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# MEASURING ENTERPRISE SYSTEMS SUCCESS: A PRELIMINARY MODEL

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## Abstract

*The business value of Enterprise Systems (ES), and in general large software implementations, has been extensively debated in both the popular press and in the academic literature for over three decades. Organizations have invested heavily in Enterprise Systems (and related infrastructure), presumably expecting positive outcomes to the organization. Some studies have reported large productivity improvements and substantial benefits from Enterprise Systems, while others have reported that Enterprise Systems have not had any bottom-line improvements. This paper discusses preliminary findings from a study of evaluating ES success in 27 organizations in Queensland, Australia. Two surveys, an exploratory survey followed by a confirmatory survey, were conducted and data from four hundred and fifty four respondents was analyzed. An a priori model of ES success with five constructs and forty-two sub-constructs was tested. Validation of the model constructs through exploratory factor analysis identified four dimensions of ES success.*

**Keywords:** Enterprise systems, enterprise resource planning, ES success

## Introduction

Information Systems (IS) investments are under increasing scrutiny and pressure to justify their value and contribution to productivity, quality and competitiveness of the organization. Assessing the value of IS is consistently reported by organizational executives throughout the world as a key issue (Ball and Harris, 1982; Brancheu and Wetherbe, 1987; Dickson, Leitheiser, Nechis, Wetherbe, 1984). Evidence on the success of IS has been mixed. Some studies have shown positive impacts of IS in organizations (e.g. Barua and Lee, 1997; Barua, Kriebel, Mukhopadhyay, 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, 1988; Wilson, 1993). The success of large IS, particularly Enterprise Systems (ES), are arguably difficult to measure (e.g. Baer, 1999; Davis, 1999; Deloitte Consulting, 2000; Knowles, Fotos, Henry, 2000; Sedera, Rosemann, Gable, 2001). An ES generate substantial tangible and intangible benefits and the systems entail many users ranging from top executives to data entry operators, many applications that span the organization, and a diversity of capabilities and functionality. Thus measuring ES success is a complex endeavor.

This paper presents preliminary findings of a study designed to identify impacts and ultimately develop a comprehensive model for measuring success of Enterprise Systems. The study was conducted across 27 organizations in Queensland, Australia that had implemented SAP during the second half of the 1990s. ES success measures are first empirically identified, through an exploratory survey, and then measured, through a confirmatory survey. An a priori model for measuring ES success is then proposed and tested to derive a final model. The paper proceeds as follows. First, Enterprise Systems (ES) are defined; outlining

how these systems are different to a stand-alone IS, describing how ES systems have proliferated, and presenting a brief synopsis of the current status of ES systems generally. Next, the dual-survey research methodology is described, followed by discussion on the research findings. The paper concludes with a summary and an outlook to future directions for the research.

## Enterprise Systems (ES)

Enterprise Systems encompass a wide range of software products supporting day-to-day business operations and decision-making. ES serves many industries and numerous organizational areas in an integrated fashion, attempting to automate operations, including supply chain management, inventory control, manufacturing scheduling, sales support, customer relationship management, financial and cost accounting, human resources and many other functions and processes in organizations. While most organizations, prior to ES, already had information systems that addressed much of this functionality, ES systems provide a standardized, integrated process-focused environment that is difficult to attain and viably maintain, with stand-alone, custom-built software systems. Particularly due to its process-orientation, the ES system's ability to disseminate information in real-time can substantially improve management and decision making (e.g. O'Leary, 2000; Klaus, Rosemann, Gable, 2000; Bingi, Sharma, Godla, 1999; Parr, Shaks, Darke, 1999; Ross and Vitale, 1999). Despite the positive motivations for ES adoption, there exists much controversy surrounding the success of these systems (e.g. Bingi et al., 1999; Calogero, 2000; Gable, Scott, Davenport, 1998; Chung and Snyder, 1999).

## Research Methodology

The study design followed the full research cycle proposed by Mackenzie and House (1979), employing a two-phased approach to data collection. First, a qualitative, open, and exploratory survey aimed to inventory the range of organizational experiences of ES. A confirmatory survey was then conducted to quantify the measures identified in the exploratory round. Figure 1 depicts the dual-survey approach followed in this study.

### *The Exploratory Survey*

The study was first introduced to the Queensland State Government agencies in August 2001 at a special 'benefits realization' interest group gathering. The initial survey round was sent in September 2001. The survey was non-anonymous and had three main sections. The first section requested respondents' demographics (i.e. Name, Position, Number of years with the current agency, years with the Queensland Government) and a brief description of their involvement with SAP R/3 system. The second section sought to identify specific impacts associated with their SAP system.<sup>1</sup> One hundred and thirty seven responses were received, citing a total of 485 citations (i.e. averaging 3.6/respondent). In the third section respondents were asked to list any past, in-progress or pending initiatives for increasing positive impacts from the SAP system as well as any suggestions on further possible improvements. One hundred and thirty-seven responses were received, citing a total of 485 citations (i.e. mean of 3.6 citations per respondent). The "open" format of the exploratory survey yielded a large amount of qualitative, unstructured, non-numeric data. Thus, the synthesis of this morass of evidence into a useful framework of success measures and constructs was a critical and complex stage of the study. The objectives of this exercise were to yield a framework that is 1) generalizable beyond the current study, and 2) meaningful to study participants in the study context. The literature suggests two main approaches for data coding and synthesis: 1) 'bottom-up', data driven, open coding approach or 2) 'top-down', structured coding, framework approach. The top-down approach employs a deductive research approach and begins with a logical framework/model to categorize the responses. The bottom-up approach is an inductive research approach starting with the data in hand that is arranged into a logical classification. Given the relative advantages and disadvantages of these approaches, it was decided that the top-down approach first be attempted, and that a bottom-up approach only be adopted given poor fit of the data with candidate frameworks (Critique of both approaches are in Sedera, Gable, Palmer, 2002; Chan, Gable, Smythe, and Timbrell, 2000).

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<sup>1</sup>Though some time had passed since initial implementation and the situation had become more settled, we were loath to ask any questions that probe levels of 'success' directly. We positioned the study as one of 'impacts' rather than 'levels of success', feeling this more likely to elicit objective responses rather than emotional party-line responses.

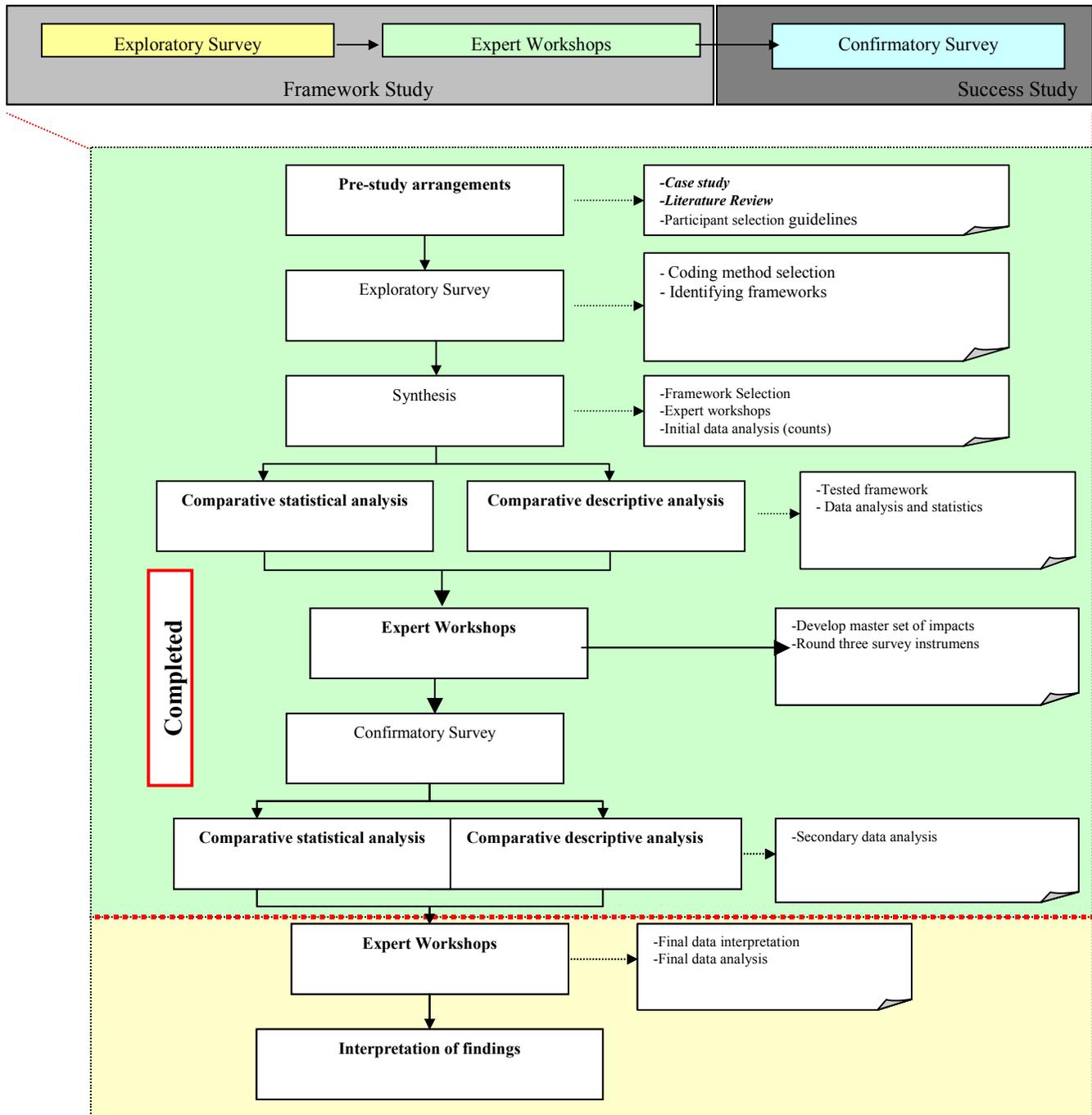


Figure 1. The Research Design

Several frameworks and models including MIT 90s IT impacts framework (Scott Morton, 1990; Allen and Scott Morton, 1992), Balanced Scorecard (Kaplan and Norton, 1992, 1996, 2000), IS function performance evaluation framework (Saunders and Jones, 1992), IS assessment selection model (Myers, Kappelman, Prybutok, 1998) and ES benefits framework (Shang and Seddon, 2000) were examined and tested to identify the most suitable framework to be used in the data synthesis process of the research.

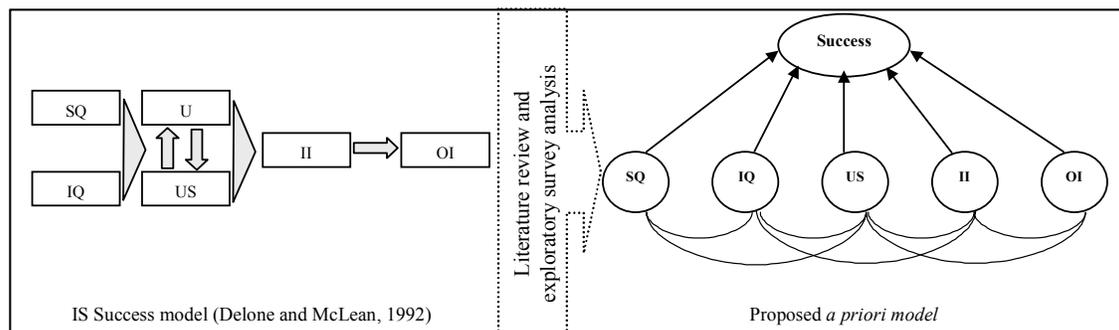
An attempt was made to map the first-round survey ‘citations’ into both the Delone and McLean IS success model (1992) – supplemented with the Myers et al (1997), as well as into the Shang and Seddon ERP benefits framework (2000). The synthesis

process identified the constructs and underlying measures of the Delone and McLean (1992) model and the associated measures from Myers et al (1997), as the most suitable taxonomy of ES success. On this basis, the Delone and McLean constructs, and measures, served as the basis of the starting ES success model.

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). 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) Organizational Impact. The constructs/ measures of the Delone and McLean model provided a holistic view across the organization – from top managers' view to the data entry officers' – and provided detailed categorization of success dimensions. Furthermore, the mutually exclusiveness of the measures provided better synthesis of the results in the Delone and McLean model, compared to the Shang and Seddon ERP benefits framework.<sup>2</sup>

In addition to identifying new measures specific to the ES context, the mapping exercise facilitated to the exclusion of any extraneous measures. In order to avoid individual judgment errors, three academics and two senior business analysts from Queensland Government conducted the mapping exercise. Final revisions were agreed at an expert workshop.

Based on analysis of data from the exploratory study and on relevant literature, the *a priori* model of ES success in Figure 2 is proposed. Unlike the *original* Delone and McLean model, the *a priori* model is a *measurement* model for assessing ES success using five independent dimensions (constructs); System Quality, Information Quality, Satisfaction, Individual Impact and Organizational Impact. These dimensions are posited to be correlated and additive measures of the same multidimensional phenomenon, namely ES success. The *a priori* model includes 42 sub-constructs that measure the five dimensions (Appendix A lists the sub-constructs of the *a priori* model). A further, major deviation from the Delone and McLean model, is the exclusion of the 'Use' dimension.<sup>3</sup> As Delone and McLean (1992) point out "usage, either perceived or actual is only pertinent when such use is not mandatory" (p 68). Use of the ES system in Queensland Government, however, is mandatory.



**Figure 2. ES Impacts Measurement Model**

<sup>2</sup>Reasons for dropping the Shang and Seddon (2000) ERP benefits framework include: overlaps between the constructs and measures, framework's limited emphasis on top manager's view – not holistic view and the emphasis on organizational performance.

<sup>3</sup>Seddon (1997) argue that the underlying construct IS researchers have been trying to gauge is Usefulness, not Usage. The ES system under investigation is mandatory for all users, and thus changes advocated by Seddon (1997) 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.

## **The Confirmatory Survey**

The purpose of the confirmatory survey was to test the *a priori* model (see figure 2<sup>4</sup>). A survey instrument was designed that operationalized the five constructs and the 42 measures. Where possible, question items for specific measures were drawn from or adapted from previously validated instruments.

As suggested by Bailey and Pearson (1983) and Ives et al., (1983), each measure is represented by a single item. All survey data except respondent's name and name of the respondent's department were mandatory. Items were measured on a seven point likert scale with the end values (1) 'Strongly disagree' and (7) 'Strongly Agree', and the middle value (4) 'Neutral'. Dissemination of the survey instrument was completed through (i) a Web survey facility, and (ii) MS Word instrument attached to email. Objective, quantitative and demographic data, such as the number of SAP user licenses for each agency, SAP version, number of employees, and other systems used (*if any*), were gathered separately from other sources (such as system documentation and interviews). Similar to the exploratory study phase of the study, all Queensland Government agencies (Departments) with live SAP systems were targeted yielding a total of 317 valid responses.

## **Instrument Validation**

In Management Information Systems (MIS) research, measurement of constructs is neither simple nor straightforward (Straub, 1989). Bias towards the expected outcomes, inaccuracies of measures, length of the instrument, research method utilized are some aspects where the researcher needs to think through in designing and validating an instrument<sup>5</sup> (Ives et al., 1983; Cook and Campbell, 1979; Coombs, 1964). The following section describes the rigorous instrument validation and model building process in this study.

### **Content Validity**

Cronbach (1971) and Kerlinger (1964) suggest that an instrument is valid 'in content', if that (*instrument*) (i) has drawn representative questions from a universal pool, and (ii) has been subjected to a thorough review by experts until a formal consensus is reached. Prior studies of information systems success and related instruments were thoroughly and carefully analyzed, with many instrument items being based on prior validated instruments.<sup>6</sup> 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.<sup>7</sup>

### **Construct Validity**

Construct validity testing assesses whether the selected measures are true indicators of the phenomenon of interest (Cronbach, 1971; 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).<sup>8</sup> The survey items (Appendix A) were factor analyzed using principal component extraction and orthogonal (*Varimax*) rotation. There were no missing values as all respondents answered all questions. The final factor solution is depicted in Table 1 with loadings less than .3 suppressed.<sup>9</sup> The factor solution explained 65% of the model variance. As predicted, Individual Impact, Organizational Impact and Information Quality loaded as predicted. However, Systems Quality and Satisfaction loaded together, yielding a new factor named System Quality Satisfaction.

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<sup>4</sup> SQ – System Quality, IQ – Information Quality, U – Use, US – User Satisfaction, II – Individual Impact, OI – Organizational Impact.

<sup>5</sup>External Validity, which deals with persons, settings, and times to which the findings can be generalized, is not discussed in this paper.

<sup>6</sup>Due to space limitations of this paper, detailed discussion on this cross-referencing of past instrument items is excluded. Note that final instrument items are reflected in Appendix A.

<sup>7</sup>Detailed outcomes of the expert workshops can be obtained from the contact author.

<sup>8</sup>Concurrent and predictive validity are generally considered to be subsumed in construct validity and thus will not be discussed in this paper.

<sup>9</sup>Items without a loading on any factor greater than .5 were dropped.

**Table 1. Final Factor Solution**

	Component			
	1	2	3	4
II1			0.814367	
II2			0.815793	
II3			0.818811	
II4	0.303963	0.333871	0.777927	
OI1		0.734677		
OI2		0.820548		
OI3		0.829282		
OI4	0.349894	0.685294	0.422541	
OI5	0.419911	0.623193	0.417827	
OI6		0.533218	0.364958	
OI7		0.638672		
OI8	0.391551	0.620471	0.31658	
IQ1				0.559942
IQ2	0.451991	0.400884		0.45974
IQ3	0.412083			0.587252
IQ4	0.562181			0.616321
IQ5	0.550214			0.628261
IQ6	0.568738			0.604319
IQ8	0.427057			0.536159
SQ4	0.781718			
SQ5	0.739356			
SQ6	-0.51155			
SQ7	0.593109	0.361635		
SQ8	0.610144			
SQ9	0.620816			
SQ10	0.674104			
SQ13	0.593738			
SQ14	0.595686			
SQ15	0.60418			
SA1	0.719025			
SA2	0.699195		0.309582	
SA3	0.75395		0.347708	
SA4	0.706005	0.396311	0.379041	
SA5	0.607901	0.31658		

### Reliability

The notion of reliability of a measure refers to its consistency. *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 measure of reliability is *Cronbach's alpha*. Study alpha values for all of the dimensions (II=0.9397, OI=0.9204, IQ=0.8895, SQ=0.8224, SA=0.9180) are high, indicating strong reliability.

### Contributions of the Research

Lack of research and literature **on the success of ES systems** is the main driver of this research. To date, ES literature has focused mostly on areas such as implementation issues, critical implementation success factors, and product testimonials; and only a very few have rigorously evaluated the impacts that these systems have on organizations and their overall success. Even the meager

literature available on ES success has a range of limitations. Most existing studies are biased in that they report only the ‘positive impacts’ (benefits) of ES systems, and mostly only from the perspective of a single organizational level. Furthermore, they are often conducted only across a very small number of organizations, making the generalizability of study results questionable (e.g. Dolmetsch, Huber, Fleisch, Osterle, 1998; McAfee, 1999; Gibson, Holland, Light, 1999; Westerman, Cotteleer, Austin, Nolan, 1999; Shang and Seddon, 2000). The validated study survey instrument can be adapted to measure success of ES in similar circumstances. Benbasat (1989) states that the existence of such validated instruments allows the IS field to be more proactive, and to expedite research activities without repeating the instrument derivation process.

IT/IS studies conducted over the years have attempted to quantify the overall success of IT/IS by analyzing data collected only at very high levels. Studies in this area have mainly concentrated on the Economy, Industry, and Firm levels, and have largely ignored the IT application or process levels (e.g. Belcher and Watson, 1993; Chan, 2000; Mukhopadhyay et al., 1995; Pinsonneault and Kraemer, 1993; Rosemann and Wiese, 1999). The importance of analyzing IT/IS success from the perspectives of multiple levels within organizations has been discussed among academics for several decades. This study looks at ES success from **multiple perspectives from multiple stakeholder groups** (Strategic Users, Operational Users, Process owner, and Technical staff), **focusing on the ES application**.

Delone and McLean (1992) suggest that the **dimensions (constructs) and measures should be systematically selected** in order to develop a comprehensive measurement model/instrument, while considering contingencies. Furthermore, one needs to validate measurement constructs and measures in the study context before employing them in a success assessment. Most studies in this arena include little discussion on the selection of constructs and measures employed. This study employed two survey rounds (i.e. exploratory and confirmatory) completing the full research cycle proposed by completing the full research cycle proposed by Mackenzie and House (1979). The exploratory survey identified ES-specific salient success factors and justified their inclusion in the confirmatory survey instrument.

The exploratory survey (supplemented by a comprehensive literature review) identified forty-two measures (sub-constructs) of ES success to be included in the subsequent confirmatory survey. **The 42 measures constitute perhaps the most comprehensive ES measurement instrument validated** yet. While a limited number of IS success evaluation studies have employed all constructs suggested by Delone and McLean (1992), it is unclear whether these have employed appropriate *sub-constructs* to measure the constructs.

## Conclusion and Outlook

This paper has presented preliminary model for measuring ES success. Data analysis is ongoing, and may yield alternative interpretations. A full scientific research cycle including an exploratory and a confirmatory survey was conducted and data was analyzed. The exploratory phase of the study was completed in order to understand the context of the study, identify new measures relevant to the context and to qualify the existing measures to the research context. The main emphasis of the study was to test the *a priori* model, using the confirmatory survey data. Information received from 317 respondents from 27 Australian public sector organizations. Responses were analyzed to statistically validate the constructs and measures employed in the survey instrument. The exploratory factor analysis identified 4 dimensions of success and their measures. Furthermore, the criterion validity and reliability of items were also tested and findings were presented. Further analysis will be done to test the *a priori* model using advanced statistical methods and tests will be done in relation to the 4 respondent cohorts (i.e. Operational users, Strategic users, Technical Staff and Process Owners) and organizational characteristics (i.e. size, budget, ES version).

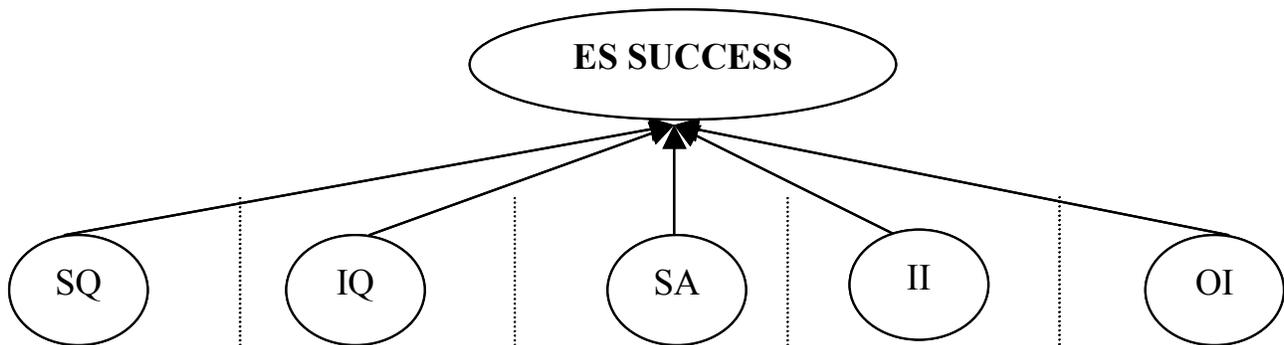
## References

- Allen, T., Scott Morton, M. S. (1992) “Information Technology and the corporation of the 1990’s”, New York, Oxford Press.
- Baer, T., (1999) “Finding Value in all the right places”, Manufacturing Systems, November.
- Bailey, J. E., Pearson, S. W. (1983) “Development of a tool for measuring and analyzing 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., 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, pp145-166.
- Barua, A., Kriebel, C., Mukhopadhyay, T. (1995) “Information Technologies and business value: an analytic and empirical investigation”, Information systems research, 6, 1, pp3-50.

- Belcher, L. W., Watson, H. J. (1993) "Assessing the value of Conoco's EIS value", *MIS Quarterly*, pp 239-253.
- Bingi, P., Sharma, M., Godla, J (1999). "Critical factors affecting an ERP implementation" *Information Systems Management*, Summer
- Brancheau, J., Whetherb, J. (1987) "Key issues in Information Technology management", *MIS Quarterly*, 11(1), 23-45
- 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
- Calogero, B., (2000) "Who is to blame for ERP failure?", *Sunsaver*, June.
- Campbell, D. T., Fiske, D. W. (1959) "Convergent and Discriminant validation by Multitrait Multi Method Matrix", *Psychological Bulletin*, 56, 81-105
- 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
- Chan, She-I, Gable, G., Smythe, E. and Timbrell, G. (2000) "Major Issues with Enterprise Systems: A Case study and survey of five Government agencies" *Proceedings of the International Conference on Information Systems*, Brisbane, 10-13 December, pp 494-500
- Chan, Y. E. (2000) "IT Value: The great divide between qualitative and quantitative and individual and organizational measures", *Journal of Management Information Systems*, 16, 4, pp 225-161
- Chung, S., Snyder, C., (1999) "ERP initiation - A historical perspective" in *proceedings of the Americas Conference of Information Systems (AMCIS '99)*.
- Cook, T. D., Campbell, D. T. (1979) "Quasi-experimentation: Design and analytical issues for field settings, Rand McNally, Chicago, IL
- Coombs, C. H. (1964) "A Theory of data", Wiley, New York, NY
- 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, B., (1999) "ERP vendors offer integrated analysis", *Informationweek*, May.
- Delone, W. H., McLean, E. R. (1992) "Information Systems success: The quest for the dependent variable", *Information Systems Research*, 3, 1, pp 60-95.
- Deloitte Consulting, (2000) "ERP second wave: Maximizing the value to Enterprise applications and process"
- Dolmetsch, R., Huber, T., Fleisch, E., and Osterle, H. (1998) "Accelerated SAP: 4 case studies, Institute for Information Management, University of St. Gallen, Switzerland
- Dickson, G., Leitheiser, R. L., Nechis, M., Wetherbe, J. (1984) "Key Information Systems issues for the 1980's" *MIS Quarterly*, 8(3), 135-159
- Gable, G., Scott, J. and Davenport, T. H. (1998) "Cooperative ERP life cycle knowledge management" in *proceedings of the 9th Australasian Conference on Information Systems*, Sydney
- Gibson, N., Holland, C., Light, B. (1999) "A case study of a fast track SAP R/3 implementation at Guilbert", *International Journal of Electronic Markets*, 9, 3, pp 190-193
- Heo, J., Han, I. (2002) "Performance measures of Information Systems (IS) in evolving computing environments: an empirical investigation", *Information & Management*, 1(14), 1-14
- Ives, B., Hamilton, S., Davis, G. B. "A framework for research in computer based management information systems", *Management Science*, 26(9), 910-934
- 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
- Klaus, H., Rosemann, M., Gable, G., (2000) "What is ERP?", *Information Systems Frontiers*, 2:2, pp 141-162.
- Knowles, H., Fotos, S., Henry, N., (2000) "Q & A from the internet: Implementing SAP", *The controllers update*, September.
- Long, J. S. (1983) "Confirmatory Factor analysis", Sage, Beverly Hills, CA
- 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.
- Mackenzie, K. D., House, R. (1979) "Paradigm Development in the social sciences", in *Research organizations: Issues and controversies*, Goodyear Publishing, Santa Monica, CA

- Mason, R. O. (1978) "Measuring Information output: A communication systems approach", *Information & Management*, 1(5), 219-234
- McAfee, A. (1999) "The impact of enterprise resource planning systems on company performance", Unpublished presentation at Wharton electronic supply chain conference, December.
- Mukherjee, K. (2001) "Productivity growth in large US commercial banks: the initial post regulation experience", *Journal of Banking and finance*, 25, 5, pp913.
- Mukhopadhyay, T., Kekre, S., Kalathur, S. (1995) "Business value of information technology: A case study of Electronic Data Interchange", *MIS Quarterly*, pp 137-154.
- Myers, B. L., Kappelman, L. A., Prybutok, V. R. (1997) "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.
- Nunnally, J. C. (1967) "Psychometric Theory", MacGrawHill, New York, NY
- O'Leary, D. (2000) "Enterprise Resource Planning System: Systems, Lifecycle, Electronic commerce and risk", Cambridge University Press.
- Parr, A., N., Shanks, G., Darke, P., (1999) "Identification of necessary factors for successful implementation of ERP systems" in 'New Information technologies and theoretical organizational processes: field studies and theoretical reflections on the future of work.', IFIP publications.
- Pinsonneault, A., Kraemer, K. L. (1993) "The impact of Information Technology on Middle managers", *MIS Quarterly*, pp271-292
- Rosemann, M. and Wiese, J. (1999) "Measuring the performance of ERP software - a balanced scorecard approach", Proceedings from the 10th Australasian Conference of Information Systems (ACIS), 1-3rd December, Welington, New Zealand.
- Ross, L., M., Vitale, M., R., (1999) "The ERP Revolution: Surviving versus Thriving", Massachusetts Institute of Technology.
- 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. (1997) "A respecification and extension of the Delone and McLean model of IS success", *Information Systems Research*, 8 (September), pp 240-253
- Sedera, D., Rosemann, M., Gable, G., (2001) "Using Performance Measurement Models for Benefit Realization with Enterprise Systems- The Queensland Government Approach", in proceedings of the 9<sup>th</sup> European Conference on Information Systems (ECIS '01), Bled, Slovenia.
- Sedera, D., Gable, G., Palmer, A. (2002) "Enterprise Resource Planning systems impacts: a Delphi study of Australian public sector organizations" in proceedings of the Pacific Asian Conference on Information Systems (PACIS '02), Tokyo, Japan, September 3-5.
- 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.
- Straub, D. W. (1989) "Validating instruments in MIS research", *MIS Quarterly*, June
- Westerman, G., Cotteleer, M., Austin, R., Nolan, R. (1999) "Tektronix: Implementing ERP: Harvard Business School Case, Report No: 9-699-043.
- Wilson, D. (1993) "Assessing the impact of Information Technology on Organizational performance", *Strategic Information Technology Management*, Harrisburg, PA, Idea Group.

## Appendix A



System Quality	Information Quality	Satisfaction**	Individual Impact	Organization Impact
<ul style="list-style-type: none"> <li>• Data accuracy</li> <li>• Data currency</li> <li>• Database contents</li> <li>• Ease of use</li> <li>• Ease of learning</li> <li>• Access</li> <li>• User requirements</li> <li>• System features</li> <li>• System accuracy</li> <li>• Flexibility</li> <li>• Reliability</li> <li>• Efficiency</li> <li>• Sophistication</li> <li>• Integration</li> <li>• Customization</li> </ul>	<ul style="list-style-type: none"> <li>• Importance</li> <li>• Availability</li> <li>• Usability</li> <li>• Understandability</li> <li>• Relevance</li> <li>• Format</li> <li>• Content Accuracy</li> <li>• Conciseness</li> <li>• Timeliness</li> <li>• Uniqueness</li> </ul>	<ul style="list-style-type: none"> <li>• Information **</li> <li>• Systems **</li> <li>• Overall **</li> <li>• Knowledge management **</li> <li>• Enjoyment</li> </ul>	<ul style="list-style-type: none"> <li>• Learning</li> <li>• Awareness/Recall</li> <li>• Decision making effectiveness</li> <li>• Individual productivity</li> </ul>	<ul style="list-style-type: none"> <li>• Organizational costs</li> <li>• Staff requirements</li> <li>• Overall productivity</li> <li>• Product/service quality</li> <li>• Business Process Change</li> </ul>