framework for Classifying Benefits of ERP Systems", Proceedings of the 2000 Americas Conference on Information Systems, Long Beach California, August 10-13, 1005-1014.

Shannon, C. E., Weaver, W.(1949) "The mathematical theory of communication", Urbana, University of Illinois press.

Staples, D. S., Wong, I., Seddon, P (2002) "Having expectations of information systems benefits that match received benefits: does it really matter?" Information and Management, 1-17

Straub, D. W. (1989) "Validating instruments in MIS research", MIS Quarterly, June

Straub, D. W., Limayem, M., Karahanna-Evaristo, E. (1995) "Measuring System Usage: Implications for IS research", Management Science, 41(8), 1328-1342

Thompson, R. L., Higgins, C. A., Howell, J. M. (1991) "Personal computing: Toward a conceptual model of utilization", MIS Quarterly, March, 125-143

Wang, R. Y., Strong, D. M. (1996) "Beyond accuracy: what data quality means to data consumers", Journal of management information systems, 12(4), 5-34

Weill, P., Vitale, M. (1999) Assessing the health of an Information Systems application portfolio: An example from process manufacturing, MIS Quarterly, 23, 4, pp 601-624.

Wilson, D. (1993) "Assessing the impact of Information Technology on Organizational performance", Strategic Information Technology Management, Harrisburg, PA, Idea Group.

Appendix A: Concept, Constructs, sub-constructs and question items

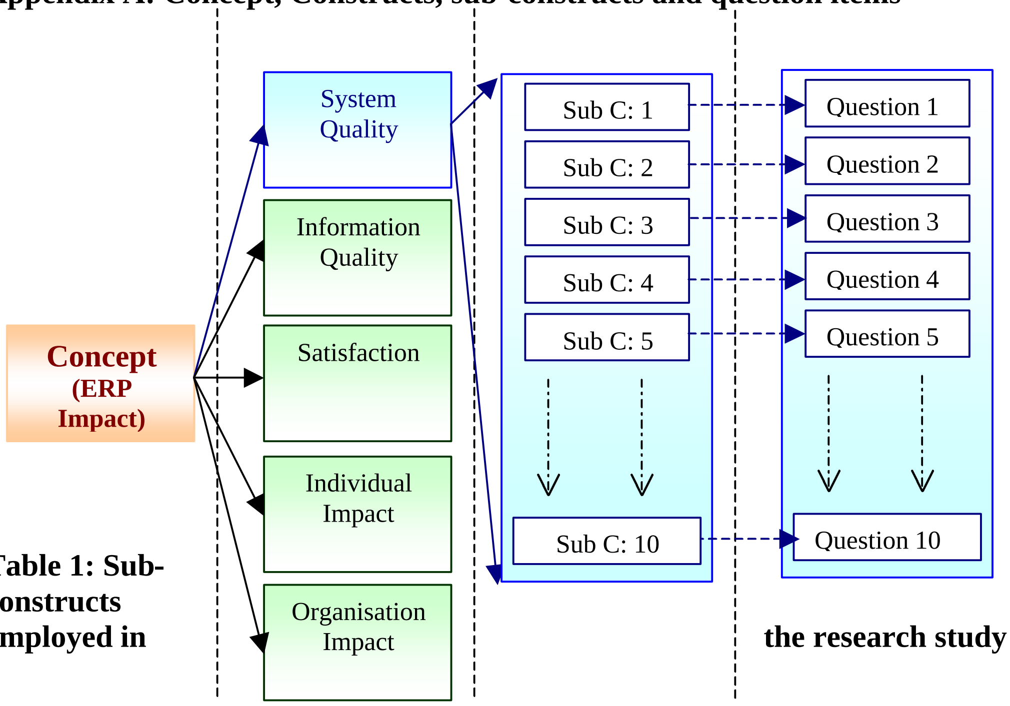


Table 1: Sub-constructs employed in the research study

System Quality	Information Quality	Satisfaction**	Individual Impact	Organisation Impact
- Data accuracy - Data currency - Database contents - Ease of use - Ease of learning - Access - User requirements - System features - System accuracy - Flexibility - Reliability - Efficiency - Sophistication - Integration - Customisation	Importance Availability Usability Understandability Relevance Format Content Accuracy Conciseness Timeliness Uniqueness	- Information ** - Systems ** - Overall ** - Knowledge management ** - Enjoyment	- Learning - Awareness / Recall - Decision making effectiveness - Individual productivity	- Organisational costs - Staff requirements - Overall productivity - Product / service quality - Business Process Change

Appendix B: Literature Review cross reference - Sample[7]

	SQ																IQ																			Use										Sa							II								OI									Total
Study	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	T	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	T	1	2	3	4	5	6	7	8	9	T	1	2	3	4	5	6	T	1	2	3	4	5	6	7	T	1	2	3	4	5	6	7	8	T	
Amoli and Farhoomand, 1996	y	y		y				y			y	y				6				y			y			y		y		y					5										0							0						y		1									0	12
Bailey and Pearson,				y		y				y	y	y		y		6		y								y		y		y	y	y	y		7								y		1							0								0				y			y		2	16
Carr, 1992				y	y	y	y		y	y	y	y	y			9					y								y						2										0							0								0									0	11
Davis, 1989				y	y			y		y						4																			0										0							0						y		1									0	5
Doll and Torkzadeh, 1988				y		y	y		y	y	y	y				7		y					y		y	y	y		y	y	y	y	y		10										0		y			y		2				y	y	y		3									0	22
Doll and Xia, 1994					y											1										y		y					y		3										0							0								0									0	4
Du Plessis, 1993				y								y		y	y	4																			0										0							0								0									0	4
Franz and Robey, 1986	y			y												2		y											y						2									y	1							0						y		1							y		1	7
Gelderman, 1998				y												1										y		y		y			y		4	y									1							0								0									0	6
Goodhue and Thompson, 1995		y	y	y		y	y				y					6							y					y							2										0							0						y	y	2				y					1	11
Hartwick and Barki, 1994																0																			0	y									1							0								0									0	1
Heo and Han, 2002											y	y	y			3												y		y			y		3					y					1	y						1		y			y		y	3			y		y				2	13
Hong and Kim, 2001							y									1																			0										0							0								0									0	1
Igabaria, Ninatelli, Cavaye, 1998				y												1																			0										0							0								0				y					1	2
Ishman, 1996				y												1		y		y			y			y		y		y			y		7										0		y					1								0									0	9
Ives, 1982																0					y														1										0							0					y			1									0	2
Kraemer, Danziger, Dunkle and King, 1993						y		y								2		y		y															2										0							0					y			1									0	5
Leopoldo et al., 1990				y												1		y											y						2										0							0								0							y		1	4
Miller and Doyle, 1987						y	y	y		y	y	y				6		y		y			y					y		y	y		y		7										0							0								0	y		y	y					3	16
Naumann and Palvia, 1982																0																			0										0							0								0	y								1	1
Palvia, 1996	y			y	y	y	y	y	y						y	8									y						y		y		3										0		y			y		2						y		1							y		1	15
Post, Kagan, Kiem 1999		y		y		y		y			y			y	y	7											y								1										0							0								0			y				y		2	10
Rainer and Watson, 1995				y	y	y	y			y	y	y		y		8		y										y	y	y			y	y	6										0							0	y		y		y			3									0	17
Saarien, 1996																0																			0										0							0								0									0	0
Seddon and Kiew, 1992				y	y				y							3									y	y			y	y	y		y		6										0		y			y		2						y		1									0	12
Seddon and Yip, 1992																0																			0										0							0								0									0	0
Seddon, 1997																0																			0										0							0								0									0	0
Sethi and King, 1996																0																			0										0							0								0				y					1	1
Staples, Wong, Seddon 2002				y	y		y		y			y				5		y							y	y		y	y	y	y				7										0	y			y	y		3	y					y	y	3			y						1	19
Strub, Limayem, Karahanna-Evariston, 1995																0																			0	y	y			y		y			4							0								0									0	4
Thompson, Higgins and Howell, 1991				y												1																			0										0							0						y		1									0	2
Wang, Strong, 1996						y										1	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	18										0							0								0									0	19
Weill and Vitale, 1999				y			y				y	y				4		y						y	y	y	y	y			y	y			8					y					1							0								0									0	13
This Study				y	y	y	y	y	y	y			y	y	y	10	y	y	y	y	y	y	y	y											8	Deleted									0	y	y	y	y	y		5	y	y	y	y				4	y	y	y	y	y	y	y	y	8	35

[7] T – Total number of sub-constructs employed

Appendix C: Final Factor Solution

Table 1: Rotated Component Matrix

	Components			
	1	**2**	**3**	**4**
II1			**0.809194**	
II2			**0.80106**	
II3		0.304439	**0.808916**	
II4	0.312649	0.354262	**0.766552**	
OI1		**0.740325**		
OI2		**0.818108**		
OI3		**0.826218**		
OI4	0.349049	**0.697244**	0.410757	
OI5	0.416574	**0.638056**	0.408153	
OI6		**0.548255**	0.361902	
OI7		**0.641248**		
OI8	0.386459	**0.628919**	0.316426	
IQ1			0.323426	**0.55553**
IQ2	0.453208	0.415339		**0.458162**
IQ3	0.413253			**0.573745**
IQ4	0.557543	0.31086		**0.616939**
IQ5	0.545489			**0.630306**
IQ6	0.563512			**0.611265**
IQ8	0.417582			**0.54689**
SQ4	**0.780124**			
SQ5	**0.73938**			
SQ6	**-0.51943**			
SQ7	**0.577451**	0.38107		
SQ8	**0.606796**			
SQ9	**0.60573**			
SQ10	**0.664129**			
SQ13	**0.604202**			
SQ14	**0.597497**			
SQ15	**0.595678**	0.315074		
SA1	**0.71281**			
SA2	**0.690288**			
SA3	**0.753123**		0.355117	
SA4	**0.698967**	0.407831	0.377431	
SA5	**0.594246**	0.323381		

Table 2: No: Items dropped

Construct	# items dropped
Individual Impact	0
Organisational Impact	0
Information Quality	3
System Quality	5
Satisfaction	0
Total	*8*

Table 3: Reliability of items

Construct	# items	Alpha
Individual Impact	4	0.9345
Organisational Impact	8	0.9226
Information Quality	7	0.8898
System Quality	10	0.8215
Satisfaction	5	0.9178
System Quality + Satisfaction	*15*	0.9144