5-2011

The Influence of Simulation-Based Information Systems Education on Enterprise Systems Knowledge and User Satisfaction

Pamela Jeanne' Schmidt
University of Arkansas, Fayetteville

THE INFLUENCE OF SIMULATION-BASED INFORMATION SYSTEMS EDUCATION ON ENTERPRISE SYSTEM KNOWLEDGE AND USER SATISFACTION

THE INFLUENCE OF SIMULATION-BASED INFORMATION SYSTEMS EDUCATION ON ENTERPRISE SYSTEM KNOWLEDGE AND USER SATISFACTION

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy in Business Administration

By

Pamela Jeanne' Schmidt
University of Kansas
Bachelor of Science in Computer Science
University of Southern California
Master of Science in Computer Science
Northwestern University
Master of Arts in Communications
Northwestern University
Master of Management

May 2011
University of Arkansas

ABSTRACT

Enterprise systems implementations are often high cost and high risk with many companies failing to achieve their targeted business objectives. At the individual level, negative user reactions to enterprise systems lead to resistance to IT use, counter-productive adaptations, and reduced job satisfaction. Factors that contribute to these individual level effects include a lack of understanding of reengineered business processes and a lack of understanding of economic interdependencies. In this research, a computer-based business simulation educational intervention is investigated to determine its effectiveness in facilitating enterprise systems knowledge acquisition and promoting job satisfaction. Simulation-based education utilizes an experiential learning model, immersing participants in a realistic, dynamic business environment.

This dissertation consists of three related essays. Two essays compare simulation-based education against traditional education to determine their relative effectiveness at imparting enterprise business process knowledge (essay 1), business motivational knowledge of economic interdependencies (essay 2), and at influencing job satisfaction. In essays 1 and 2, user knowledge structures are assessed using concept relatedness measures and analyzed using established Pathfinder network structure techniques. Results support the importance of accurate business process knowledge and understanding of enterprise economic interdependencies as antecedents to improved job satisfaction but the two types of knowledge appear to operate differently. Business process knowledge has a relatively stronger effect on perceptions of opportunities and control over the technology; whereas business motivational knowledge resulted in stronger reductions to perceptions

of threat relative to a positive influence on opportunity. These influences all led to greater enterprise systems satisfaction among users.

Essay 3 investigates salient factors of simulation-based education as an effective transitional intervention for enterprise change management. Based on the organizational behavior concept of realistic job previews, a new concept of realistic technology previews is introduced to IT change management. Simulation education is evaluated for its ability to provide a safe and supportive ‘transitional space’ facilitating IT adaptation by improving IT self-efficacy and improving cognitive appraisals which influence ES job satisfaction. Overall, results of these essays support the importance of user knowledge of business processes and economic relations to improve job satisfaction and adaption to enterprise systems. Simulation-based education is found to be superior to traditional education in imparting business process knowledge. Further, use of simulation-based enterprise systems education is found to positively influence IT self-efficacy and to provide a realistic technology preview, both of which improve cognitive appraisals resulting in higher enterprise systems job satisfaction.

This dissertation is approved for
Recommendation to the
Graduate Council

Dissertation Directors:

____
Dr. Timothy Paul Cronan

____
Dr. Fred D. Davis

Thesis Committee:

____
Dr. Christine C. Davis

____
Dr. Gary Peters

DISSERTATION DUPLICATION RELEASE

I hereby authorize the University of Arkansas Libraries to duplicate this dissertation when needed for research and/or scholarship.

Agreed ____

Pamela Jeanne' Schmidt

Refused ____

Pamela Jeanne' Schmidt

ACKNOWLEDGEMENTS

A doctoral dissertation is a major accomplishment that is the result of the direct efforts of one scholar and the indirect support of many mentors, professors, and peers who shaped and influenced the academic journey. It is a reflection of a broader program of knowledge acquisition and personal growth by which a new academic is formed. I have greatly valued the many and varied experiences of this academic journey. I want to acknowledge the outstanding academics who have offered their immense knowledge, talent, time, effort and patience in providing me an academic education.

The Walton College of Business has offered me many opportunities, most particularly the information systems department and the accounting department. I have the greatest respect and appreciation for my dissertation committee who have supported me in many ways throughout this journey and have become colleagues as well as friends. Dr. Fred Davis is a constant inspiration, patient teacher, a great colleague and has guided me throughout my academic life at the University of Arkansas. Dr. Cronan is an exemplar academic innovator and educator who has always been a truly supportive and caring mentor. Sharing my cross-disciplinary interests and similar business experiences, Dr. Christine Davis understood the challenges of my research and offered me a truly synergistic working relationship. Dr. Gary Peters supported my accounting research interests and offered me opportunities to expand my auditing expertise and teaching experience.

Special thanks go to Dr. Viswanath Venkatesh for providing his extraordinary leadership as PHD program coordinator and leading many research seminars which provided us with an academic education of the highest caliber and loftiest aspirations. In addition, I have benefited from the guidance of Dr. Vern Richardson as a cross-discipline researcher and an accounting academic mentor. In the information systems department and accounting department, my homes away from home for many years, I have been supported by many current and past faculty members. You are all remembered and greatly appreciated. I was afforded the opportunity to be in an outstanding information systems doctoral student cohort including Tracy, Xiajun, Sandeep, and Omar. It was also my pleasure to be welcomed into a great accounting doctoral student cohort including Liddy, Adi and Drew. We have all come a very long way together. I am sure these two cohorts' impacts will be widely felt in the academic world. Too numerous to list, many other Walton College faculty and staff have supported me in this effort. All have provided me with insights and much appreciated help along the way.

As in many ways, my doctoral education has been a team-supported effort. I especially thank my peer-friends in doctoral programs across many disciplines, particularly Jaime, Heather, Kim, Liddy, Mary, Andrea and Chris. You have each earned my undying thanks. Your friendship is the true gold at the end of this rainbow.

Foremost, I am blessed with an amazing and loving family which I am honored and humbled to be part of. If I am anything, and if I accomplish anything, it is of their doing in shaping, encouraging and always supporting me. I hope that my academic efforts will in some way contribute to their lives and others we come in contact with.

DEDICATION

This dissertation is dedicated to my first, best and forever teachers:

Mom and Dad, Donna M. Schmidt and Marion J. Schmidt.

And to my brothers, Mayo and Garret, and my sister, Sandy.

All of you continually inspire me, challenge me, teach me, support me, and love me.

And this is dedicated to the next generation,

Grier, Nolan, Lauren, Harrison, Carson, Darian, Elaine and Kaitlyn,

who will no doubt reach farther the we can currently dream.

I love you all more than I can possibly say or show.

TABLE OF CONTENTS

CHAPTER 1

Introduction

By 2002, 67 percent of mid-sized to large firms had already implemented enterprise resource planning (ERP) systems, a leading form of enterprise system (ES), with another 21 percent considering their adoption (Liang et al. 2007). Commercial ES are a growing presence among small and medium enterprises (SMEs). By 2006, the ERP subset of the ES market had already reached total market revenues of over $28 billion with projections for the ERP market to reach revenues of over $47 billion by 2011 (Jacobson et al. 2007). When firms implement an enterprise system (ES), a major concern is how to quickly achieve the benefits of ES-based operations improvements. Still largely unknown is the long term impact of an ES on technology innovation with ES (Srivardhana and Pawlowski 2007), organizational performance and on maintenance costs (Glass 1998; Kumar et al. 2003). Up to 75% of firms surveyed report productivity decreases in the year immediately following ES implementation (Davenport 1998; Peterson et al. 2001). Often employees react negatively to ES implementation. Conversion to an ES is met with individual stress and coping reactions (Beaudry and Pinsonneault 2005), workarounds (Ignatiadis and Nandhakumar 2009) and user resistance to use (Dery et al. 2006b; Kim and Kankanhalli 2009) and that can greatly reduce productivity compared to levels prior to ES implementation.

User resistance to IT use is a widely acknowledged problem as described in recent research including the coping model of user adaptation (Beaudry and Pinsonneault 2005), the technology threat avoidance theory (TTAT) (Liang and Xue 2009) and the theory of technostress (Ragu-Nathan et al. 2008). As stated by BOUDREAU and ROBEY Boudreau and Robey (2005) “an integrated technology like ERP, which potentially represents a “hard” constraint on human agency, can be resisted and reinvented in use” (Boudreau and Robey 2005, p. 3). Resistance to use, dissatisfaction and workarounds by ES users may well be symptoms of the user’s lack of complex ES-related business knowledge (Sein et al. 1999; Kang and Santhanam 2003) and their reaction to the added control and monitoring engendered in the ES (Orlikowski and Robey 1991). It is important to investigate the ES knowledge demands and stress-related appraisals which drive ES-related coping behaviors and job satisfaction. To improve outcomes from ES adoption, change management interventions at the individual level are needed to minimize negative reactions to ES and to increase positive adaptation to ES in order to achieve earlier and greater positive ES organizational outcomes.

ES implementations are widely known to have major impacts on business processes (Robey et al. 2002), employee job definitions (Scott and Vessey 2000) and job satisfaction (Bradley 2008; Morris and Venkatesh 2010). Both technical issues and employee emotional reactions have been cited as the major barriers in ERP implementations (Botta-Genoulaz and Millet 2006). Recent literature indicates that social and emotional factors may have the largest impact on individual ERP use (Chang et al. 2008; Grabot et al. 2008; Beaudry and Pinsonneault 2010). This area of IT research points out the need for greater focus on individual level sociological research in ES (Dery et al. 2006b). Yet, the social context of ES use has not received much attention regarding its influence at the individual level (Dery et al. 2006b; Grant et al. 2006). After largely focusing on the technical nature of ES to explain implementation outcomes, ES sociological and technosocial research is growing in its focus on human social structure and an individual's technosocial interactions with an ES**.** Education is a broadly recognized as a critical success factor (CSF) in IT research (Nelson and Cheney 1987). This is particularly true in ES implementations (Markus and Tanis 2000; Somers and Nelson 2001; Al-Mashari et al. 2003; Nah et al. 2004; Moon 2007; Bradley 2008). In the context of ES, knowledge acquisition and change management are not yet sufficiently well understood. Little ES research has addressed the unique knowledge and educational demands of ES adoption and adaptation (Dery et al. 2006a). Traditionally, ES knowledge acquisition methods focus on application skills; so much of ES education overlooks the importance of business context knowledge (such as business processes and economic relationships) which is crucial to effective ES adaptation (Sein et al. 1999; Kang and Santhanam 2003). And, too often, ES education is seen as a one-time event rather than an on-going process that is a fundamental part of ongoing IT change management (Markus and Tanis 2000; Markus 2004; Santhanam et al. 2007).

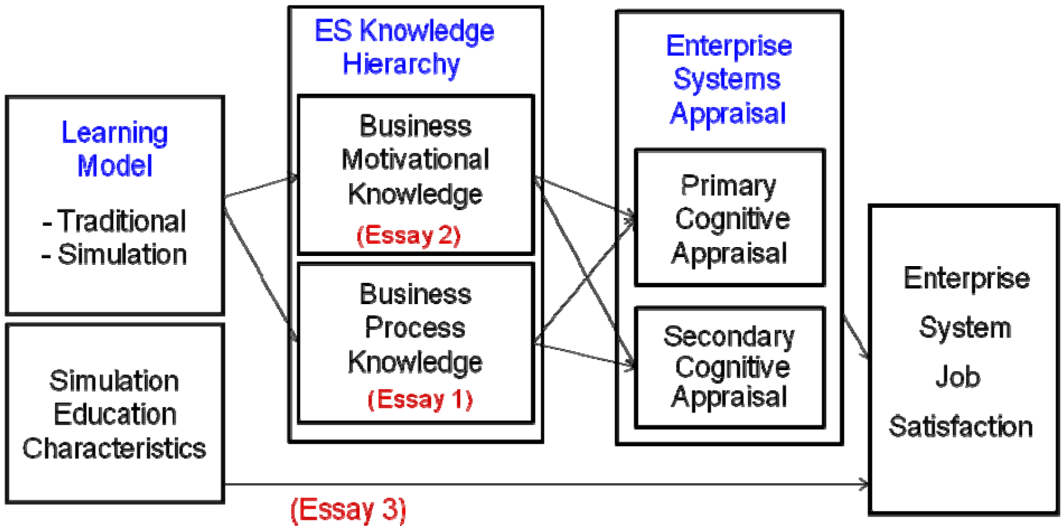
This research investigates the nature of different types of ES educational interventions as well as their influence on individual's ES knowledge acquisition and affective reactions. In this research, different learning models are compared within an enterprise systems (ES) context – the more traditional 'objectivist' learning model focusing on conveying factual application usage knowledge to learners and the experiential 'constructivist' learning model which facilitates learners in constructing their own knowledge through experience (Leidner and Jarvenpaa 1995). Underlying these two educational theories is the distinction that objectivist's strive for complete and correct understanding of objective reality, while constructivists believe that an individual's reality is the outcome of an internal constructive process and that no complete shared reality can be achieved (Duffy and Joanassen 1992). A key distinction in training operationalization is that traditional education takes place in a static system context whereas the experiential constructivist method occurs in a dynamic system context. These two educational models are compared to assess the differential influence on enterprise system's business context knowledge and the resulting satisfaction with the use of the enterprise system.

This research is organized as three related essays. The first and second essays compare the influence of two different types of educational interventions (traditional hands-on and experiential simulation-based ES exercises) on the individual's business context knowledge (business process and business economic motivational knowledge, respectively) and ES-related affective outcomes. These two essays investigate both explicit and implicit learning by assessing ES knowledge structures (aka, mental models). The two educational interventions are assessed for their influence on the job-related affective outcomes of cognitive appraisal (from stress and coping literature) and ES satisfaction (from organizational behavior/management literature). More specifically, essay 1 investigates two primary questions about enterprise systems business process knowledge acquisition: 1) is simulation-based education more effective than traditional education in developing accurate *business process knowledge*, and 2) does accurate *business process knowledge* influence ES stress coping reactions and job satisfaction?

Essay 2 focuses on two research questions regarding enterprise systems economic knowledge acquisition: 1) is simulation-based education more effective than traditional education in developing accurate accounting and economic oriented *business motivational knowledge*, and 2) does accurate *business motivational knowledge* influence ES stress coping reactions and job satisfaction? These research models build on an accepted model for end user education where education experiences and IT characteristics influence formation of knowledge structures, attitudes and performance (Bostrom et al. 1990; Davis and Bostrom 1993; Sein et al. 1999). In Bostrom et al.'s model (1990), knowledge structures perform a central role as mediator between educational approaches and the outcomes of user perception of the system.

The third essay investigates the influence of various ES simulation-based educational factors and proposes that the simulation-based education offers a safe and supportive 'transitional space' for sociotechnical adaptation to the ES (Wastell 1999). It investigates ES simulation-based education's ability to provide a *realistic technology preview* (RTP) that influences the individual's affective outcomes, namely user stress coping reactions (cognitive appraisal) and job satisfaction. Experiential simulation-based education provides repeated opportunities to acquire and refine several levels of ES knowledge through experiential practice with feedback. Figure 1 provides a combined conceptual model of these three essays.

Figure 1. Dissertation Conceptual Model (Essays 1, 2 and 3).



REFERENCES

Al-Mashari, M., Al-Mudimigh, A., and Zairi, M. "Enterprise Resource Planning: A Taxonomy of Critical Factors," *European Journal of Operational Research* (146:2) 2003, pp. 352-364.

Beaudry, A., and Pinsonneault, A. "Understanding User Responses to Information Technology: A Coping Model of User Adaptation," *Management Information Systems Quarterly* (29:3) 2005, pp. 493-524.

Beaudry, A., and Pinsonneault, A. "The Other Side of Acceptance: Studying the Direct and Indirect Effects of Emotions on Information Technology Use," *MIS Quarterly* (34:4) 2010, pp. 689-710.

Bostrom, R.P., Olfman, L., and Sein, M.K. "The Importance Of Learning Style In End-User Training," *MIS Quarterly* (14:1) 1990, pp. 101-119.

Botta-Genoulaz, V., and Millet, P.A. "An Investigation Into the Use of ERP Systems In the Service Sector," *International Journal of Production Economics* (99:1-2), Jan-Feb 2006, pp. 202-221.

Boudreau, M., and Robey, D. "Enacting Integrated Information Technology: A Human Agency Perspective," *Organization Science* (16:1) 2005, pp. 3-18.

Bradley, J. "Management-Based Critical Success Factors in the Implementation of Enterprise Resource Planning Systems," *International Journal of Accounting Information Systems* (9) 2008, pp. 175-200.

Chang, M.-K., Cheung, W., Cheng, C.-H., and Yeung, J.H.Y. "Understanding ERP System Adoption From the User's Perspective," *International Journal of Production Economics* (113:2), June 2008, pp. 928-942.

Davenport, T.H. "Putting the Enterprise Into the Enterprise System," *Harvard Business Review* (76:4), Jul-Aug 1998, pp. 121-131.

Davis, S.A., and Bostrom, R.P. "Training End Users - An Experimental Investigation of the Roles of the Computer-Interface and Training Methods," *Management Information Systems Quarterly* (17:1), Mar 1993, pp. 61-85.

Dery, K., Grant, D., Harley, B., and Wright, C. "Work, Organisation and Enterprise Resource Planning Systems: An Alternative Research Agenda," *New Technology Work and Employment* (21:3), Nov 2006a, pp. 199-214.

Dery, K., Hall, R., and Wailes, N. "ERPs as 'Technologies-in-Practice': Social Construction, Materiality and the Role of Organisational Factors," *New Technology Work and Employment* (21:3), Nov 2006b, pp. 229-241.

Duffy, T.M., and Joanassen, D.H. "Constructivism: New Implications for Instructional Technology," in: *Constructivism And The Technology of Instruction; A Conversation*, Lawrence Erlbaum Associates, Hillsdale, NJ 1992, pp. 1-16.

Glass, R., L. "Enterprise Resource Planning-Breakthrough and/or Term Problem?," *Database for Advances in Information Systems* (29:2) 1998, pp. 14-16.

Grabot, B.E., Mayère, A.E., and Bazet, I.E. *ERP Systems and Organisational Change: A Socio-technical Insight* Springer-Verlag London Limited, 2008.

Grant, D., Hall, R., Wailes, N., and Wright, C. "The False Promise of Technological Determinism: The Case of Enterprise Resource Planning Systems," *New Technology, Work, and Employment* (21:1) 2006, pp. 2-15.

Ignatiadis, I., and Nandhakumar, J. "The Effect of ERP System Workarounds on Organizational Control: An Interpretivist Case Study," *Scandinavian Journal of Information Systems* (21:2) 2009, pp. 59-90.

Jacobson, S., Shepherd, J., D’Aquila, M., and Carter, K. "The ERP Market Sizing Report, 2006–2011," 2007, pp. 1-34.

Kang, D., and Santhanam, R. "A Longitudinal Field Study of Training Practices in a Collaborative Application Environment," *Journal of Management Information Systems* (20:3), Win 2003, pp. 257-281.

Kim, H.-W., and Kankanhalli, A. "Investigating User Resistance to Information Systems Implementation: A Status Quo Bias Perspective," *Management Information Systems Quarterly* (33:3) 2009, pp. 567-582.

Kumar, V., Maheshwari, B., and Kumar, U. "An Investigation of Critical Management Issues in ERP Implementation: Emperical Evidence From Canadian Organizations," *Technovation* (23:10), Oct 2003, pp. 793-807.

Leidner, D.E., and Jarvenpaa, S.L. "The Use of Information Technology to Enhance Management School Education: A Theoretical View," *Management Information Systems Quarterly* (19:3) 1995, pp. 265-291.

Liang, H., Saraf, N., Hu, Q., and Xue, Y. "Assimilation of Enterprise Systems: The Effect of Institutional Pressures and the Mediating Role of Top Management," *Management Information Systems Quarterly* (31:1) 2007, pp. 59-87.

Liang, H., and Xue, Y. "Avoidance of Information Technology Threats: A Theoretical Perspective," *Management Information Systems Quarterly* (33:1) 2009, pp. 71-90.

Markus, L.M., and Tanis, C. "The Enterprise System Experience – From Adoption to Success," in: *Framing the Domains of Information Technology*, R.W. Zmud (ed.), Pinnaflex Education Resources, Inc., 2000, pp. 173-207.

Markus, M.L. "Technochange Management: Using IT to Drive Organizational Change," *Journal of Information Technology* (19:1) 2004, pp. 4-21.

Moon, Y.B. "Enterprise Resource Planning (ERP): A Review of the Literature," *International Journal of Management and Enterprise Development* (3:4) 2007, pp. 235 - 264

Morris, M., and Venkatesh, V. "Job Characteristics and Job Satisfaction: Understanding the Role of Enterprise Resource Planning System Implementation," *Management Information Systems Quarterly* (34:1) 2010, pp. 143-161.

Nah, F.F., Tan, X., and Teh, S.H. "An Empirical Investigation on End-Users' Acceptance of Enterprise Systems," *Information Resources Management Journal* (17:3) 2004, pp. 32-53.

Nelson, R.R., and Cheney, P.H. "Training End Users - an Exploratory-Study," *Management Information Systems Quarterly* (11:4), Dec 1987, pp. 547-559.

Orlikowski, W., and Robey, D. "Information Technology and the Structuring of Organizations," *Information Systems Research* (2:2) 1991, pp. 143-169.

Peterson, W.J., Gelman, L., and Cooke, D.P. "ERP Trends, Report Number: R-1292-01-RR ", The Conference Board, /www.conference-board.org, pp. 1-31.

Ragu-Nathan, T., Tarafdar, M., Ragu-Nathan, B., and Tu, Q. "The Consequences of Technostress for End Users in Organizations: Conceptual Development and Empirical Validation," *Information Systems Research* (19:4) 2008, pp. 417-433.

Robey, D., Ross, J.W., and Boudreau, M.C. "Learning To Implement Enterprise Systems: An Exploratory Study of the Dialectics of Change," *Journal of Management Information Systems* (19:1), Sum 2002, pp. 17-46.

Santhanam, R., Seligman, L., and Kang, D. "Postimplementation Knowledge Transfers to Users and Information Technology Professionals," *Journal of Management Information Systems* (24:1), Sum 2007, pp. 171-199.

Scott, J.E., and Vessey, I. "Implementing Enterprise Resource Planning Systems: The Role of Learning from Failure," *Information Systems Frontiers* (2:2) 2000, pp. 213-232.

Sein, M.K., Bostrom, R.P., and Olfman, L. "Rethinking End-User Training Strategy: Applying a Hierarchical Knowledge-Level Model," *Journal of End User Computing* (11:1) 1999, pp. 32-39.

Somers, T.M., and Nelson, K. "The Impact of Critical Success Factors Across the Stages of Enterprise Resource Planning Implementations," *Proceedings of the 34th Annual Hawaii International Conference on System Sciences* (HICSS-34), 3-6 Jan. 2001, pp. 1-10.

Srivardhana, T., and Pawlowski, S.D. "ERP Systems as an Enabler of Sustained Business Process Innovation: A Knowledge-Based View," *Journal of Strategic Information Systems* (16:1), Mar 2007, pp. 51-69.

Wastell, D.G. "Learning Dysfunctions In Information Systems Development: Overcoming The Social Defenses With Transitional Objects," *Management Information Systems Quarterly* (23:4) 1999, pp. 581-600.

CHAPTER 2 (Essay1)

ES Change Management:
User Acquisition of Business Process Knowledge
Through the Enterprise System Simulation

Abstract

This essay compares the influence of two types of enterprise systems (ES) educational interventions, traditional objectivist versus simulation-based constructivist educational methods, to determine the relative influence on the acquisition of business process knowledge (BPK) and on enterprise system-related affective outcomes. ES business process knowledge structures are assessed for accuracy to help determine BPK's influence on cognitive appraisal (from stress and coping literature) and ES satisfaction (from organizational behavior/management literature).

Specifically, this essay assesses the organization of business process knowledge using concept relatedness measures and well-established Pathfinder network analysis techniques in order to determine the accuracy of acquired knowledge of ES integrated business processes. BPK is defined as applying application-based procedures to execute a business process or support a business task. Business process knowledge is hypothesized to benefit from constructivist simulation-based educational interventions (versus traditional objectivist education) and improve affective outcomes of user's stress and coping cognitive appraisals and job satisfaction (related to subjective well being). The two primary questions about enterprise systems business process knowledge acquisition: 1) is simulation-based education more effective than traditional education in developing accurate *business process knowledge,* and 2) how does accurate *business process*

knowledge influence stress and coping (assessed by cognitive appraisal) related to ES use and ES job satisfaction? Findings support the value of constructivist, experiential education benefiting accounting and finance experts. Strong support is provided for BPK positively influencing ES job satisfaction as mediated by the cognitive appraisal of opportunity and control. The role of cognitive appraisal of threat appears to be complex and further investigation is needed.

Introduction

For the last decade, the growth and revenues of ERP and other ES implementations have led the software market. In 2006, ERP market revenues alone topped $28 billion with eventual growth is anticipated to reach $47 billion by 2011 (Jacobson et al. 2007). As of 2002, 67% of medium to large firms had already adopted ERP with an additional 21% of firms considering ERP implementations (Liang et al. 2007). Implementation of an ES brings major change to the firm's business processes, information systems infrastructure and employee's job roles (Gibson 2003). The ES implementation is often used as the catalyst for business process improvements (BPI) to achieve greater operational efficiencies. Since the Sarbanes Oxley Act of 2002, ES have been relied on by management to institute monitoring, reporting and managerial control for regulatory compliance. Hence, the implementation of an enterprise system (ES) is usually the most visible evidence of a much broader change initiative which simultaneously introduces business process innovation and increases managerial monitoring and controls. Individual level (user) acceptance and adaptation to using ES effectively is critical to the ES success (Somers and Nelson 2001; Peslak et al. 2007). But, the pervasive change accompanying an ES has frequently resulted in resistance to use (Ragu-Nathan et al. 2008; Kim and Kankanhalli 2009), maladaptive use (Beaudry and Pinsonneault 2005), workarounds (Ignatiadis and Nandhakumar 2009) and negative impacts on individual satisfaction (Robey et al. 2002; Markus 2004; Markus and Grover 2007; Morris and Venkatesh 2010). Some negative adaptive behaviors bypass ES-enabled business processes monitoring and controls (Orlikowski and Gash 1992;

Ignatiadis and Nandhakumar 2009). These maladaptive behaviors can also subvert the organization’s improvement goals by reducing the anticipated efficiencies arising from the ES implementation and improved business processes.

From the perspective that firms are knowledge-based entities (Balogun and Jenkins 2003; Srivardhana and Pawlowski 2007), organizational change can be conceptualized as a knowledge-based activity (Orlikowski 1996). The study of ES critical success factors (CSF) has repeatedly identified ES user education as a leading determinant of ES implementation success (Markus and Tanis 2000; Somers and Nelson 2001; Al-Mashari et al. 2003; Nah et al. 2004; Moon 2007; Bradley 2008; Ngai et al. 2008). “Education/training is probably the most widely recognized critical success factor, because user understanding and buy-in is essential” (Umble et al. 2003p. 246). Meanwhile, ES education has fallen short in light of the high rate of ES failure (Anderson 1996; Scott 1999; Scott and Vessey 2000; Somers and Nelson 2001; Al-Mashari et al. 2003; Umble et al. 2003) and loss of productivity following ES implementations (Peterson et al. 2001). Still, ES educational interventions have limited empirical research and ES educational methods show little variation in industry practice. A shortfall in ES education is that it often focuses on technology interface skills without addressing other important types of collaborative enterprise knowledge and the need for continued learning in use (Santhanam et al. 2007). In one study of maladaptive reactions to ES, the antecedent of ES education “was mostly on the workings of SAP, and not on the business rationale for carrying out business processes within SAP in a way that was different to the pre-SAP era (Ignatiadis and Nandhakumar 2009, p. 71).” ES education requires new methods that also include understanding business processes and other aspects of the business context (Sein et al. 1999; Kang and Santhanam 2003).

In addition to conveying more types of ES knowledge, effective change management interventions also need to improve affective reactions to ES use and to reduce maladaptive behaviors in ES adaption. The objective of this essay is to evaluate different ES educational interventions to determine which has more positive effects on knowledge acquisition and user affective reactions. The affective outcomes of interest are cognitive appraisal from stress and coping literature, and ES-related job satisfaction from organizational behavior literature. Given ES's frequent role as change agent in business process innovation (BPI), promising ES educational interventions should convey business process knowledge. *Business process knowledge* (BPK) is based on business-procedural knowledge which is part of the business-context knowledge category in Kang and Santhanam's (2003) ES knowledge hierarchy. BPK is defined as applying application-based procedures to execute a business process or support a business task (Kang and Santhanam 2003). BPK focuses on enterprise-wide business processes. It is distinct from the lower level application knowledge which addresses the structure of the application and the user interface specifics of using it to complete specific low-level technical tasks. BPK focuses on understanding and effectively operating the ES to carry out business processes within enterprise's overall business context.

The study takes a sociotechnical approach to understand the relationship between the individual and the ES technology during the ES change management process. Two theoretical lenses used, the ACT theory of knowledge acquisition (Anderson 1982;

Anderson 1996) and Actor Network Theory (ANT) (Law 1992). In the ACT system of cognition and knowledge acquisition (Anderson 1982; Anderson 1993; Anderson et al. 1997), individuals develop procedural knowledge as she/he gains experience and refines knowledge. Knowledge compilation processes rely on practice, exposure to new situations and feedback to proceduralize tacit knowledge. ANT is a theory of knowledge and of social interaction. ANT takes the emphasis away from the human as the primary importance and treats the human as another actor within a network of interacting actants. ACT theory emphasizes the iterative process of acquiring and refining tacit knowledge from rehearsal and experience under varied conditions. The focal knowledge-generating interactions under study are the ES educational interventions occurring early in the ES change management process. In this essay, it is hypothesized that simulation-based ES education generates higher BPK which will mitigate negative affective reactions. More specifically, higher BPK will decrease negative ES cognitive appraisals and mitigate the ES's negative influence on ES-related job satisfaction. Two educational interventions are studied, traditional hands-on ES application procedural education in a static system context and experiential ES simulation-based education in a dynamic system context. Traditional education focuses on factual, procedural knowledge related to the use of the IT application interface. Simulation-based education provides experiential learning, a constructivist learning approach whereby participants construct their knowledge based on experience.

The remainder of this essay is organized as follows. The following section provides a brief review of applicable theory. Next, the hypothesis development section provides supporting rational for each relationship in the research model. Subsequently, the methodology and results section provide details of the empirical study and findings, respectively. The paper concludes with a discussion of research findings, generalized insights for research and practice.

Theoretical background

Enterprise Systems Knowledge Hierarchy

Enterprise systems such as ERP's are categorized as collaborative workflow systems which are complex applications that span a wide set of functionalities, support cross-functional business processes and enforce a high degree of task interdependence (Swanson 1994). For collaborative applications like ERPs and other enterprise systems, the hierarch of knowledge is theorized to include three knowledge categories of a) application knowledge, b) business context knowledge, and c) collaborative task knowledge (Sein et al. 1999; Kang and Santhanam 2003). The base level is application knowledge focusing on the user interface and the specific commands used in an ES task. A next level is business context knowledge which is a broad understanding of the policies, procedures and impacts related to using the application. The business context category contains two distinct knowledge types, business motivational knowledge (BMK) and business process knowledge (BPK), containing both conceptual and procedural knowledge (Sein et al. 1999; Kang and Santhanam 2003). A higher level is collaborative task knowledge which is the understanding of the interdependencies involved in using the ES to make business decisions and solve problems. Figure 1 depicts this collaborative application knowledge hierarchy that is applied to enterprise systems. The focus of this essay is business-process knowledge (BPK) which is defined as applying application-based procedures to help execute a business process or support a business task (Sein et al. 1999; Kang and Santhanam 2003).

Knowledge Acquisition and Learning Theory

According to the ACT and ACT-R system of cognition and knowledge acquisition (Anderson 1982; Anderson 1993; Anderson et al. 1997), after a declarative learning stage, individuals enter a procedural knowledge growth stage as she/he gains experience. Declarative knowledge is factual understanding that can be verbalized while procedural knowledge is displayed in our behavior, is mostly unconscious and not easily verbalized (Anderson et al. 1997). Knowledge compilation processes rely on practice, exposure to new situations and feedback to proceduralize tacit knowledge by developing productions in memory. *Productions* are primitive rules defined as ‘condition and action’ pairs such that when a given condition occurs then a related, subsequent mental or physical action is identified as appropriate (Anderson 1982; Anderson 1993). Experiencing novel situations while in pursuit of goals and experimenting with feedback refines knowledge productions which become tuned to a wider number of more refined situations. Refined productions result in improved task performance because the actions are precisely targeted to more efficiently address specific conditions (Anderson 1982). Practice with the corresponding outcome feedback allows participants to directly observe the results of their actions and prompts creation of more precise, refined knowledge productions addressing ever more specific situations (Anderson 1987). Knowledge compilation increases when feedback is perceived as being within one's control (Martocchio and Dulebohn 1994).

Experiential learning in dynamic situations is further explained by implicit learning theory. Implicit learning is defined as the act of learning complex information in an incidental manner, without explicit focus or conscientious awareness (Reber 1989; Seger 1994). Awareness and self-assessment of outcome feedback also helps develop tacit understanding of complex causal relations through implicit learning. Dynamic simulation-based learning has been shown to facilitate learning about hidden relations even when such relationships are not made explicit. In a factory simulation study, implicit learning allowed individuals to gain an understanding of hidden cross-relationships between business elements resulting in acquiring tacit knowledge of interactions and causal relationships (Berry and Broadbent 1987; Garris et al. 2002).

Actor Network Theory and Organizational Routines

In the past two decades, more researchers have taken a sociotechnical approach to studying information systems (Walsham et al. 1997; Clegg and Walsh 2004; Beaudry and Pinsonneault 2005; Dery et al. 2006; Grant et al. 2006; Beaudry and Pinsonneault 2010; Grabski et al. 2011). Actor Network Theory (ANT) has been applied in information systems research to describe interactions between information systems and individuals (Walsham et al. 1997; Orlikowski and Yates 2006; Grabot et al. 2008). Actor Network Theory treats the human as another actor within a network of interacting human and non-human actants. ANT has much in common with other sociological theories used in information systems such as structuration theory (Giddens 1984) and adaptive structuration theory (DeSanctis and Poole 1994). In contrast to sociological theories which grant primacy to human interactions, ANT is distinguished by 1) asserting that human and nonhuman actors have equal status and importance in network interactions and by 2) using a metaphor of the heterogeneous, patterned network of interactions. ANT asserts that it is important to study a human's embeddedness in a network of human and nonhuman actors in order to understand human actions (Latour 1996). All actors (or actants) are influence the network, all perform some type of agency and each varies in the degree to which they delegate to others, substitute for each other, and influence or resist the influence of other actors (Callon 1998). The ANT viewpoint emphasizes the interconnectedness and interdependencies among heterogeneous actors in a network (Somerville 1999).

From an ANT perspective, the non-human ES actant automates many tasks previously completed by human actors. An ES is less flexible in performing business processes than previous human delegates as it automates and extends management control. By design, an ES performs more rigid delegated functions, links more cross-functional information and enforces more business process restrictions on human actors than most prior information systems have done. An ES can also be seen as a delegate of management, serving as their proxy by performing monitoring functions and implementing controls (Orlikowski and Gash 1992; Ignatiadis and Nandhakumar 2009). As such, the ES actant is a prominent and inflexible actor in the network, enforcing business processes and expecting non-negotiable interactions from human actants to achieve desired business outcomes. In ANT, networks are seen as contingent and emergent, continuously changing by adding elements or redefining relationships between actors (Somerville 1999). *Translation* is defined as the process by which an actor negotiates, persuades or forces it's role of authority in acting on behalf of another actor in the network (Callon 1998). *Punctualization* is an ongoing process whereby actors continually negotiate interactions toward greater consistency (Law 1992). When networks operate consistently, then complexity is reduced and outcomes are more dependable. Therefore, well-established organizational routines (e. g. business processes) are the result of actant negotiations and more mature *punctualized* routines offer greater consistency and predictability – a key goal of management. A key goal of ES-enabled business processes is to enact repeatable, reliable and efficient business operations to achieve pre-defined goals, i. e. to establish dependable organizational routines. Organizational routines can be conceptualized as generative systems that contain both the performative and ostensive aspects. *Performative* aspects can be described as actual performances by specific people, at specific times, in specific places. *Ostensive* aspects are the abstract patterns that are used to guide, account for and identify specific performances of a routine (Feldman and Pentland 2003; Pentland and Feldman 2005). Organizational routines focus attention on collective performances as a means for participants & observers to create the *ostensive* aspect.

In summary, ANT is distinguished by 1) asserting that human and nonhuman actors have equal importance in network interactions and by 2) the concept of a heterogeneous network of interconnected and negotiated interactions among various actants including organizations, human agents, and non-human agents (such as the ES) in a emergent patterned network of business processes (Law 1992). ANT provides useful insights for studying ES-enabled business processes which can be views as emergent organizational routines, an ANT-based concept.

Stress, Coping and IT User Adaptation Research

Stress is defined as a relationship between the individual and the environment that is assessed as over-taxing or exceeding the individual's resources and endangering one's well-being. In prior studies, stress was also defined as an individual's judgment that particular demands exceeded the resources for dealing with them and thus affected individual's sense of well being (Folkman and Lazarus 1985; Drach-Zahavy and Erez 2002). *Coping* is defined as an individual's dynamic cognitive and behavioral efforts to handle external or internal demands that are seen as taxing or exceeding the individual's available resources (Lazarus 1993). Evidence shows that choices of coping strategies are based on both the perception of threat or challenge (Tomaka et al. 1997; Drach-Zahavy and Erez 2002; Beaudry and Pinsonneault 2005) and the individual's perceived level control in the situation (Lazarus 1993; Major et al. 1998; Gowan et al. 1999). Stress and coping literature has identified two basic processes, *cognitive appraisal* and *coping processes*, which mediate between stressful person-environment relationships and their short-term or long-term outcomes (Folkman et al. 1986a; Folkman et al. 1986b). Two forms of cognitive appraisal are *primary cognitive appraisal* where a person evaluates what they have at stake in the encounter and *secondary cognitive appraisal* where a person evaluates if anything can be done to prevent harm, overcome barriers or to improve the possibilities for benefits. Secondary cognitive appraisal has been summed up as an assessment of an individual’s perceived control in the situation (Major et al. 1998). In primary cognitive appraisal, the situated goals are assessed as being threatening or challenging which has a direct influence on performance of complex tasks and adaptation to change (Tomaka et al. 1997; Drach-Zahavy and Erez 2002). *Challenges* are seen as *opportunities* for self-growth or to gain benefits by utilizing one's available coping strategies. *Threats* are circumstances seen as leading towards *failure* given one’s lack of adequate abilities or resources (Drach-Zahavy and Erez 2002). When the primary cognitive appraisal of an event is assessed as a opportunity, rather than as a threat, then the individual adapts better to change and achieves higher performance (Drach-Zahavy and Erez 2002). In IT adaptation literature, perceptions of an IT event as an opportunity instead of a threat result in more productive user coping strategies such as ‘benefits maximizing’ (i.e. innovative use) or ‘benefits satisficing’ (i. e. limited adaptive use) (Beaudry and Pinsonneault 2005). Anxiety caused by use of IT has been negatively related to IT use, both directly and indirectly through psychological distancing (Beaudry and Pinsonneault 2010), suggesting that appraisal of threat would lead to reducing job satisfaction and IT use.

Hypothesis Development

In this essay, BPK acquisition is viewed through two theoretical lenses - ACT learning theory (Anderson 1982; Anderson 1993; Anderson et al. 1997) and Actor Network Theory (ANT) (Latour 1996) as it relates to organizational routines (Pentland and Feldman 2005). A business process is defined as a set of logically related activities executed in order to achieve a specific business outcome. Business processes can be thought of as an organization's mindful, purposeful design and completion of organizational routines among interdependent actants in order to achieve desired organizational goals. Based on ANT, Feldman & Pentland (2003) propose several ways to study organizational routines including studying the relationships among the various parts of the routine. Business processes are a form of organizational routine so knowledge structures (also known as mental models or conceptual schemas) are used here to study the relationships among business process concepts.

Traditional ES education typically provides specific written directions for using the ES user interface in a static system to complete predefined tasks that result in a specific, expected outcome. From an ANT organization routine perspective, traditional ES lessons address well-defined, isolated performative aspects of the ES user interface as an IT application but not as a dynamic situated business activity. Namely, it does not directly convey underlying business process aspects (Feldman and Pentland 2003) of situated ES use (i.e. organizational routines) nor provide dynamic and novel variations that reveal ostensive aspects of business processes (i.e. organizational routines). In short, traditional education's focus on *performative* aspects of the ES user interface does not reveal the underlying complexity or interdependencies present in ES-enabled organization routines (aka business processes). This traditional approach does not address business context, important knowledge at a higher level of the ES knowledge hierarchy (Sein et al. 1999; Kang and Santhanam 2003). In contrast, constructivist education using an ES business simulation immerses the user in a realistic and dynamic business environment where users gain ES experience in an integrated enterprise business context.

Simulation-based ES education is a situated learning experience within a well-defined 'best practice' business process context (Léger 2006). In this realistic environment, business processes are presented as the underlying pattern guiding ES interactions. The user determines the details of each ES interaction based on goal-oriented business strategies situated in a realistic business context. Situated experiences in novel, dynamic conditions provide a realistic business context whereby rehearsals under varying conditions develop into stabilized organizational routines over time (Pentland and Feldman 2005). Financial results reported by the simulation provide important feedback on progress towards achieving business goals. The formed patterns of ES use go beyond knowledge of the performative aspects of the ES application itself to encompass both performative and ostensive aspects of ES-enabled business processes. From ES practice using the simulation, the user gains a better understanding of prototypical 'best practice' organizational routines. Patterns of interaction with the ES stabilize from experience to form knowledge of emergent organizational routines (Feldman and Pentland 2003; Pentland and Feldman 2005).

In addition to ANT, ACT learning theory also supports the benefits of simulation-based constructivist education for developing BPK. Per the ACT theory, proceduralization occurs through novel and dynamic experiences which allow refinement of procedures tuned more precisely to the variety of situations encountered. Simulation-based situated ES use provides variation and novel ES usage experiences that support 1) practice with the ES in a realistic business context, 2) discovering the procedural aspects of business processes and 3) developing tacit knowledge (ostensive aspects) of the business processes. Ostensive knowledge of ES within a business context includes the tacit knowledge of organization routines, goals and available operational alternatives (Pentland and Feldman 2005). Per ACT theory, refined procedures addressing more variations of business activities will allow the individual to perform more successfully in a wider range of situations and to respond more effectively when new situations are encountered.

In summary, simulation-based education provides a more realistic context for ES use. With the opportunity to enact dynamic routines with sufficient business context and variation, users can develop new organizational routines that can eventually stabilize into effective patterns of usage (Pentland and Feldman 2005). Per ANT, such experiences support acquisition of both the performative and ostensive aspects of business processes during negotiation of organizational routines between user and ES. Negotiating business processes during the simulation is analogous to ACT theories notion of refining proceduralizations of ES interactions in support of performing ES business processes. These knowledge refinements allow the individual to develop more complete BPK along with knowledge of ES interface usage. In contrast, training in the static context of traditional ES education lacks exposure to dynamic business situation and result in less knowledge of underlying business processes. For these reasons, it is anticipated that simulation education will provide greater BPK than is provided by traditional education.

H1a: Compared with traditional learning methods, simulation-based learning has a greater positive influence on the business process knowledge.

As in other educational treatments, the instructor's management of the educational experience has a strong influence on how a learning method is delivered. To account for variations in the execution of the treatments, a variant similar to hypothesis H1a is formulated below. This hypothesis is formulated to capture how well the instructional method achieves the intention implementing a constructivist, experiential educational experience and how well the traditional education is presented as an objectivist educational experience. In this hypothesis, categorizing the treatment as simulation or traditional is replaced with a broader learning categorization based on the degree of experiential, constructivist learning.

> *H1a': Compared with traditional learning methods, constructivist learning has a greater positive influence on the business process knowledge.*

Individuals with more accounting and financial expertise are educated about the economic impacts of business activities and are likely less mindful of the non-financial processes making up day to day business operations. These individuals should have the most to gain from simulation-based constructivist education learning whereby they perform operational tasks and directly observe production results. During ES simulation-based education, individuals execute operational transactions within a dynamic marketplace and directly observe the corresponding economic results. Existing accounting and financial knowledge provides a knowledge framework which is extended as business processes are experienced. Gaining experience through ES practice towards economic goals conveys the ostensive aspects of ES use (i.e. a tacit knowledge of business processes**).** Dynamic ES interaction reveals underlying business processes by providing the operational knowledge built on and existing accounting and financial existing knowledge base to form more complete BPK. Therefore, it is expected individuals whose main expertise is in accounting and financial areas will achieve higher BPK from simulation education rather than from traditional hands-on education.

> *H1b: When compared with traditional learning methods, simulation-based learning methods have a greater positive influence on business process knowledge for individuals with accounting and finance expertise.*

While change management often addresses IT-related knowledge requirements, there is also a need to address emotional and adaptive reactions to IT such as stress and coping strategies (Wastell 1999; Beaudry and Pinsonneault 2005; Beaudry and Pinsonneault 2010). Affective reactions are often unconscious and reflexive and can occur without identifying the source of the reaction (Kappas 2006). Potential sources of stress reactions to ES are a) simultaneous demands for learning multiple types of ES knowledge, b) the panoptic nature of ES monitoring, c) rigid enforcement of business processes (both ES interface information demands and business process steps) and d) irreversibility, the inability to delete or abandon problematic ES transactions. Each of these four issues is described in greater detail as follows. **(a) Demand for multiple types of knowledge:** While the ES application is often the most visible evidence of organizational change, business process change is also an important underlying source of job change. As new business processes are introduced through the implementation of an ES, individuals face major demands to simultaneously learn new business processes along with gaining ES application usage knowledge (Boudreau and Robey 2005). Stress occurs when excessive job change and concurrent knowledge demands overwhelm the user. Stress is increased when underlying processes are not understood or visible, but are strictly enforced by the ES. Without BPK, reactions to stress are more negative because the individual lacks the business context for performing ES-related tasks and for reasoning through ES-related problems (Beaudry and Pinsonneault 2005). **(b) Panoptic Monitoring**: User's actions and mistakes are widely visible to management and peers through the panoptic control of the ES system (Elmes et al. 2005) wherein information is centralized and accessible by management and peers. The ES enables unprecedented monitoring of user actions and performance effectiveness which can be perceived as stressful and threatening. **(c) Rigid procedures**: Per ANT theory, The ES acts as a *delegate*, defined as actors who substitute or 'speak on behalf' of particular viewpoints that have been inscribed in them (Walsham et al. 1997). Inscription can be so complete and concrete that routines essentially become frozen. When the ES is inscribed with management's exacting informational requirements and the strict sequencing of business transaction steps, the ES essentially enforces a prescribed and non-negotiable business process (Orlikowski and Gash 1992; Ignatiadis and Nandhakumar 2009). The ES's lack of interface flexibility and its demands to adherence to new process steps can be seen as a source of perceived threat. **(d) Irreversibility**: An ES is a network actant which has the properties of irreversibility. ANT recognizes an attribute of *irreversibility* which is the degree to which it becomes impossible to go back to a prior point where alternative possibilities exist and can be explored (Walsham et al. 1997). Prior to ES implementation, the user had greater discretion and flexibility in executing their role.

Afterwards, the ES enforces strict adherence to informational requirements and the detailed task sequences. A source of threat is the fact that, once initiated, an ES transaction must be correctly completed or risk being left in a problematic (or abandoned) status. The ES retains a detailed documentation trail including incomplete, incorrect or abandoned transactions – all now observable to users across the ES, and considered unacceptable from a management control perspective. In sum, the ES instantiates business rules and management controls which restrict job functions and enforce ES user interactions. BPK, an understanding of the stabilized routines for using the rigid ES, is important to successfully handle routine and atypical transactions, cancel erroneous transactions and solve business transaction problems. Without BPK, the inability to handle transaction information demands, correct errors or reverse erroneous ES transactions can be a source of negative stress reactions and promote negative coping behaviors.

In the transactional model of stress and coping, Lazarus (1995) emphasizes that the subjective appraisal of stress is critical to performance outcomes. The perception of stress is very important because choices of coping strategies are based on both the perception of threat or challenge/opportunity (Tomaka et al. 1997; Drach-Zahavy and Erez 2002; Beaudry and Pinsonneault 2005). Opportunity is perceived when there is a chance for self-growth with available abilities, resources and coping strategies, whereas threat is experienced when the situation is perceived as overtaxing one's current abilities and resources and would likely lead to failure (Tomaka et al. 1997; Drach-Zahavy and Erez 2002). In *primary cognitive appraisal,* the user evaluates what they have at stake in the encounter with new IT from two aspects, the evaluation of opportunity and of threat (Folkman et al. 1986a; Folkman et al. 1986b; Major et al. 1998). BPK is procedural business knowledge that supports more effective ES usage towards enterprise goals. Having a high degree of BPK indicates that the user understands performative and ostensive aspects of business processes. BPK confers a sense of efficacy in performing operational tasks because it provides an understanding of the required process steps and interdependencies enforced by the ES. BPK knowledge helps to successfully complete ES transactions, correct errors, identify alternatives and solve problems when interfacing the ES. The individual with low BPK lacks process knowledge and strategies to recover when the rigid ES actant blocks the individual's progress (e.g. due to missing information or lack of ES knowledge). Without BPK, the individual's problem solving abilities are hampered and they are more likely to assess the ES as a threat. Therefore, it is anticipated that BPK will negatively influence cognitive appraisals of the ES as a threat and that BPK will positively influence cognitive appraisals of the ES to be a challenge.

In summary, BPK supports the user's ability to function effectively in the ES-enabled business environment and to respond productively to perceptions of stress. Users experience stress reactions to the ES due to a) demands for multiple knowledge types, b) panoptic monitoring c) rigid procedures, and d) irreversibility. Heightened job pressures can be mitigated with high BPK Alternatively, with higher BPK, the individual can foresee opportunities for informed decision making, improved job performance and broader business impact. Without high BPK, the user feels threatened because they cannot function effectively through the ES in handling typical and atypical business situations. Overall, individuals with higher BPK understand business context and how to apply ES to increase their value within it. As such, they should see the ES as an opportunity and not a threat.

> *H2a: Business process knowledge (BPK) has a positive influence on primary cognitive appraisal of opportunity.*

> *H2b: Business process knowledge (BPK) has a negative influence on primary cognitive appraisal of threat.*

A user's *secondary cognitive appraisal* is an evaluation of what resources, options or abilities they possess or can obtain to prevent harm, overcome barriers or to improve the possibilities for benefits (Folkman et al. 1986a; Folkman et al. 1986b; Major et al. 1998). BPK provides a conceptual business framework in which to perform ES-related job functions. Conceptual models are important for enduring and well-informed IT knowledge and they facilitate knowledge transfer tasks (Sein and Bostrom 1989). In other words, BPK provides critical ostensive (tacit) knowledge of the ES application's business environment. With the conceptual model of business operations provided by high BPK, the user is more confident about making good decisions regarding occasions and extent of ES use. Knowledge of ES best practices instills in users the belief that they can exert control over the ES, enabling more effective adaptation to using the ES. Conceptual BPK helps the user understand the broader impacts of ES use and to become a more innovative problem solver, seeing possibilities beyond the routine prescribed use of the ES.

This broader business context knowledge imparts an understanding of task interdependencies that enable more control over the ES. For example, understanding how processes enforce and use customer credit information could enable the user to execute sales order transactions in the face of credit restrictions. If a sales order transaction is rejected, BPK helps the user identify possible causes and alternatives for action (e.g. request a pre-paid order, requesting a customer credit line increase, or get approval for one-time exception). Perceptions of control are afforded by knowing the business rules and underlying organizational routines which are part of business process knowledge. BPK enables the user to leverage ES capabilities and supports problem solving by providing the business context needed to investigate errors, inconsistencies or other operations dependencies. Because a greater understanding of business processes enables the user to exert more self-reliance in using the ES, business process knowledge positively influences secondary cognitive appraisal of perceived controllability. In sum, because business process knowledge enables problem solving, innovative approaches to business problems, and supports continued ES knowledge growth, BPK positively influences secondary cognitive appraisal of perceived controllability.

H2c: Business process knowledge has a positive influence on secondary cognitive appraisal of perceived controllability.

The study of job satisfaction has a rich tradition in organizational behavior literature because of its relationship with key personnel variables including job performance (Judge et al. 2001), job commitment (Riketta 2008) and job turnover (Joseph et al. 2007). In IT literature, Joseph (2007) points out key gaps in organizational behavior and turnover research, calling for use a better understand how IT professionals respond to job factors that trigger turnover, such as the impact on IT workers when an enterprise system is introduced. The deployment of an ES is coupled with many other changes such as reengineered business processes and changes to job task definitions (Boudreau and Robey 1996; Morris and Venkatesh 2010). These concurrent changes often redefine job roles and enforce new regimented business processes through use of the ES. The ES environment has a strong influence on job characteristics (Morris and Venkatesh 2010) which are the major predictors of job satisfaction (Hackman and Oldham 1976; Loher et al. 1985; Humphrey et al. 2007). The Job Characteristics Model (Hackman and Oldham 1976) identified five job factors which influence job satisfaction. Recently, Morris and Venkatesh (2010) found that the ES environment moderated the influence of three job characteristics (autonomy, feedback and skill variety) on job satisfaction. In the ES environment, these three moderated job characteristics were found to negatively influence job satisfaction instead of having the positive relationship consistently found in prior studies. These three job characteristics (task identity, autonomy and feedback) operate significantly differently in an ES business context. Here, BPK is expected to mitigate the negative influence of these characteristics on ES-related job satisfaction.

Task Identity: From an ANT perspective, with ES enabled change, the ES encodes business process requirements and operates as a delegate of management that has irreversible, inscribed expectations. The individual human actor must now interact with a demanding and inflexible non-human actor (the ES) which is heavily inscribed with business process requirements, rather than with adaptable and collaborative human actors as in the past. Interdependencies have changed, are less visible and there is less flexibility in completing job tasks. *Task identity* is the degree to which the job requires completing a full and identifiable piece of work from beginning to end with visible results (Hackman and Oldham 1976). The ES accompanies changes to job roles and the individual’s sense of making an identifiable, complete and meaningful work contribution is reduced. Directly making incremental and impactful process improvements is no longer possible. However high BPK allows the individual to see how their role contributes to the overall business process and to company goals. Furthermore, the ES provides new opportunities for increased individual decision making, a broader and more impactful form of individual contribution. These opportunities would only be evident with increased BPK, i.e. with the growth of *ostensive* and *performative* knowledge of the new business processes. Thus, BPK can enhance task identity, which is a job characteristic that positively influences job satisfaction (Loher et al. 1985). While the ES brings a reduction of task flexibility and an increase in task monitoring and control, this can be mitigated by high BPK whereby the individual sees their contribution to the overall business process and new opportunities for decision making. Therefore, higher BPK should improve job satisfaction over and above the impacts of the ES itself on job satisfaction.

Autonomy: Autonomy is “the degree to which the job provides substantial freedom, independence, and discretion to the individual in scheduling the work and in determining the procedures to be used.” (Hackman and Oldham 1976`, p. 258). Of the five job characteristics, autonomy has been found to have the greatest positive influence on job satisfaction (Loher et al. 1985). An ES can have differing impacts on various aspects of autonomy. Three distinct dimensions of autonomy have been identified as a) work methods autonomy, b) work scheduling autonomy, and c) decision making autonomy, with the later having the greatest impact on job satisfaction (Humphrey et al. 2007). Work method autonomy is defined as the freedom to control what methods and procedures are used, work scheduling autonomy is freedom to control the timing of work and decision making autonomy is defined as the freedom to make decisions at work (Humphrey et al. 2007). While an ES restricts an individual's freedom to determine work methods and scheduling, it also provides access to timelier, centralized operational and financial information. Direct access to a broad range of real-time information is expected to move more decision making to the individual worker level. BPK is essential to using ES information reporting and decision support capabilities. With BPK, individual decision making increases by utilizing company-wide data to make informed decisions benefiting one's own job tasks. With BPK, the individual has a greater understanding of process dependencies, interactions, variations and improvement alternatives. For example, knowing the process dependencies for production planning, one can access raw materials orders, lead times and shipment arrivals through the ES, enabling real time adjustments to keep production flowing smoothly and efficiently. Using the ES to make well-informed decisions should increase feelings of decision making autonomy, even in cases where work method and work scheduling autonomy may have been reduced by the ES. All things being equal, greater BPK leads to higher decision making autonomy, an important facet of autonomy. This supports the hypothesis that individuals with higher business process knowledge should have higher feelings of autonomy resulting in greater job satisfaction. While Morris and Venkatesh (2010) found that autonomy had an inverse relationship with job satisfaction in the ES environment, they did not decompose nor investigate the three types of autonomy. In an ES environment, BPK and other higher level business knowledge is needed in addition to ES application skills (Kang and Santhanam 2003). Given their findings that facets of autonomy respond differently in an ES environment, greater BPK should have a positive influence on decision making autonomy resulting in higher job satisfaction than for those with lesser BPK. Autonomy and ES likely have a complex relationship that requires looking at the individual's hierarchy of ES knowledge along with the three types of autonomy. Further study in this area is needed.

Feedback: Per the job characteristics model of work motivation (Hackman and Oldham 1976), feedback is the extent to which the job imparts information about the individual's job performance. Feedback is an important antecedent to job satisfaction (Loher et al. 1985). The ES supports extensive information collection and reporting, but accessing and interpreting ES feedback requires both ES and business context knowledge. Job tasks are tightly inter-connected across the business process so a key measure of effectiveness is how a task contributes to downstream business process success. BPK along with ES skills will allow the user to proactively seek feedback to see their contribution to business success. The ES also tracks real time impacts to financial measures. The knowledgeable user who understands business process impacts and can track financial measures will be able to gather their own valuable job feedback.

The three job characteristics discussed above have negative impacts on job satisfaction in an ES environment (Morris and Venkatesh 2010). However, the presence of high BPK can mitigate negative impacts of ES context and also offers the benefits of revealing task identity imbedded within integrated business processes, opportunities for greater decision making autonomy, and a direct means to proactively garner job feedback.

H3: Business process knowledge has a positive influence on enterprise systems job satisfaction.

The introduction of an ES is a major change to the work environment which can bring on stress and coping reactions. Assessing job impacts like this initiates a mental projection of the degree of change in job role and the future outcomes of using the ES in a work situation. An ES requires a wide range of knowledge including application interface skills, changes to business processes, new task interdependencies, and collaborative problem solving skills (Kang and Santhanam 2003). This cognitive appraisal of job impacts in turn influences an individual's expected job satisfaction. When individuals expect new opportunities by using the ES to complete job tasks, then primary cognitive appraisal is high and the expectation of positive outcomes is also high.

The type of stress perceived during cognitive appraisal influences outcomes such that appraisals of threat often lead to failure (Tomaka et al. 1997; Drach-Zahavy and Erez 2002). For example, threat appraisals of IT events lead to non-productive emotion-focused coping strategies such as self-preservation, disturbance-handling or avoidance, rather than the productive problem-oriented coping strategies of benefits-maximizing or exploration-to-innovate or exploitation (Beaudry and Pinsonneault 2005; Bala 2008). Non-productive, emotion-focused coping based on a lack of important ES knowledge, such as BPK, can cause avoidance and expend energy addressing emotional responses to the ES. Therefore, projection of increased threat should have negative impact on job satisfaction. Therefore, primary cognitive appraisals assessing increased opportunity and low threat of the technology should positively impact job satisfaction.

H4a: Primary cognitive appraisal of opportunity positively influences ES job satisfaction.

H4b: Primary cognitive appraisal of threat negatively influences ES job satisfaction.

Secondary cognitive appraisal is an evaluation of the resources, options or abilities an individual possesses or can obtain to prevent harm, overcome barriers or to improve the possibilities for benefits (Folkman et al. 1986a; Folkman et al. 1986b; Major et al. 1998). Perceptions of control are needed to achieve possible benefits or to overcome barriers presented, so high secondary appraisal of control is a recognition of having the mechanisms and abilities to maximize the potential presented in various situations. In this way, perceptions of control influence satisfaction and overall well-being by contributing to the mastery needed to achieve benefits (Folkman et al. 1986a). When a individual feels out of control of a situation, this leads to energy spend on emotion-focused coping (Lazarus 1993), greater passivity, helpless and can even lead to depression (Folkman et al. 1986b). So, low perceptions of control over the ES would increase emotion-focused reactions, diminish job-related problem-focused activities, lead to passivity on the job and avoidance of the ES which lowers satisfaction and overall well-being. The secondary cognitive appraisal of perceived controllability is essential to feeling competent to use the ES to complete job tasks, which in turn positively influences ES job satisfaction.

H4c: Secondary cognitive appraisal of perceived control positively influences ES job satisfaction.

Stress and coping literature has identified cognitive appraisal as one of the basic processes mediating the relationship between stressful person-environment relationships and their short-term or long-term outcomes (Folkman et al., 1986a, 1986b). Mediation of BPK's influence on job satisfaction is expected to operate through cognitive appraisal. An accurate understanding of business processes is important to completing job tasks and contributes to feelings of role competency and job satisfaction. Job satisfaction is a summary assessment of current and future expectations of happiness with one's job situation (Spector 1997; Judge et al. 2001). Introduction of an ERP is a disruption to the job situation and can have sizable impact on an individual's job role and needed job skills. The stress and coping literature has established the value of cognitive appraisals of projected benefits (primary cognitive appraisal of opportunity), projected risks or negative consequences (primary cognitive appraisal of threat) in assessing stressful situations (Folkman et al. 1986a; Folkman et al. 1986b; Lazarus and Folkman 1987). Accurate business process knowledge is an important contributor to successfully utilizing the ES for effective job performance (Sein et al. 1999). When primary cognitive appraisal assesses the ES as high opportunity and low threat, then the ES is seen as providing job prospects and enrichment. Job enrichment can improve both employee performance and satisfaction by building greater scope for personal achievement and recognition on the job. This is particularly true for individuals with high 'growth needs strength' (Loher et al. 1985). A secondary level of cognitive appraisal is perceived control which is the projected expectation of having or gaining the ability to manage and operate effectively in a situation or use a technology (Major et al. 1998). Literature has long established that a high degree of perceived control is associated with high levels of job satisfaction and low levels of role stress (Spector 1986). Given that business process knowledge contributes to the different aspects of cognitive appraisal, these appraisals will shape the individual's assessment of overall job satisfaction.

Several studies by Tomaka et al. (1997) support the importance of cognitive appraisal processes in capturing threat and challenge (opportunity) responses to potentially stressful situations. These cognitive appraisal assessments then contribute significantly to an overall assessment of job satisfaction. In the enterprise systems context, there is support for perceived fit fully operating through attitude to influence ES symbolic adoption (Nah et al. 2004). In this study, cognitive appraisals are essentially perceptions of fit between the ES and the individual's job role which then influence the attitude towards the job, conceptualized here as job satisfaction. In summary, it is expected that business process knowledge will influence all three forms of cognitive appraisal (opportunity, threat and control) which act as mediators in carrying this influence through to influence ES job satisfaction. As such, BPK influence on job satisfaction should be fully mediated by cognitive appraisal, leading to the following hypotheses.

H5a: The influence of business process knowledge (BPK) on ES job satisfaction is mediated by primary cognitive appraisal of opportunity.

H5b: The influence of business process knowledge (BPK) on ES job satisfaction is mediated by primary cognitive appraisal of threat.

H5c: The influence of business process knowledge (BPK) on ES job satisfaction is mediated by secondary cognitive appraisal of perceived controllability.

H5d: The influence of business process knowledge (BPK) on ES job satisfaction is fully mediated by cognitive appraisal (opportunity, threat, and perceived controllability).

Methodology

The SAP enterprise system technology was selected for this study because SAP is the leading commercial ERP system covering a third of the ERP market for large enterprises (Jacobson et al. 2007). SAP is a collaborative workflow application that supports a variety of corporate business activities, providing a vast array of business transactions and best practice-based business processes. Learning to use SAP is a challenge due to its rich feature set, unfamiliar user interface, introduction of changes to underlying business processes and enforcement of cross-functional interdependencies and internal controls.

Learning Model Treatments

In both the traditional and simulation treatment conditions, participants interface directly with SAP the enterprise system, executing standard SAP transactions to complete common business operations. The SAP system and education materials were available through the SAP University Alliances program[1]. Traditional IT learning methods typically include lectures and hands-on ES lessons covering ES user interface and procedural knowledge in a static environment. The traditional ES educational treatment

[1] Information about the SAP University Alliances program is available at https://www.sdn.sap.com/irj/scn/uac.

utilizes SAP Business Process Integration (BPI) lessons. The simulation environment consists of a functional SAP[2] system and the ERPsim, the ERP business simulation[3] developed by HEC Montreal (Léger 2006). The ERP simulation lessons include introductory instructions, a simulation participant manual[4] and hands-on interaction with a dynamic, real-time simulated marketplace. The ES simulation learning method provides experiential learning through goal-oriented activities in a dynamic business environment. The role of the simulation system is to emulate a realistic business marketplace of suppliers and customers external to the hypothetical cereal manufacturing firms. Teams of approximately four learners operate a cereal production company in a made-to-stock manufacturing supply chain requiring them to interact with suppliers and customers to complete the cash-to-cash cycle. Participants operate within production constraints to implement operational business decisions using the commercial SAP system. The business goal is to maximize company revenues and return on investment (ROI) while maintaining a high credit rating. The educational objectives are to maximize knowledge acquisition across the ES knowledge hierarchy. The simulation compresses three months of business operations into about an hour, offering repeated opportunities for decision-making and problem-solving. Outcome feedback is provided hourly through end-of-quarter financial results.

---

[2] Information about the commercial SAP enterprise resource planning system can be found at http://www.sap.com.
[3] The simulation environment (ERPsim) system was made available for use in this research by Baton Simulations, http://batonsimulations.com/
[4] Information about ERPsim learning materials is available at http://erpsim.hec.ca/.

Business Process Knowledge Instrument

The importance of developing internal conceptual models (i.e. knowledge structures) is well accepted (Anderson 1982; Bostrom et al. 1990; Frederick 1991; Frederick et al. 1994). Accurate knowledge structures withstand the passage of time, facilitate far-transfer tasks and result in superior task performance (Karuppan and Karuppan 2008). Evidence shows that the learners with incorrect conceptual models, aka weak methods problems, (Anderson 1987) are unable to perform effectively in tasks such as accounting IS database design (Gerard 2005). Network structural models, such as the Pathfinder technique employed here, have been used extensively to assess knowledge structures in many areas of cognitive science, education and computing (Dearholt and Schvaneveldt 1990). Many researchers consider Pathfinder analysis to be the most effective method for assessing knowledge structures (Schvaneveldt 1990; Karuppan and Karuppan 2008). Knowledge structures are very useful in assessing tacit and procedural knowledge (Goldsmith and Johnson 1990) such as knowledge of dynamic relationships. Network models of IS system designs have been show useful in assessing user's knowledge structure about an IT application (Kellogg and Breen 1990). Here, BPK has been conceptualized (Sein et al. 1999) and identified empirically as a business context knowledge (Kang and Santhanam 2003) or 'know-why' ES knowledge (Santhanam et al. 2007). Rather than relying on self-reported knowledge, use of knowledge structure measurement and analysis offers an objective assessment of both tacit and declarative knowledge. Such analysis determines *similarity* or *accuracy* of knowledge in comparison to an expert's referent knowledge structure.

For assessment by survey methods, no existing operationalization of a BPK instrument was found, so an ES BPK survey design was undertaken. The following steps were done to develop BP knowledge structure measures for relatedness as required for a Pathfinder network knowledge assessment. First, the key concepts of the BPK domain were identified to serve as nodes in the Pathfinder network knowledge structure. ES business process concepts were identified by reviewing traditional and simulation education materials focusing on likely differences in understanding between novices and experts. Novices tend to focus on surface features (such as the user interface) while experts understand deep structure and hidden relations (such as master data, configuration and cross-functional dependencies) concepts (Haerem and Rau 2007). The intention was to ensure coverage of both obvious and hidden ES business process relationships. These BPK concepts were further refined in interviews with course instructors and ES experts. For practical reasons of survey instrument size, a full business process model is not feasible means of determining knowledge organization. Instead, a subset of BPK concepts were selected, emphasizing three major business processes (procurement, production and sales) used in many ES educational lessons. The goal was to achieve sufficient variation across instrument responses, an essential characteristic for good measurement. Additional ES instructors were interviewed to confirm the BP concepts, categorize them and reduce the relatedness scale to manageable survey size. Next, 20 students completed the revised instrument, 10 of whom were also interviewed regarding the instrument and their responses. Based on interview feedback, the survey instructions and relatedness question format were redesigned for greater understandability. The interviews and survey pre-tests identified a scale suppression effect, so concept selection was slightly adjusted.

Knowledge structure assessment uses relatedness comparisons of all possible pairs of concepts within the knowledge domain. For ‘n’ concepts, this requires (n*(n-1))/2 survey items per knowledge structure. This study used nine BPK concepts (Appendix A, table 1) requiring 36 pairwise relatedness questions in the survey. The measurement scale for concept relatedness data is collected using a 7-point Likert scale from 1 = “Not all related” to 7=”Very highly related”. The full knowledge structure survey instrument is contained in Appendix A, table 3. Each individual’s concept relatedness responses are then analyzed by Pathfinder network analysis to determine the knowledge network graph and a ‘coherence’ metric reflecting the consistency of knowledge organization. See appendix B for a discussion of the Pathfinder network analysis methods. Each individual’s knowledge structure is then compared against that of an expert referent. This comparison determines knowledge structure accuracy by a single ‘index of similarity’ metric. The expert referent for business process knowledge structures is a composite of several ES experts’ and instructors’ BPK knowledge structures obtained using the same BPKS instrument. The formation of the BPK expert referent structure is detailed in Appendix C.

Other Measurement Scales

Scales for other latent variables utilized previously published and validated scales which were measured using a 7-point Likert scale from 1=’Strongly Disagree’ to 7= ‘Strongly Agree’. Two independent variables measured the learning model – a single item, binary variable representing whether the participant experienced a traditional or simulation-based education model (Trad0_Sim1), and a four item scale measuring the degree to which the intervention displayed constructivist characteristics of being experiential, discovery-based education. The constructivist scale is a parsimonious reduction of a prior constructivist learning scale as validated in multimedia online contexts by Wen et al. (2004) and Maor and Fraser (2005). Binary dummy variables were used to indicate the combined effects of accounting and finance expertise with each of the two treatments (Acct_Trad and Acct_Sim). The three forms of cognitive appraisal (opportunity, appraisal and control) were assessed using measurement scales from Bala (2008) as adapted from Major et al. (1998) with opportunity measures additionally adapted from Drach-Zhavy and Erez (2002). ES-related job satisfaction relied on accepted scales for job satisfaction about the work itself from Spector (1985) augmented by a few items from Tsui et al. (1992).

Two control variables were used to ascertain prior self-reported business process knowledge and perceptions of the length of the training intervention. The business process knowledge scales was from Cronan et al. (2011) as adapted from Seethamraju (2007). A single item measure determined if the training intervention was too long. Appendix A (tables 2, 3 and 4) contains the Likert survey measurement items based on pre-existing measurement scales.

Results

Participants in this study were graduate and undergraduate students participating in the traditional or simulation-based education in an ERP course at several large North

American universities with membership in the SAP University Alliance. Data collection took place in two semesters, the fall of 2009 and spring of 2010. Pre and post treatment survey responses (including the full BPK set of KS relatedness items) were obtained from 170 participants. A usable sample size of N=151 remained after dropping incomplete and invariant responses. In most instances, invariant response sets were recognizable based on Pathfinder network analysis of the relatedness measures for BPK because a threshold of relatedness variation must be exceeded in order to be able to assess a network graph. In Pathfinder analysis, invariant responses for BPK resulted in a very low, a negative or a non-computable coherence metric (when the same relatedness response was given for all but four or fewer responses out of the 36 pairwise comparisons). The Cook's D measure of global influence was used to identify possible outliers. All Cook's D values were below 0.2 which is well below the outlier critical value of Cook's D > 1.0 (Cohen et al. 2003`, p. 404). Of the usable responses, 46% experienced the traditional education treatment while 54% experienced the simulation treatment. The average participant age was 24 years old (standard deviation of 6.441) with ages ranging from 17 to 53 years of age. Participants consisted of 61% women and 39% men with a mean of 3.168 years (standard deviation 5.506) of full time work experience and 3.658 years (standard deviation 2.945) of part time work experience. 19% of participants have accounting or financial expertise. Descriptive statistics are presented in table 1.

The dataset was checked to verify the standard assumptions required for linear regression methods. The assumptions for linearity, normally distributed error terms and homoscedasticity were verified using data plots and normal distribution graphs. Data independence is a concern when data has a natural time sequence characteristic so the Durbin-Watson statistic was used to verify that successive residuals are not correlated. The Durbin-Watson statistic typically was over 2.0 with the lowest value being 1.805 for the H2b: threat variable regression which exceeds the D_U =1.76 requirement (Montgomery et al. 2001). All Durbin-Watson statistical values exceed the D_U upper critical value required to accept the null hypothesis that error terms are not autocorrelated.

Factor analysis determines if measurement items loaded on the appropriate latent variables. Factor analysis identified six factors using the principal component analysis (PCA) extraction using the Varimax rotation method with Kaiser Normalization (table 2). For retained items, the factor loadings were greater than .70 for most constructs (all were greater than .60 as used in exploratory factor analysis) with most cross-loadings being lower than 0.3 (except for cross-loadings between job satisfaction and cognitive appraisal of opportunity and control). Two items for the *opportunity* latent variable were slightly below the 0.70 level (at 0.693 and 0.692) but only one was dropped so as to still capture the breadth of the construct. With the remaining three items, a high Cronbach alpha of .949 was attained (See ICR in table 3). One item for *control* has a loading of 0.643. This item was the most strongly worded of the four items for control, stating "I am confident that I will be able to use the system *without any problems*" (emphasis added). The rigorous criteria of 'without any problems' is likely to have skewed responses as the other items were more moderately worded. Therefore, this item was retained to preserve the full scope and nature of the latent factor and with all four items a Cronbach alpha of

0.843 was achieved for the *control* variable (See ICR in table 3). To address the concern that some variables display some multicolinearity, variance inflation factors (VIF) were checked. Traditionally, VIF's below 10 were considered evidence of acceptable minimal multicolinearity. However, Cohen et al. (2003`, p. 424) advises use of much stricter criteria. Here, all VIFs were below 2.0, well below an acceptable threshold.

Note that the constructivist variable was given special consideration. To ensure it could discriminate across a wider range of educational methods, the factor loadings for the *constructivist* latent variable were analyzed across the two datasets for essay 1 and essay 2. The nature and purpose of this variable is to distinguish a key underlying characteristic that differentiates various educational approaches. It was important to consider this factor across as many educational treatments as available and essay 2 provides three additional ES educational approaches (beyond the two methods in this essay 1 study) on which to validate it. One item for the *constructivist* latent variable had a low loading of only 0.552 for this essay's BPK dataset, but loaded much higher in additional factor analyses done for essay 2 dataset (see table 2 in essay 2), as well as having a acceptable factor loadings for a dataset combining essay 1 and essay 2 responses. Therefore, all four *constructivist* items were retained in order to retain the broader characteristics of the latent construct and use a broader svalidate it. With all four items, the constructivist latent variable achieves a Cronbach Alpha of 0.787. For the dependent variable of *job satisfaction*, one item was dropped due to a very low loading of 0.520 and second item was dropped due to high cross-loadings, resulting in a four item measure with a high Cronbach Alpha of 0.950.

In summary, all constructs had strong reliabilities displaying internal consistency reliabilities (ICRs) greater than .70 for all constructs (table 3). Most variables have a Cronbach Alpha greater than 0.90 except for the *control* and *constructivist* variables with Cronbach Alphas of 0.843 and 0.787, respectively (ICR column in table 3). Construct validity and reliability were assessed using guidelines by Fornell and Larcker (1981) and Nunnally (1978). The square roots of the average variance extracted (AVE in table 3), i.e. the variance shared between the constructs and their measures, were higher than the correlations among constructs, supporting convergent and discriminant validity (Fornell and Larcker 1981).

BPK Similarity Measurement and Results

The special nature of the BPK similarity variable requires some discussion because the 36 relatedness survey items must be reduced to a single BPK accuracy variable for use in linear regression analysis. The relatedness measures represent a network graph of the organization of conceptual knowledge and these measures are pre-processed using Pathfinder network graph analysis. This pre-processing provides two individual measures of the individual's knowledge structure, namely its *accuracy* and internal *consistency*. C*oherence* is the statistic provided by Pathfinder network analysis to indicate the consistency of the individual's relatedness data (Interlink 2007). *Similarity* represented by Pathfinder's similarity or closeness metric) indicates the accuracy of the participant's BPK as determined by comparison to an expert referent's knowledge structure. Special Pathfinder analysis steps were taken to establish an expert referent BPK knowledge structure as the basis on which to evaluate the accuracy of participant's

BPKS. Appendix C contains the method and results for establishing the expert referent BPK knowledge structure used in this study. Then, the BPK similarity measure represents the BPK latent factor in linear regression tests of the research model.

Linear Regression Results

The hypotheses in the research model (figure 2) were tested with a series of linear regression analyses using PASW/SPSS Version 17 (results in table 4). First, the influence of specific types of ES educational treatments on the development of a BPK was tested in H1a and H1' in the presence of two control variables of 'training not too long' and self-reported prior BPK. H1a was not supported as the binary indicator for use of traditional or simulation method alone did not predict BPK (with a beta coefficient of 0.055 at a non-significant p-value of .521). However, the *constructivist* variable was a significant predictor of BPK (with a beta coefficient of 0.191 at a significance level of .020) supporting hypothesis H1a'. Next, the moderation hypothesis H1b was tested to determine whether there was an interaction effect between accounting and financial expertise and the treatment condition. Following Cohen and Cohen's interaction analysis (2003), an interaction term (Account x Sim1) was calculated to represent moderation effects between accounting and finance expertise and the traditional/simulation treatment. As required, the moderation test included the main effects of each variable. Regression results showed the model was significant with a beta coefficient of 0.046 and R-square of 0.075, but both direct effects of the treatment and of accounting expertise were non-significant. Most importantly, the interaction term was non-significant with a beta coefficient of 0.171 with a p-value of 0.167. These findings do not support the moderation hypothesized in H1b (figure 3a). Consequently, the remaining regression tests were performed without the direct effects of accounting and financial expertise and without the interaction term. Results labeled H1c are included in the table to show regression results when the constructivist variable is included with the binary treatment variable. Subsequent regression texts also include the constructivist variable which is significant in the H1c model, having a p-value of 0.199.

In H2a, H2b, and H2c, BPK is hypothesized to influence the three forms of cognitive appraisal, namely opportunity, threat and control, respectively. H2a is supported by regression results finding that the influence of BPK on *opportunity* is highly significant having a beta coefficient of 0.311 with a p-value of 0.000 and a highly significant R^2 of 0.123 (column H2a in table 4). Also, H2b is supports the finding that BPK has a significant negative influence on the *threat* variable with a beta coefficient of -0.168 at a p-value of 0.029 and a highly significant R^2 of 0. 192 (column H2b in table 4). Hypothesis H2c is only marginally supported finding that the influence of BPK on the *control* variable has a beta coefficient of 0.150 with a marginal p-value of 0.059 and a highly significant R^2 of 0. 128 (column H2c in table 4).

Regression analysis finds support for H3 finding that BPK has a significant direct effect on job satisfaction. This finding along with H2a, H2b and H2c establishes some initial conditions for testing for cognitive appraisal as a possible mediator of the effects of BPK on job satisfaction. Next, the influence of the three forms of cognitive appraisal on job satisfaction must be established. Both the H4a and H4c hypotheses are supported with the cognitive appraisal of *opportunity* (with a beta coefficient of 0.539, p-value <

0.000) and *control* (with a beta coefficient of 0.324, p-value < 0.000) each having a significant positive effect on ES job satisfaction. But, the appraisal of *threat* (beta coefficient of -0.006, p-value of 0.929) is not significantly related to job satisfaction. The contribution of cognitive appraisal (opportunity and control) to variance in job satisfaction has a highly significant highly R^2 of 0. 582 (column H4 (a) in table 4). These relationships were additionally tested in the presence of other independent variables in the model in order to determine if the combined effects were consistent. These findings appear robust, as testing with all model variables continues to support significant relations for only two forms of cognitive appraisal (opportunity and control) as antecedents of job satisfaction (column H4 (d) in table 4). With full direct effects of all model variables, the results show little change as opportunity (beta coefficient of 0.486, p-value < 0.000) and control (beta coefficient of 0.304, p-value < 0.000) each maintain a significant positive effect on ES job satisfaction, while the appraisal of threat (beta coefficient of -0.014, significance level of 0.819) is non-significant in relation to job satisfaction. The full regression of direct results on job satisfaction has a highly significant highly R^2 of 0.597. The linear regression results described here are summarized in figure 3b.

Mediation Hypothesis Results

In H5 (a, b, c and d), effects of accurate business process knowledge are hypothesized to operate on job satisfaction through three forms of cognitive appraisal, namely, opportunity, threat and perceived control, both individually and collectively. Mediation testing followed guidelines established by Baron and Kenny (1986) which require establishing direct relationships before testing for mediation in the presence of all variables. To test for mediation, first, each cognitive appraisal variable is tested for significance as a single mediator (H5a, H5b and H5c). Subsequently, for H5d, the cognitive appraisal variables are tested together to determine if mediation holds in the presence of all three cognitive appraisal variables. The Sobel mediation test (Sobel 1990; MacKinnon et al. 2007) was also used to verify each mediation variable individually. The first mediation tests check each individual cognitive appraisal variable (H5a: opportunity, H5b: mediation by threat, and H5c: mediation by control) indicate highly significant support for mediation occurring individually through opportunity, but with only marginally significant Sobel test results for mediation individually through threat (calculated indirect effect of 0.520 with a p-value of 0.0515+) or through control (calculated indirect effect of 0.916 with a p-value of 0.0806+) (tables 5 and 7). Note that the Baron and Kenny mediation method (table 5) provides support for mediation through threat and marginal support for mediation by control (each control mediation sub-test was significant except that the initial relation between BPK and control was marginally significant with a beta coefficient of 0.145 with a p-value of 0.075). Based on this series of mediation tests, mediation does occur through opportunity with support for some degree of mediation also occurring via threat and control, at a marginally significant level given the current sample. This supports H5a, with marginal support for H5b and H5c (table 5a, 5b and 5c, respectively, individual Sobel tests in table 7). These results were promising enough to warrant the next step of testing H5d to determine if BPK was fully mediated through the set of three cognitive appraisal variables. There is partial support for the full hypothesis H5d, since there was no support for threat as a mediator when combined with the effects of opportunity and control, as the relationship between threat and job satisfaction is non-significant both with and without the presence of BPK (table 6a). In combination, opportunity and control are significant in fully mediating the effects of BPK on the outcome of job satisfaction (table 6b).

In summary, mediation tests support that opportunity is clearly an individual mediator between BPK and job satisfaction, as confirmed using Baron and Kenny's (1986) mediation analysis and the Sobel mediation test (Sobel 1990; MacKinnon et al. 2007) (table 7). Sobel test findings provide marginally significant support that threat and opportunity each individually act as a mediator (table 7). Based on the final Baron and Kenny mediation test (table 6b), jointly the opportunity and control variables fully mediate the effects of BPK on job satisfaction with an R^2 R-Square of 0.578 as the direct effects of BPK become insignificant in the presence of opportunity and control (with coefficients of 0.0553 and 0.334, respectively and both at a significance level of 0.000) (Table 6b, Figure 4).

Discussion

It is challenging to capture the essence of educational experiences. This study finds support for the continuous constructivist variable predicting BPK (H1a') but not for the binary simulation/traditional variable (H1a)**.** The continuous *constructivist* variable is able to capture different degrees of constructivism where the binary variable is only differentiating by category or overall approach. There is a relationship between these two independent variables, as the correlation of 0.190 between them is significant. This indicates that the simulation treatment is considered to be the more constructivist approach when compared with the traditional treatment. The non-significance of the simulation/traditional variable in the regression could indicate substantial variable in approach and execution when different instructors at different universities ran the simulation and traditional education sessions. Thus, a simulation/traditional treatment binary variable alone could not fully account for variability in BPK, where a continuous variable scale can capture broader variation in the degrees of constructivism. Educational experiences vary based on instructor influence, situational conditions and student perceptions, so each ES educational treatment studied may not always embody a fully constructivist or fully traditionalist learning approach.

The significant positive relationship of the constructivist variable with BPK indicates that an experiential approach does contribute to more accurate BPK. The correlation between just BPK and the traditional/simulation binary variable in isolation reveals a significant correlation (beta coefficient of 0.140 with p-value of 0.043), so it is likely that the presence of the constructivist variable in the model has taken on some variance it actually shares with the traditional/simulation variable (check partials). In summary, results indicate that the mere selection and use of a specific educational instrument is not a significant indicator of developing BPK. Given that H1a' was supported; the important attribute appears to be the degree of constructivist, experiential learning experience as a significant predictor variable for BPK. Additionally, there is some support to expect that simulation-based training (versus traditional education methods) is more likely to embody and enable a constructivist learning experience, but that the degree of constructivism is an essential ingredient to imparting accurate BPK.

H1b investigates possible moderation of BPK by an interaction between educational treatment and expertise, but the H1b moderation effect was not supported. Additional post hoc testing looked at possible contingency effects by group. A post hoc contingency test was performed on respondent expertise in subgroups based on both expertise type and exposure to each treatment condition. It was determined that one group, whose with accounting expertise who were in the simulation treatment, had a significant increase in BPK. This analysis was performed following Cohen and Cohen (2003, p. 304.). Two binary dummy variables were coded to represent responses from accounting and finance experts in the simulation treatment and those in the traditional treatment, respectively. Regression results showed that accounting and finance experts in the simulation treatment had a significant beta coefficient of 0.178 with a p-value of 0.038, while those in the traditional treatment had a non-significant beta coefficient of -0.003 with a p-value of 0.975. Similar group tests were performed by coding technical expertise in both conditions but those groups were insignificant. H1c results support the benefit of ES simulation-based education methods over traditional methods as the better means to gain business process knowledge for accounting and financial specialists. Accounting and finance expertise provides an underlying framework for assessing business economic results. The dynamic, experimental nature of the simulation treatment allows participants to experience business processes directly linked to observable financial business outcomes. This allows accounting and finance experts to build on their existing framework of financial understanding. In this way, accounting experts develop new ACT productions that extend existing financial knowledge, refining and extending their conceptual framework with new BPK knowledge. Knowledge acquisition theory espouses the value of building on existing knowledge frameworks (in this case, the knowledge of accounting and finance) as described in ACT (Anderson 1993; Anderson 1996). In sum, these post hoc group findings provide partial support for H1b indicating that accounting and finance experts experienced significant positive effects on BPK from the simulation treatment but not from the traditional treatment. Perhaps with a higher power test or control over more confounding factors, the hypothesized moderation effect might be uncovered in future research.

As hypothesized in H2a, H2b and H2c, BPK influences the three aspects of cognitive appraisal, although the relationship with control is only of marginal significance. This may be explained by the fact that, even with high levels of BPK, the basic ability to control the ES technology at the user interface command level still relies on ES application skills and so control could not be enhanced solely by increased BPK. Kang & Santhanam (2003) theorize that a hierarchy of knowledge is needed to support enterprise systems use. The hierarchy's base is application interface skills (figure 1) but other knowledge is critical, including business process knowledge to being fully capable with an ES. This assertion is further supported by Santhanam et al. (2007) who found the importance of *know-how* (application) knowledge of the steps to complete an enterprise system-related task as well as the *know-why* (business process) knowledge of the business rules incorporated into the system. Therefore, these hypotheses indicate that BPK is most influential in forming an appraisal of what benefits (opportunity) and what risks (threats) are posed by the ES system, while BPK alone is not as influential in influencing the individual's perceived control of the ES. It is likely that ES application skills have an important role in promoting perceived control of an ES. It is important to note that BPK still is a significant predictor of control, so BPK likely works concurrently with application skills to impart a sense of control over the ES. This finding supports the importance of imparting business processes alongside all ES application interface training in order to ensure individuals can more realistically appraise the opportunities and threats posed by the ES, and gain a sense of control to enable future mastery and acceptance of the ES. Business process learning may well be a missing link in ES education that should be made an essential ingredient of ES change management and training initiatives.

At first glance, it is surprising to find support for hypotheses H4a (opportunity influencing job satisfaction) and H4c (control influencing job satisfaction), without support for H4b (threat influencing job satisfaction). Appraising information systems (IS) as a threat has been identified as common problem in IS and enterprise research literature (Nah et al. 2004; Beaudry and Pinsonneault 2005; Kim and Kankanhalli 2009; Beaudry and Pinsonneault 2010) **,** especially in light of many large and highly visible ES implementation failures (Scott 1999; Scott and Vessey 2000; King and Burgess 2008)**.** The expectation is that both opportunity and threat would operate as forms of primary cognitive but operate in different directions, in assessing potential for benefits and risk, respectively. By their nature, the possibility exists that one factor could counteract or suppress expressions of the other factor, with the stronger factor exhibiting the discernable effect. BPK has a significant negative influence on threat, yet the influence of threat on job satisfaction appears non-existent. Digging deeper into the combinatory effects of these factors, it appears that the strong positive nature of perceived opportunity (and possibly important factors not specified in the model) appears to diminish threat's influence on job satisfaction, making it insignificant. In reviewing the correlations (table 3), both opportunity (r = 0.701**) and threat (r = - 0.204*) have significant correlations with job satisfaction. But in the regression, opportunity's influence on job satisfaction is reduced to a smaller, but still highly significant, beta coefficient of 0.539, while the influence of threat is rendered non-significant with a beta coefficient of essentially zero (beta coefficient of -0.006). This indicates a type of effect suppression, whereby the combined influence of these two opposing variables offset each other's effects on the dependent variable. This would suggest that business process knowledge is a very powerful factor that increases perceptions of opportunity thereby reducing perceptions of ES threat. This suggests that improving BPK can be very effective in affecting both challenge and threat perceptions as a means to improving ES job satisfaction. Therefore, BPK holds great promise to help alleviate the prevalent problems of user resistance to, and avoidance of, enterprise systems. On the other hand, it is still possible that unspecified factors may also influence the relationship, hide or confound possible effects of threat on job satisfaction in this study. It is also important to note that the effect of control (with a correlation of r= 0.601** with job satisfaction) is similar (to opportunity effect in the presence of threat) in having a smaller, but highly significant, beta coefficient of 0.324*** in the regression. It is no surprise that some shared variance exists among the cognitive appraisal variables. Even so, the combined effects are large, explaining over half of the variance in job satisfaction (Table 4, H4(b), $R^2 = 0.578$ with a p-value < 0.000). Noting that opportunity has the largest effect size (0.557 with a p-value of 0.000) showing that exposure to the benefits of the ES can have the greatest positive effect on individual's job satisfaction, even in the presence of appraisals of threat and limitations in perceived control.

The significant findings for full mediation (of BPK's influence on job satisfaction through two cognitive appraisal variables of the opportunity and control variables, but not the threat variable) could indicate that strong perceptions of opportunity can overshadow lower levels of threat in this context. This relation appears to be strengthened when the individual also perceives significant levels of control over the ES technology. Perceived control is well-recognized to be a major determinant of personal functional outcomes. It would be natural that, with greater perception of control, that an individual will feel better equipped to act on perceived opportunity, foreseeing great possibility of job success (and therefore, greater job satisfaction). In fact, many theorists believe that perceived control is a much more powerful predictor of performance than actual control – since the individual must be aware of the gain or loss of control for there to be a psychologically significant affect (Skinner 1996). In simulation experiential education, conditions are established to provide actual experiences of control over the ES. As opposed to objective control (actual conditions of control) or subjective control (belief of having control), the experience of control refers to a person's feelings as he or she is interacting with the environment while attempting to produce a desired or prevent an undesired outcome

(Skinner 1996). The positive impact of perceived control should be magnified when there are actual experiences of control to validate those feelings. Experiences of control exist when an individual consciously puts forth effort toward a goal and can feel the value of that effort transmitted to produce the outcome. Such experiences are sometimes referred to as feelings of efficacy (White 1959) or experiences of mastery (Harter 1978). The realistic business experience provided in the ERP business simulation provides the experience of control which may well increase both perceived control and feelings of greater efficacy towards future potential success at taking advantage of opportunities presented. Thus, the combination of perceived opportunity along with perceived control and experiences of control, proved to be a strong combination for carrying the effects of higher BPK to positively influencing job satisfaction outcomes.

Other research supports a combined role of variables similar to these three forms of cognitive appraisal in assessing future technology use. Venkatesh (2000) presents an anchoring and adjustment-based theoretical model of the determinants of system-specific perceived ease of use. That model proposes control (such as computer self-efficacy), intrinsic motivation (such as perceived opportunity) and emotion (such as computer anxiety or threat) as anchors that determine early perceptions of a new system. In this study, stronger perceptions of opportunity and control seem to have overshadowed or suppressed threat’s possible role as a mediator. BPK contributes to ES job satisfaction by operating through raising perceptions of opportunities, diminishing threats, and helping improve perceived level of control in initial use of the ES. In combination, opportunity and control seem to have diminished the role of the threat, which was a significant individual mediator in isolation (table 5b). Perhaps the experiences involved in developing the BPK knowledge structure have provided greater insight into the individual's ability to exert greater control over the ES as they learn ways to actualize the opportunities presented while neutralizing perceptions of threat. As indicated by the Venkatesh (2000) anchoring and adjustment model, as knowledge and experience increase, it is expected that system-specific perceived ease of use will adjust to reflect objective usability and perceptions of external control specific to the new system. With ease of use as a frequent complaint about an ES, perhaps the experience embodied in BPK has increased objectivity, improved perceptions of control, and illuminates opportunities - all of which help increase the overall ES-related job satisfaction. Therefore, these findings indicate that more accurate business process knowledge contributes positively to ES job satisfaction by operating through cognitive appraisal of opportunities and control over the ES technology.

Limitations

There are several limitations to this research. BPK is the only knowledge type from the ES knowledge hierarchy (Kang and Santhanam 2003) addressed in this essay due to the complexity of measuring knowledge structures to assess knowledge. As is common in knowledge structure research, the concept relatedness instrument contains only a subset of the possible business process knowledge concepts. This is a practical limitation found in many Pathfinder network analysis studies due to the large size of survey instruments required to capture a network structure (Schvaneveldt 1990). Existing knowledge structure literature supports the effectiveness of using condensed knowledge maps to assess domain specific knowledge. The study's sample size limits the power of some statistical tests which may provide non-significant or marginal results for some actual relationships **(increases type II error?).** The sample size of 151 is actually quite large among Pathfinder knowledge structure studies (REF) **found in the literature**. An additional limitation is the small number of participants with accounting and financial expertise. However, this limitation actually makes the results more striking, given that significant effects were found for the effect of simulation educational methods in developing BPK in accounting and finance experts.

Study participants are graduate and undergraduate college students with limited business experience, although a majority had a few years of prior work experience (mean full-time experience of 3.168 years and mean part-time experience of 3.68 years). Therefore, this research focuses on educating new hires who are becoming ES users which somewhat limits the generalizability and application of this study to individuals with extensive business experience or prior ES experience. In spite of these constraints, this essay provides a valuable and insightful step towards understanding the impacts of different ES educational interventions and on the important role of business process knowledge on appraisals and adaption to ES.

Contributions

This research answers the call to address gaps in ES research regarding change management (Grabski et al. 2011); stress, coping and emotional responses (Beaudry and Pinsonneault 2005; Beaudry and Pinsonneault 2010); and to understand the ES knowledge hierarchy (Kang and Santhanam 2003; Santhanam et al. 2007). By comparing two very different types of ES educational interventions, this study contributes to enterprise change management literature offering valuable insights regarding how to leverage BPK to improve user adaptation to ES. By empirically contrasting constructivist and traditional methods, this study provides support for experiential, simulation-based ES education as a viable means to increase business process knowledge, improve stress and coping reactions (by improving cognitive assessments), and thereby increase overall ES-related job satisfaction. To build on these findings, future research should investigate opportunities to learn the company-specific business processes working within actual interdependent work teams should be explored, perhaps through guided dynamic experiences after initial ES education. This study also contributes to further explicate the definition and role of business process knowledge, aka business-procedural knowledge, within the ES knowledge hierarchy. It provides an initial operationalization of BPK along with a viable BPK measurement instrument which is based on knowledge structure theory and analyzed using Pathfinder network graph techniques.

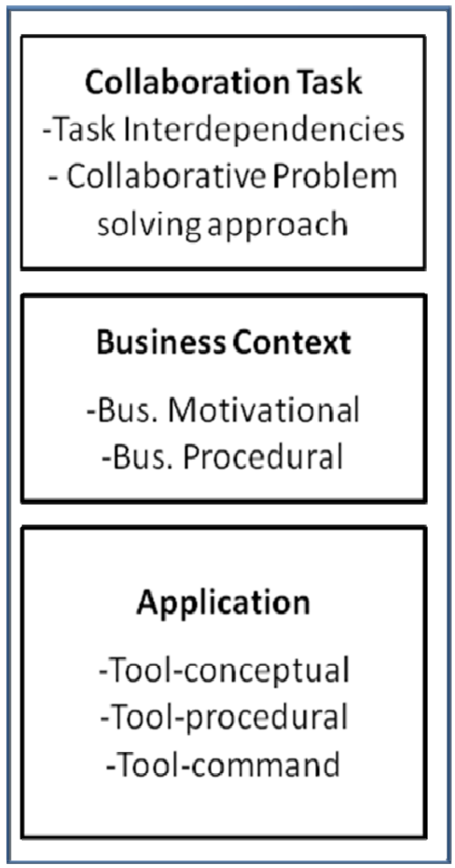
In IT literature, Joseph (2007) points out the need to better understand how IT professionals respond to job factors that reduce job satisfaction and trigger turnover, such as the ‘shock’ experienced when an ES is introduced. Their research indicates that job satisfaction is an important determinant in IT job turnover. This study supports the value of constructivist, simulation-based ES education as an effective change management intervention as well as the value of increases BPK in positively influencing ES-related job satisfaction. As prior research shows that early emotional reactions to new IT have important longer term effects on IT use (Beaudry and Pinsonneault 2010), then early positive ES interventions could have lasting beneficial impacts. These findings generalize to newer employees with little business experience or ES knowledge. Further study is needed to determine effectiveness interventions for experienced employees whose existing business process knowledge is likely to interfere greatly in learning, accepting and adapting to reengineered business processes that accompany a new ES. If inappropriate, outdated business process knowledge is applied by experienced employees in the new ES process environment, then weak problem solutions are likely to occur which limit learning and reduce job performance (Anderson 1987).

For practitioners, findings indicate a need to impart business processes knowledge alongside ES application interface education in order to ensure that individuals foresee opportunities arising from using the ES and also gain a sense of perceived control. These positive cognitive appraisals serve to mitigate perceived threats and should reduce negative coping reactions to the ES-induced change, stress and uncertainty. In a complex, interdependence, ES environment, it is not enough to *know-how* to do a transaction, it is equally as important to *know-why* and *know-when* to perform the appropriate transaction. As management's proxy for process enablement and managerial control, the ES limits task flexibility in trade for efficient transaction processing and enterprise-wide availability of consistent and timely business information. At the application interface, the ES technology is less flexible or forgiving, but such restrictions enable a higher degree of process streamlining, compliance assurance and distributed decision-making. Much research yet remains to fully overcome individual level resistance to ES in order to achieve the organizational level promise of efficient and effective operations through ES usage. This research is one step forward based on the belief that organizational success is realized through a series of small advances enacted at the individual level, one employee at a time.

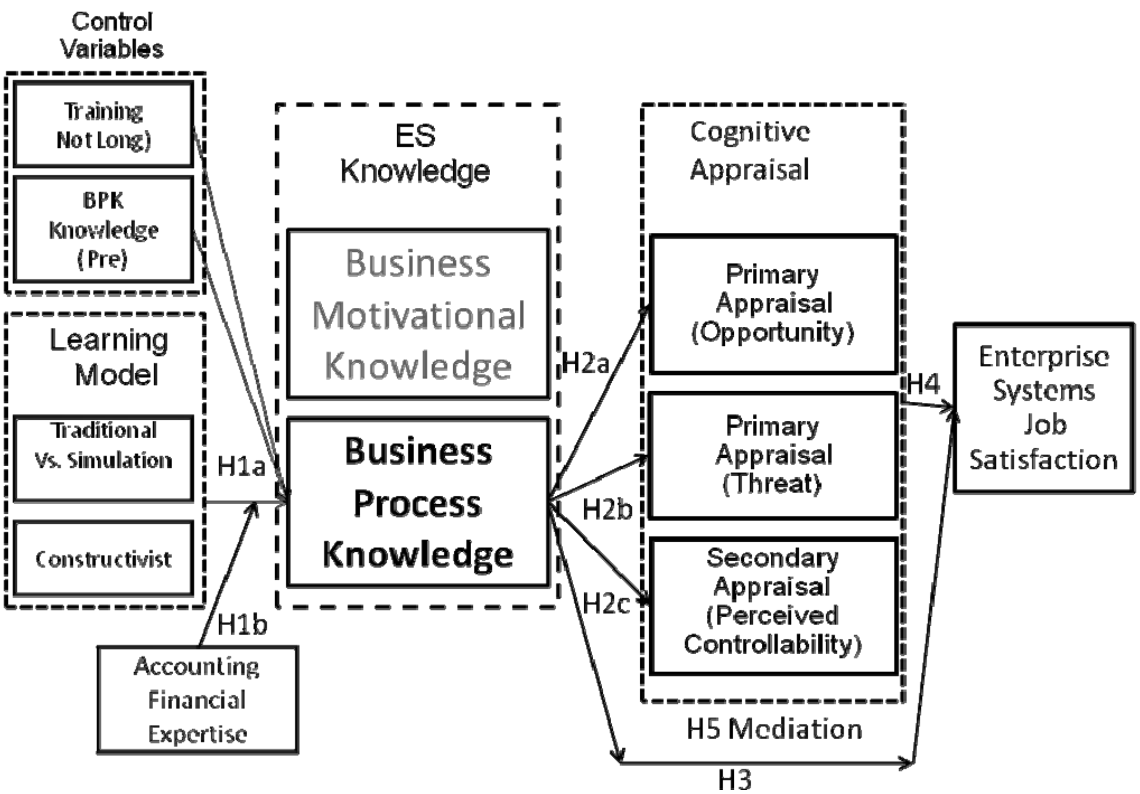
In summary, this essay provides empirical evidence of the value in using constructivist and simulation-based learning interventions to improve enterprise systems related BPK. Results support the important role of accurate BPK on user appraisals of enterprise systems and job satisfaction in an ES context. This study provides support for adding ES business context education on business processes to future ES change management initiatives and educational interventions. Business process knowledge deserves more investigation in the ES context to further determine its role as an essential ingredient of ES change management. BPK may well be one missing link in ES knowledge acquisition and user adaptation.

Research Models

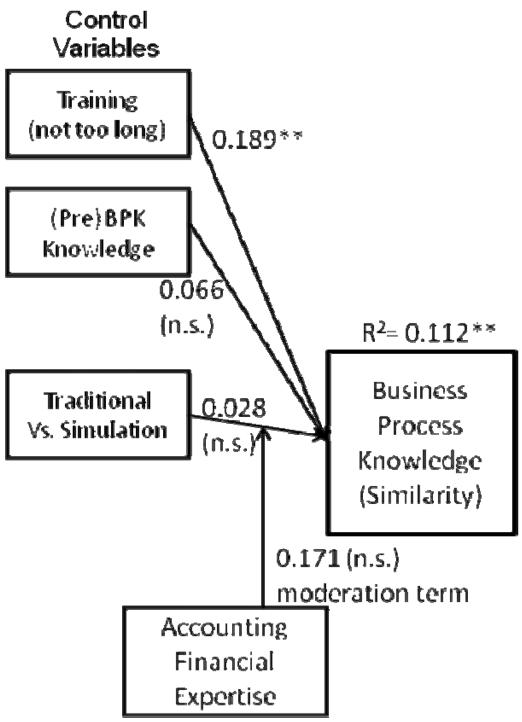
Figure 1. Enterprise Systems Knowledge Hierarchy



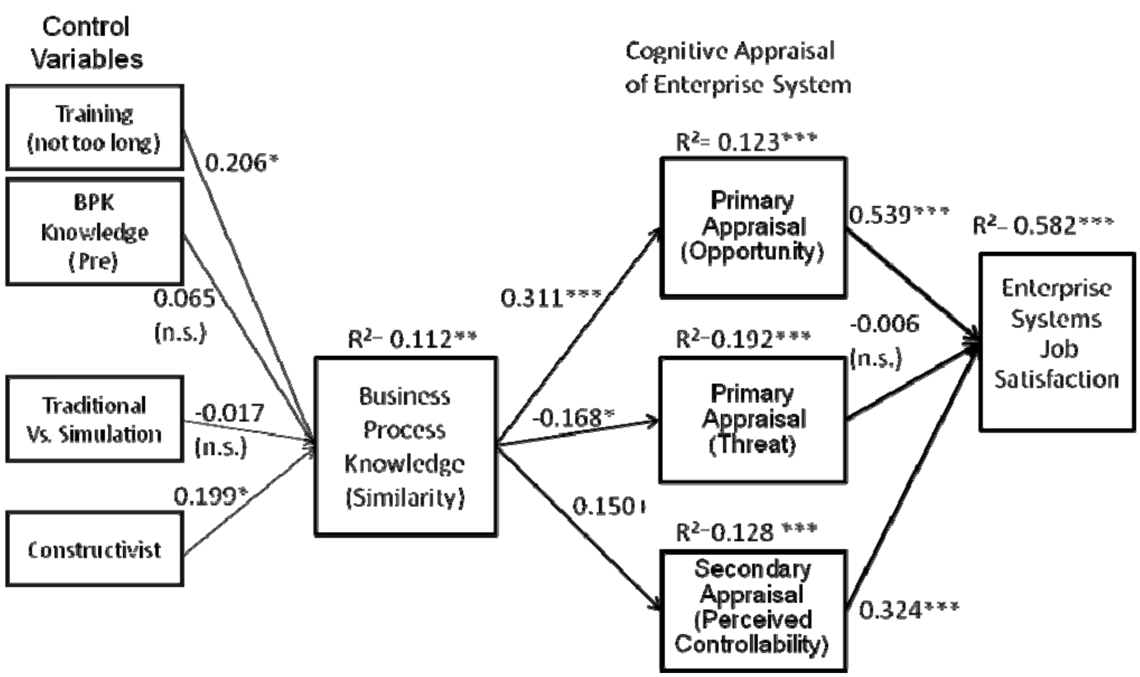
Essay 1 - Figure 2. Business Process Knowledge Research Model



Essay 1 - Figure 3a. Linear Regression Test Results (Stage 1 with Moderation Term)



Essay 1 - Figure 3b. Linear Regression Test Results (Stages without Moderation)



Essay 1 - Figure 4. Mediation Model Test Results (Baron and Kenny 1986 method)

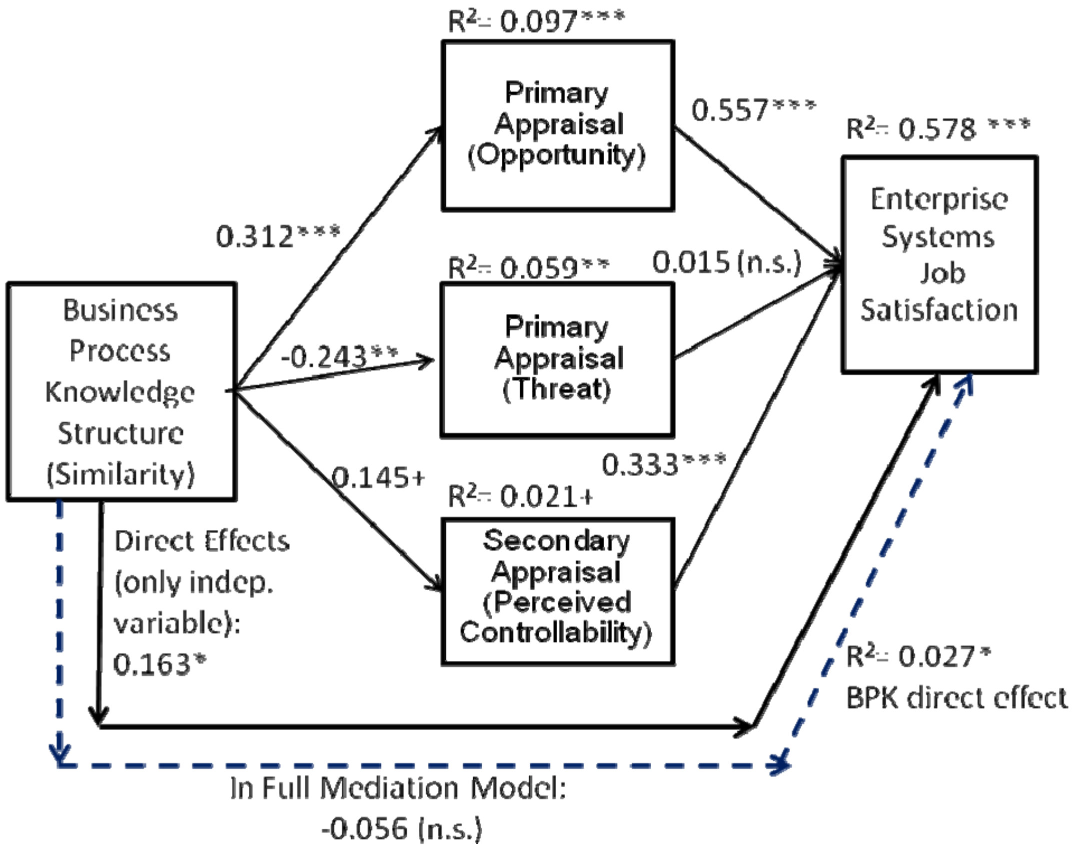


Table 1. Descriptives						
	Min.	**Max.**	**Mean**	**Std.Error**	**Std. Dev.**	**Variance**
Demographics						
Gender	1	2	1.390	0.040	0.489	0.239
Marital	1	2	1.820	0.031	0.385	0.149
Level	1	5	3.610	0.094	1.146	1.314
Age	17	53	24.070	0.526	6.441	41.485
GPA	0	4	3.192	0.046	0.561	0.315
Experience: Full Time	0	30	3.168	0.459	5.506	30.315
Experience: Part-Time	0	17	3.658	0.243	2.945	8.676
Latent Variables						
Know_BPK (pre)	1	6.75	4.411	0.085	1.047	1.096
Train_Not_Long	1	7	5.060	0.106	1.308	1.710
Trad0_Sim1	0	1	0.460	0.041	0.500	0.250
Constructivist	2	7	5.238	0.076	0.934	0.873
Expert_Acct	0	1	0.190	0.032	0.396	0.157
BPK_Sim	0	0.7	0.316	0.010	0.127	0.016
CA_Opport	1	7	5.503	0.101	1.241	1.541
CA_Threat	1	7	2.834	0.123	1.512	2.287
CA_Control	1	7	4.967	0.093	1.143	1.306
JobSat (5 items)	1	7	5.166	0.105	1.295	1.677

Key to Demographics Measures
Gender: 1=Male, 2=Female
Marital Status: 1=married, 2=single.
Level: University Rank as 1=Freshman, 2=Soph, 3=Junior, 4=Senior, 5=Graduate
Age in years
GPA (4.0=A scale)
ExpFT: Years of full time work experience
ExpPT: Years of part-time work experience

Table 2. Factor Analysis: Factor Loadings and Cross-Loadings						
	Know BP	Job Satisf.	Threat	Opportunity	Control	Constructivist
Know2_PK3_A	**0.871**	0.116	0.009	0.119	0.087	0.026
Know3_PK4_A	**0.840**	0.149	0.041	0.003	0.158	0.063
Know4_PK5_A	**0.788**	0.122	-0.025	0.048	0.126	-0.021
Know5_PK6_A	**0.855**	0.042	0.040	0.110	0.092	-0.033
Know6_PK7_A	**0.801**	-0.053	-0.011	0.131	0.099	-0.026
Know7_BK2_A	**0.839**	0.128	-0.018	-0.157	0.060	0.024
Know8_BK3_A	**0.867**	0.031	-0.073	-0.015	-0.040	0.012
Know10_BK5_A	**0.830**	0.026	-0.024	0.039	0.038	0.017
Construct2_B	0.113	0.168	-0.108	0.156	0.034	**0.728**
Construct3_B	0.178	0.460	0.044	0.297	0.040	0.552
Construct4_B	-0.147	0.038	0.055	0.070	0.195	**0.831**
Construct5_B	-0.057	0.313	-0.129	0.088	0.169	**0.728**
Appraisal1_B	0.082	0.529	-0.150	**0.693**	0.154	0.159
Appraisal2_B	0.074	0.419	-0.182	**0.785**	0.162	0.195
Appraisal3_B	0.063	0.506	-0.214	**0.736**	0.134	0.154
Appraisal4_B	0.068	0.509	-0.133	**0.692**	0.143	0.203
Appraisal5_B	-0.027	-0.065	**0.933**	-0.113	0.015	-0.063
Appraisal6_B	-0.012	-0.023	**0.941**	-0.103	-0.002	-0.06
Appraisal7_B	0.051	-0.022	**0.945**	-0.142	0.048	-0.071
Appraisal8_B	-0.058	-0.215	**0.839**	-0.009	-0.254	0.044
Appraisal9_B	0.136	0.201	0.063	-0.061	**0.704**	0.006
Appraisal10_B	0.092	0.192	-0.164	0.183	**0.779**	0.25
Appraisal11_B	0.156	0.279	-0.103	0.253	**0.764**	0.228
Appraisal12_B	0.289	0.429	-0.013	0.222	**0.643**	0.099
JobS13_B	0.067	**0.788**	-0.020	0.322	0.114	0.216
JobS14_B	0.093	**0.828**	-0.149	0.254	0.260	0.128
JobS15_B	0.078	**0.856**	-0.090	0.197	0.230	0.141
JobS16_B	0.119	**0.871**	-0.050	0.137	0.228	0.104
JobS17_B	0.102	**0.896**	-0.055	0.140	0.172	0.09
JobS18_B	0.055	0.520	-0.025	0.379	0.086	0.318

Table 3. Correlations, ICR and AVE

	No.Items	ICR	1	2	3	4	5	6	7	8	9	10
1. Know_BPK (pre)	8	0.938	0.837									
2. Training Not Long	1	NA	-.168*	NA								
3. Trad/Sim (0/1)	1	NA	.249**	.172*	NA							
4. Constructivist	4	0.787	0.076	-0.051	.190*	0.717						
5. Expert_Acct	1	NA	-0.033	-0.059	0.056	-0.011	NA					
6. BPK_Similarity	36	NA	0.041	.190*	0.14	.194*	0.102	NA				
7. CA_Opportunity	3	0.949	.168*	0.015	-0.081	.505**	0.056	.312**	0.739			
8. CA_Threat	4	0.946	-0.042	-.391**	-0.08	-0.115	-0.017	-.243**	-.323**	0.916		
9. CA_Control	4	0.843	.322**	-0.102	0.012	.424**	-0.078	0.145	.499**	-0.157	0.725	
10. Job Satisfaction	5	0.950	.212**	-0.093	-0.088	.473**	0.052	.163*	.701**	-.204*	.601**	0.863

Notes:

1. ICR: Internal consistency reliability (Cronbach's Alpha)
2. Diagonal elements are the square root of the shared variance (AVE: Average Variance Extracted) between the constructs and their measures.
3. Off-diagonal elements are correlations between constructs.
4. Single item measures are used for Train_Not_Long, Trad/Sim, Expert_Acct and BPK_Similarity.
5. BPK_Similarity is a measure of knowledge structure accuracy that is calculated from Pathfinder Network Analysis of 36 relatedness items.
6. Definitions of abbreviations used in table: Know_BPK (Pre) = knowledge of business processes before treatment; Trad/Sim (0/1) = treatment of traditional or simulation education method; Expert_Acct = expertise in accounting and finance; CA = Cognitive Appraisal which has three aspects of opportunity, threat and perceived control.
7. +p<0.10, *p < 0.05, **p < 0.01, ***p < 0.001.

Table 4. Linear Regression Results											
Hypotheses	**H1a,a'**	**H1b**	**H1c**	**H2a**	**H2b**	**H2c**	**H3**	**H4(a)**	**H4(b)**	**H4(c)**	**H4(d)**
Dep. Variable	**BPK**	**BPK**	**BPK Post Hoc**	**Opport.**	**Threat**	**Control**	**Job Satis.**	**Job Satis.**	**Job Satis.**	**Job Satis.**	**Job Satis.**
Controls:											
Training Not long	0.200*	0.189**	0.206*	-0.021	-0.375***	-0.083	-0.093	-0.066		-0.040	-0.032
Knowledge BPK	0.046	0.066	0.065	0.152+	-0.098	0.302***	0.189*	0.005		0.037	0.042
Stage 1											
Trad0_Sim1	0.055	0.028	-0.017							-0.074	-0.087
Constructivist	0.191*		0.199*							0.115+	0.12+
Account. Expert		-0.002	0.178*								0.054
Account x Sim1		0.171									
Stage 2											
BPK_sim				0.311***	-0.168*	0.150+	0.173*		-0.056	-0.046	-0.053
Stage 3											
CA_Opportunity								0.539***	0.557***	0.493***	0.486***
CA_Threat								-0.006	0.015	-0.017	-0.014
CA_Control								0.324***	0.333***	0.297***	0.304***
Model Statistics											
R-Sq	0.85*	0.075*	0.112**	0.123***	0.192***	0.128***	0.077**	0.582***	0.578***	0.594***	0.597***
Adjusted R-Sq	0.06*	0.043*	0.075**	0.105***	0.175***	0.110***	0.058**	0.567***	0.567***	0.571***	0.568***
Model Signif.	0.011	0.046	0.008	0.000	0.000	0.000	0.009	0.000	0.000	0.000	0.000

Notes: Columns give regression results for each hypothesis, with dependent variable specified in top row.

Rows: Standardized Beta Coefficients between independent variables (leftmost column) and dependent variable (top of column).

+ $p<0.10$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

H4 (a through d) – H4(a) is the test of the influence of cognitive appraisal (3 types) on the DV. The other tests include the direct relationships of antecedents in earlier stages of the overall model to indicate the robustness of the findings in the H4 relationship.

Table 5a. Individual Variable Mediation Tests: BPK Similarity Effects on Job Satisfaction through Opportunity

	Depend. Var.	R^2	Model P-value	Indep. Var.	Beta Coeff.	SE(B)	t	PValue
Step 1:	Opportunity	0.097***	0.000	(Constant)		0.267	17.065	0.000
				BPK Similarity	0.312**	0.785	4.008	0.000
Step 2:	Job Satisfaction	0.491***	0.000	(Constant)		0.346	3.176	0.002
				Opportunity	0.701***	0.061	11.996	0.000
Step 3:	Job Satisfaction	0.027*	0.046	(Constant)		0.288	15.971	0.000
				BPK Similarity	0.163*	0.847	2.014	0.046
Step 4:	Job Satisfaction	0.495***	0.000	(Constant)		0.358	3.328	0.001
				BPK Similarity	-0.062	0.645	-1.006	0.316
				Opportunity	0.72***	0.064	11.712	0.000

Table 5b. Individual Variable Mediation Tests: BPK Similarity Effects on Job Satisfaction through Threat

	Depend. Var.	R^2	Model P-value	Indep. Var.	Beta Coeff.	SE(B)	t	PValue
Step 1:	Threat	0.059**	0.003	(Constant)		0.323	11.621	0
				BPK Similarity	-0.243**	0.949	-3.06	0.003
Step 2:	Job Satisfaction	0.042*	0.012	(Constant)		0.226	25.006	0.000
				Threat	-0.204*	0.07	-2.544	0.012
Step 3:	Job Satisfaction	0.027*	0.046	(Constant)		0.288	15.971	0.000
				BPK Similarity	0.163*	0.847	2.014	0.046
Step 4:	Job Satisfaction	0.055*	0.015	(Constant)		0.393	13.165	0.000
				BPK Similarity	0.120	0.863	1.461	0.146
				Threat	-0.175*	0.072	-2.122	0.036

Table 5c. Individual Variable Mediation Tests: BPK Similarity Effects on Job Satisfaction through Control

	Depend. Var.	R^2	Model P-value	Indep. Var.	Beta Coeff.	SE(B)	t	PValue
Step 1:	Control	0.021+	0.075	(Constant)		0.249	18.299	0.000
				BPK Similarity	0.145+	0.732	1.794	0.075
Step 2:	Job Satisfaction	0.361***	0.000	(Constant)		0.388	4.321	0.000
				Control	0.601***	0.076	9.177	0.000
Step 3:	Job Satisfaction	0.027*	0.046	(Constant)		0.288	15.971	0.000
				BPK Similarity	0.163*	0.847	2.014	0.046
Step 4:	Job Satisfaction	0.367***	0.000	(Constant)		0.42	3.532	0.001
				BPK Similarity	0.077	0.693	1.166	0.245
				Control	0.590***	0.077	8.920	0.000

Table 6a. Mediation Tests: BPK Similarity Effect on Job Satisfaction via Opportunity, Threat and Control

	Depend. Var.	**R^2**	**Model P-value**	**Indep. Var.**	**Beta Coeff.**	**SE(B)**	**t**	**PValue**
First step:	Job Satisfaction	0.576***	0.000	(Constant)		0.44	0.067	0.946
				Opportunity	0.542***	0.067	8.373	0.000
				Threat	0.024	0.050	0.417	0.678
				Control	0.334***	0.072	5.390	0.000
Last Step:	Job Satisfaction	0.578***	0.000	(Constant)		0.459	0.337	0.737
				BPK Similarity	-0.056	0.6	-0.973	0.332
				Opportunity	0.557***	0.069	8.371	0.000
				Threat	0.015	0.05	0.257	0.797
				Control	0.333***	0.072	5.377	0.000

Table 6b. Mediation Tests: BPK Similarity Effects on Job Satisfaction through Opportunity and Control

	Depend. Var.	**R^2**	**Model P-value**	**Indep. Var.**	**Beta Coeff.**	**SE(B)**	**t**	**PValue**
Last Step:	Job Satisfaction	0.578***	0.000	(Constant)		0.374	0.594	0.553
				BPK Similarity	-0.058	0.591	-1.030	0.305
				Opportunity	0.553***	0.067	8.583	0.000
				Control	0.334***	0.072	5.395	0.000

+ $p<0.10$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table 7. Sobel Test for Mediation						
Hypothesis	**Hypothesis Statement**	**Finding**	**Indirect Effect (Calc)**	**Sobel SE**	**P-Value (1- tailed)**	**P-Value (2-tailed)**
H5a	The influence of business process knowledge on ES job satisfaction is mediated by primary cognitive appraisal of opportunity.	Supported	2.293	0.604	0.0001***	0.0002***
H5b	The influence of business process knowledge on ES job satisfaction is mediated by primary cognitive appraisal of threat.	Marginal Support	.520	0.245	0.0258*	0.0515+
H5c	The influence of business process knowledge on ES job satisfaction is mediated by secondary cognitive appraisal of perceived controllability.	Marginal Support	0.916	0.521	0.0403*	0.0806+

Table 8. Hypotheses and Findings

H1a	Compared with traditional learning methods, simulation-based learning has a greater positive influence on the business process knowledge.	Not Supported
H1a'	Compared with traditional learning methods, constructivist learning has a greater positive influence on the business process knowledge.	Supported
H1b	When compared with traditional learning methods, simulation-based learning methods have a greater positive influence on business process knowledge for individuals with accounting and finance expertise. (*Finding: Post Hoc tests show contingency effects for accounting expertise in simulation treatment.)	Not Supported *
H2a	Business process knowledge has a positive influence on primary cognitive appraisal of opportunity.	Supported
H2b	Business process knowledge has a negative influence on primary cognitive appraisal of threat.	Supported
H2c	Business process knowledge has a positive influence on secondary cognitive appraisal of perceived controllability.	Marginal Support
H3	Business process knowledge has a positive influence on enterprise systems job satisfaction.	Supported
H4a	Primary cognitive appraisal of opportunity positively influences ES job satisfaction.	Supported
H4b	Primary cognitive appraisal of threat negatively influences ES job satisfaction.	Not Supported
H4c	Secondary cognitive appraisal of perceived control positively influences ES job satisfaction.	Supported
H5a	The influence of business process knowledge on ES job satisfaction is mediated by primary cognitive appraisal of opportunity.	Supported
H5b	The influence of business process knowledge on ES job satisfaction is mediated by primary cognitive appraisal of threat.	Marginal Support
H5c	The influence of business process knowledge on ES job satisfaction is mediated by secondary cognitive appraisal of perceived controllability.	Marginal Support
H5d	The influence of business process knowledge on ES job satisfaction is fully mediated by cognitive appraisal (opportunity, threat, and perceived controllability).*Finding: BPK on Job Satisfaction is fully mediated by opportunity and control.	Partial Support*

Appendix A. Measurement Scales

Table 1. Business Process Knowledge Concepts: used in newly developed business process knowledge structure instrument.

1. Forecast materials
2. Planned production order
3. Purchase requisition
4. Vendor payment
5. Sales Division
6. Customer billing
7. Cash receipt
8. Vendor master data
9. Customer master data

Table 2. Control Variable Measurement Scales

Training too long: A continuous variable that captures perceived treatment duration using a Likert scale from 1=Strongly Disagree to 7= Strongly Agree. This item is reverse coded to reflect "Training not too long". Adapted from (Klein et al. 2001; Aiman-Smith and Green 2002).

- The amount of time I spent in formal training on the new system was too long.

Business Process Knowledge (pre-treatment measure): A self-reported continuous scale using a Likert scale from 1=Strongly Disagree to 7= Strongly Agree. (Cronan et al. 2008b; Cronan et al. 2008a; Cronan et al. 2011), as adapted from (Seethamraju 2007).

1. Knowledge of Procurement Business Processes and Activities.
2. Knowledge of Sales and Distribution Business Processes and Activities.
3. Knowledge of Financial Accounting Business Processes and Activities.
4. Knowledge of Production Management Business Processes and Activities.
5. Knowledge of the importance of the integrated nature of the business processes.
6. Knowledge of business terminology in Sales and Distribution (such as Sales order, discounts, freight, transfer goods, good issues etc.).
7. Knowledge of business terminology in Procurement process (such as Purchase Order, invoice verification, goods receipt, material account, etc.).
8. Knowledge of the interrelationships and interdependencies between various processes (such as accounting, marketing, production, etc.)

Table 3. Independent Variable Measurement Scales: Note: items in italics were dropped from the measurement of the related latent variable based on factor analysis.

Single Item Measures:
Traditional or Simulation Learning Method: A binary variable (Trad0_Sim1) that captures treatment condition which participant experiences where 0 = traditional and 1 = simulation treatment.

Accounting expertise in Simulation Treatment: A binary variable (Acct_Sim) that captures participant's accounting and financial expertise along with the simulation treatment condition, where 0 = accountant in traditional treatment and 1 = accountant in simulation treatment.

Accounting expertise in Traditional Treatment: A binary variable (Acct_Trad) that captures participant's accounting and financial expertise along with the traditional treatment condition, where 0 = accountant in simulation treatment and 1 = accountant in traditional treatment.

Constructivist Learning Environment: (Wen et al. 2004; Maor and Fraser 2005).

1. *ERP lessons show that real-life business environments are complex.*
2. Doing the ERP lessons, I find out answers to questions by investigation.
3. The ERP lessons get me to think deeply about my own understanding.
4. During ERP lessons, I can ask other students to explain their ideas.
5. The ERP lessons help me think about business results.
6. *At the beginning of the lesson, the ERP lesson materials make clear the exact inputs and outputs of the system.*

Business Process Knowledge (BPK) Items with Instructions: *Results of knowledge structures are calculated using Pathfinder network analysis (Appendix B). BPK accuracy is assessed against the expert referent (described in Appendix C) to calculate the Similarity metric and Coherence metric.*

ERP/SAP CONCEPTS- RELATEDNESS: This section compares two SAP concepts, which are shown separated by arrows (<-->). Indicate how closely each concept is related to the other in the pair by selecting values from: 1="Not Related" to 7="Highly Related".

Example for furniture concept pairs:
"Dresser <--> Drawer" select: 7='Highly Related"
"Dresser <--> Rug" select: 2='Somewhat Related'.

To start, find 'highly related' pairs and "not related' pairs to serve as anchors. A rating of 1 or 2 is unrelated; a rating of 6 or 7 is highly related. Give a quick intuitive judgment of relatedness, as you best understand these pairs of ERP concepts.

Business Process Knowledge Structure - Survey Concept Pairs

1. Cash receipt <--> Forecast materials
2. Sales division <--> Purchase requisition
3. Purchase requisition <--> Customer billing
4. Customer master data <--> Vendor master data
5. Customer billing <--> Vendor payment
6. Cash receipt <--> Vendor payment
7. Vendor payment <-->Vendor master data
8. Customer master data <--> Planned production order
9. Vendor payment <--> Purchase requisition
10. Sales division <--> Customer billing
11. Vendor master data <--> Planned production order
12. Forecast materials <--> Customer billing
13. Sales division <--> Cash receipt
14. Planned production order <--> Forecast materials
15. Vendor master data <--> Customer billing
16. Sales division <--> Vendor payment
17. Customer master data <--> Sales division
18. Cash receipt <--> Customer billing
19. Customer billing <--> Customer master data
20. Cash receipt <--> Vendor master data
21. Vendor master data <--> Forecast materials
22. Vendor master data <--> Sales division
23. Forecast materials <--> Sales division
24. Purchase requisition <--> Forecast materials
25. Forecast materials <--> Vendor payment
26. Customer master data <--> Cash receipt
27. Purchase requisition <--> Cash receipt
28. Planned production order <--> Customer billing
29. Planned production order <--> Cash receipt
30. Vendor payment <--> Customer master data
31. Vendor payment <--> Planned production order
32. Planned production order <--> Sales Division
33. Purchase requisition <--> Vendor master data
34. Customer master data <--> Purchase requisition
35. Customer master data <--> Forecast materials
36. Purchase requisition <--> Planned production order

Primary cognitive appraisal: Measures for perceived opportunity and perceived threat.

Perceived opportunity: (Bala 2008) as adapted from (Major et al. 1998; Drach-Zahavy and Erez 2002).

1. I am confident that the system will have positive consequences for me.
2. I feel that the system will open new avenues for success in my job.
3. The system will provide opportunities to improve my job performance.
4. *The system will provide opportunities to gain recognition and praise.*

Perceived threat - (Bala 2008) as adapted from (Major et al. 1998)

1. I am scared that the system will have harmful (or bad) consequences for me.
2. I am worried that the new system may worsen my job performance.
3. I feel that the new system might actually degrade my status in the organization.
4. I feel stressed about having to use the new system to accomplish my job.

Secondary cognitive appraisal:
Perceived controllability: (Bala 2008) as adapted from (Major et al. 1998)

1. I personally have what it takes to deal with these situations caused by the system.
2. I have the resources I need to successfully use the system.
3. I have the knowledge necessary to use the new system.
4. I so confident that I will be able to use the system without any problems.

Table 4. Dependent Variable Items
Enterprise Systems Job Satisfaction: used existing Job Satisfaction measures below.

Job Satisfaction: Work Itself. (Spector 1985)

1. *I feel my ERP work is meaningful.*
2. I like doing the work I do with ERP.
3. I feel a sense of pride in doing my ERP work.
4. My work with ERP is enjoyable.

Job Satisfaction: (Tsui et al. 1992)
1. I am satisfied with the nature of the ERP work I perform.
2. *I am satisfied with my relations with others in the organization with whom I work (i. e. my peers).*

Appendix B: Pathfinder Analysis Technique

In Pathfinder analysis, a knowledge structure is represented using network graph techniques where each concept is represented by a network node and node-to-node relationships (or relatedness) are represented as links between two nodes. Assessments of relatedness are used to set the distance (or weight) associated with each link. Essentially, Pathfinder is a data reduction method which allows for various types of network graph analyses which can be applied to knowledge structures. Pathfinder analysis reveals underlying structural characteristics by reducing the complexity and highlighting the most related links in the network. There are two important metrics that control the network graph analysis. The r-metric, based on the Minskowski's-r, determines how a path distance (or weight) is calculated between two nodes that are not directly connected. Selecting r='infinity' set the maximum weight of any individual link in the path as the value of the path. The q-metric defines the maximum number of links connecting nodes in the reduced network structure, where n represents the number of nodes in the network. It is typically set at q = n-1 which retains maximal length paths (Dearholt and Schvaneveldt 1990). The Pathfinder 6.2[5] Windows-based application will be utilized with parameters settings of r='infinity' and q=(n-1), settings which are routinely used in knowledge structure analysis. This approach produces a network structure of the most salient links for analysis (Dearholt and Schvaneveldt 1990). Two important outputs of Pathfinder network analysis are metrics for *similarity* and *coherence.* Similarity is

---

[5] Pathfinder 6.2 application is available by license on the web at http://interlinkinc.net/Pathfinder.html.

calculated when comparing two network structures and can be defined as the closeness or degree to which there is commonality among the reduced set of most salient network links. Prior research has shown that the metric of similarity is the preferred measurement for comparing structural assessments of learning. In comparing Pathfinder networks, similarity also uniquely captured important predictive variance not found in the other measures (Goldsmith and Johnson 1990). Coherence is an internal measurement of one knowledge structure network graph which reflects the internal consistency within the network data set. Coherence of a network structure is based on the assumption that relatedness measures between a pairs of items can be predicted by the relations of the items to other items in the set (Interlink 2007).

In overview, the Pathfinder methodology steps include a) collection of domain concept relatedness measures, b) network graph structure analysis with data reduction and c) comparisons between reduced network graph and a referent's graph to determine similarity (also referred to as accuracy). The accuracy measure has a range from 0 to 1 with higher numbers indicating a greater degree of similarity or closeness to the referent knowledge structure. Experts' knowledge structures are typically used as the accuracy referent (Goldsmith and Davenport 1990). Averaged experts' KS are empirically demonstrated to be a more effective accuracy standard than using an individual expert's KS (Acton and Johnson 1994). For robustness, multiple experts were surveyed and analyzed to create an averaged referent structure. In sum, Pathfinder analysis techniques are applied in this study to understand the structure of BPK as this technique is acknowledged to be effective in assessing knowledge across many domains.

Appendix C: Expert Referent BPK Knowledge Structure

Experts' knowledge structures are typically used as the accuracy referent in studies of knowledge organization (Goldsmith and Davenport 1990). Averaged composite experts' KS are empirically demonstrated to be a more effective accuracy standard than using a single individual expert's KS (Acton and Johnson 1994). The composite referent for BPKS is formed using a Pathfinder network averaging technique. The expert referent BPKS is formed from several ERP experts' knowledge structures obtained using the same BPKS instrument used to gather participant data. Multiple ERP expert/instructors (n=15) were surveyed as base for creation of an averaged expert referent BPKS (see Table C1). The process used in this study to create the averaged expert referent was 1) select top quartile of experts based on highest KS coherence metrics, 2) use Pathfinder to average these top quartile expert KS's and create an initial composite referent KS, 3) determine the Pathfinder similarity metric for each individual expert/instructor's KS in comparison to this initial composite expert referent KS, 4) in a iterative process, consider adding any expert/instructor with a high similarity to initial averaged expert referent KS while maintaining a high coherence (greater than 0.60) for the selected referents and achieving a mean expert referent KS similarity greater than 0.30 (here it is 0.522). The final composite expert referent BPKS has a coherence of .9354 (Table C2). The BPK knowledge structure for the composite expert referent is shown as a Pathfinder network graph in figure C1. For comparison purposes, another participant' BPK Pathfinder network graph is shown in figure C2 where the coherence value was significantly lower.

In this study, individual experts in the top quartile had coherence metrics over 0.75 but had a range of similarity with respect to the final referent. Pathfinder techniques are very robust with respect to variation of individual similarity measures within a composite referent (Acton and Johnson 1994). In Acton (Acton and Johnson 1994), an average similarity of 0.31 for included experts (compared to the averaged expert referent KS) was found acceptable to maintain a robust measure. In this study, the average similarity of included experts is 0.522, well above Acton's level. In fact, overall the averaged similarity of all surveyed instructors was found to be quite high at 0.464 indicating a well-established set of experts were obtained for use in the expert referent base. Overall, these metrics indicate that a well-formed and robust composite expert referent was created and used for comparing participants' BPKS in this study.

Table C1. Full Sample of Expert BPK Knowledge Structure Statistics

Business Process Knowledge Structure	Coherence	Symmetric Links	Common Links	Similarity
BPK_Expert_A *	**0.8156**	**10**	**6**	**0.4615**
BPK_Expert_B *	**0.8308**	**11**	**8**	**0.6667**
BPK_Expert_C	0.3294	12	7	0.5000
BPK_Expert_E *	**0.8301**	**12**	**7**	**0.5000**
BPK_Expert_G	0.5888	9	7	0.6364
BPK_Expert_H	0.8026	12	6	0.4000
BPK_Expert_I *	**0.9100**	**12**	**8**	**0.6154**
BPK_Expert_K	0.5476	29	8	0.2667
BPK_Expert_L	0.8129	8	6	0.5455
BPK_Expert_M	0.6873	10	6	0.4615
BPK_Expert_R	0.3019	9	6	0.5000
BPK_Expert_U *	**0.8970**	**29**	**6**	**0.1875**
BPK_Expert_V	0.6415	9	5	0.3846
BPK_Expert_W	0.1470	8	2	0.1333
BPK_Expert_Y *	**0.7614**	**8**	**7**	**0.7000**

* Included in BPK Average Expert Referent (labeled in table below as AVG_BPK_REFERENT) as calculated by Pathfinder Network Graph Analysis.
BPK Average Similarity for all instructors/experts = 0.464

Table C2. Referent BPK Knowledge Structure Statistics for Composite Expert Referent

Business Process Knowledge Structure: Selected Expert Referents	Coherence	Symmetric Links	Common Links	Similarity
BPK_Expert_A *	0.8156	10	6	0.4615
BPK_Expert_B *	0.8308	11	8	0.6667
BPK_Expert_E *	0.8301	12	7	0.5000
BPK_Expert_I *	0.9100	12	8	0.6154
BPK_Expert_U *	0.8970	29	6	0.1875
BPK_Expert_Y *	0.7614	8	7	0.7000
AVG_BPK_REFERENT**	**0.9354**	**9**	**9**	**1.00**

****** AVG_BPK_REFERENT is a composite network graph calculated by Pathfinder Network Graph Analysis.
Expert BPK Referent Instructors' mean similarity = 0.522

Figure C1. Expert Referent BPK Knowledge Structure

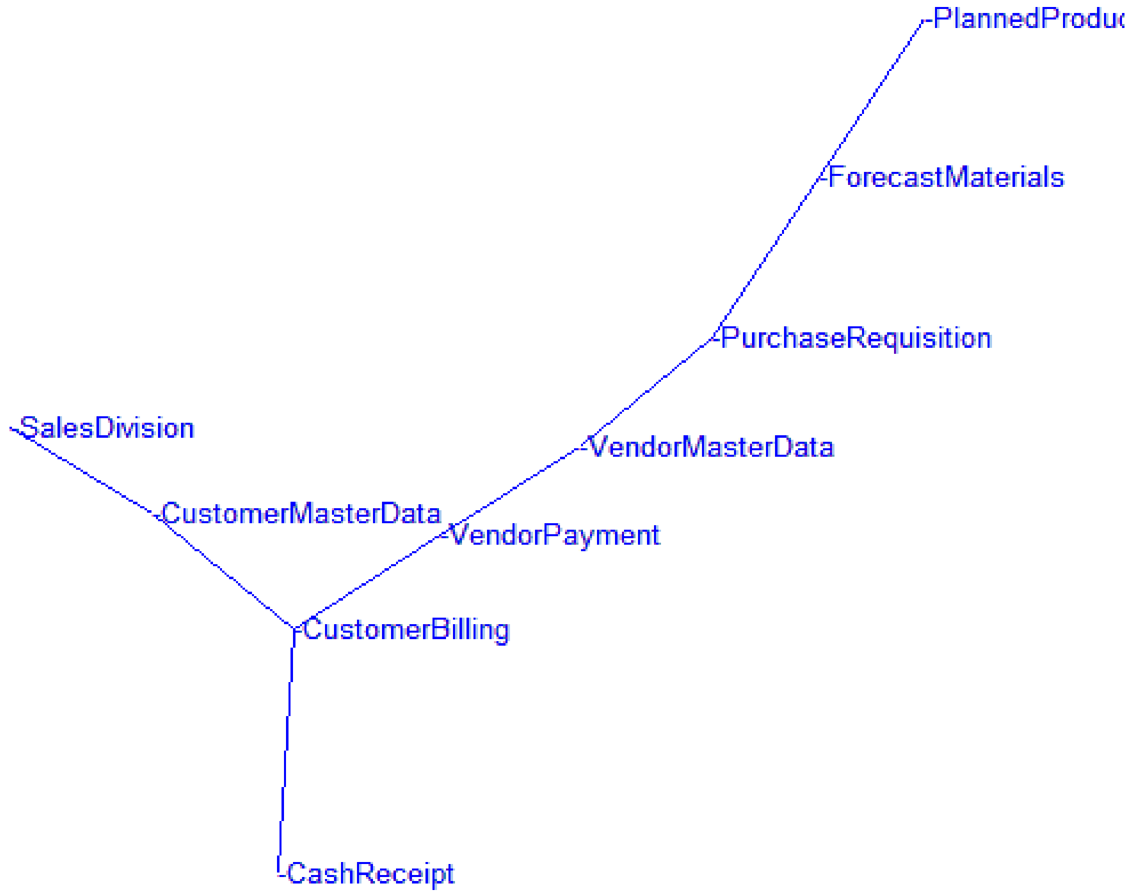
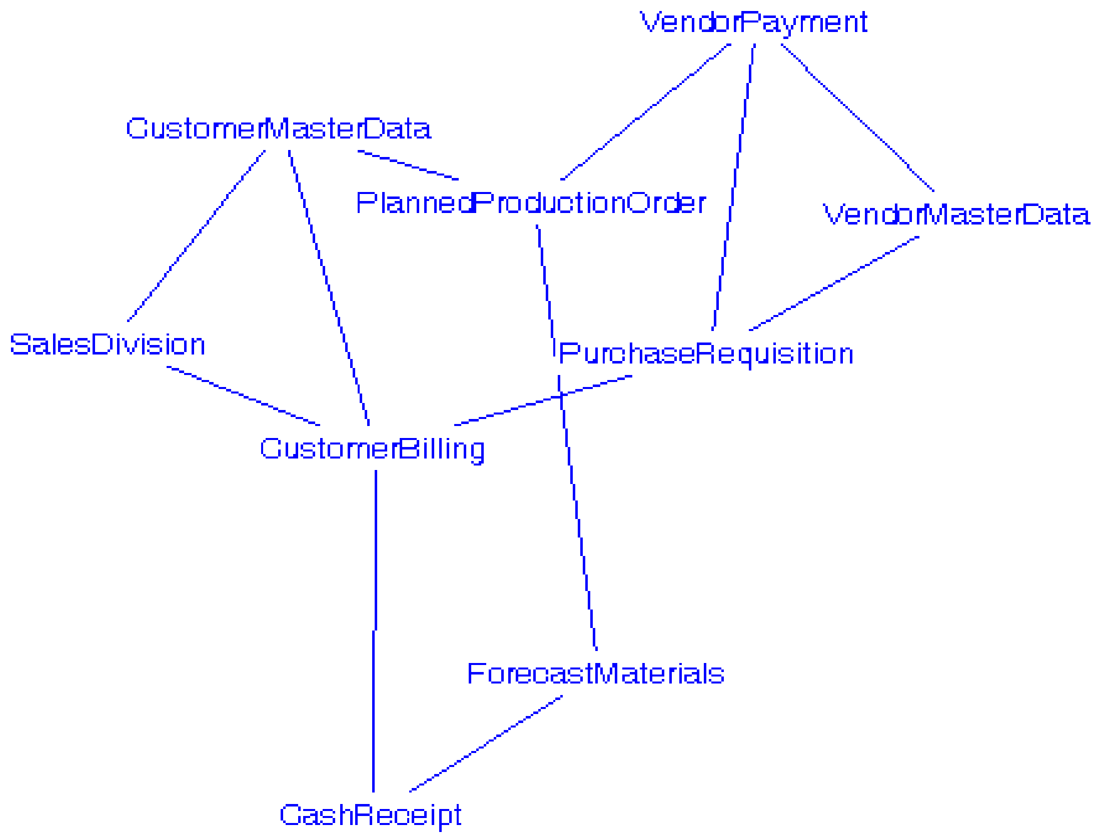


Figure C2. Sample Low Coherence BPK Knowledge Structure



REFERENCES

Acton, W.H., and Johnson, P.J. "Structural Knowledge Assessment: Comparison of Referent Structures," *Journal of Educational Psychology* (86:2) 1994, p 303.

Aiman-Smith, L., and Green, S.G. "Implementing New Manufacturing Technology: The Related Effects Of Technology Characteristics And User Learning Activities," *Academy of Management Journal* (45:2) 2002, pp 421-430.

Al-Mashari, M., Al-Mudimigh, A., and Zairi, M. "Enterprise Resource Planning: A Taxonomy of Critical Factors," *European Journal of Operational Research* (146:2) 2003, pp 352-364.

Anderson, J., R, Matessa, M., and Lebiere, C. "ACT-R: A Theory of Higher Level Cognition and Its Relation to Visual Attention," *Human - Computer Interaction* (12:4) 1997, p 439.

Anderson, J.R. "Acquisition of Cognitive Skill," *Psychological Review* (89:4) 1982, pp 369-406.

Anderson, J.R. "Skill Acquisition: Compilation of Weak-Method Problem Solutions," *Psych. Review* (94:2) 1987, p 192.

Anderson, J.R. *Rules of the Mind* Psychology Press, 1993.

Anderson, J.R. "ACT: A Simple Theory of Complex Cognition," *The American Psychologist* (51:4) 1996, p 355.

Bala, H. "Nothing Endures But Change: Understanding Employees' Responses To Enterprise Systems Implementation and Business Process Change " in: *Information Systems*, University of Arkansas, Fayetteville, Arkansas, 2008, p. 214.

Balogun, J., and Jenkins, M. "Re-Conceiving Change Management: A Knowledge-Based Perspective," *European Management Journal* (21:2) 2003, p 247.

Baron, R.M., and Kenny, D.A. "The Moderator-Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations," *Journal of Personality and Social Psychology* (51:6) 1986, pp 1173-1182.

Beaudry, A., and Pinsonneault, A. "Understanding User Responses to Information Technology: A Coping Model of User Adaptation," *Management Information Systems Quarterly* (29:3) 2005, pp 493-524.

Beaudry, A., and Pinsonneault, A. "The Other Side of Acceptance: Studying the Direct and Indirect Effects of Emotions on Information Technology Use," *MIS Quarterly* (34:4) 2010, pp 689-710.

Berry, D.C., and Broadbent, D.E. "The Combination of Explicit and Implicit Learning-Processes in Task Control," *Psychological Research-Psychologische Forschung* (49:1) 1987, pp 7-15.

Bostrom, R.P., Olfman, L., and Sein, M.K. "The Importance Of Learning Style In End-User Training," *MIS Quarterly* (14:1) 1990, pp 101-119.

Boudreau, M.-C., and Robey, D. "Coping With Contradictions in Business Process Re-Engineering," *Information Technology & People* (9:4) 1996, p 40.

Boudreau, M., and Robey, D. "Enacting Integrated Information Technology: A Human Agency Perspective," *Organization Science* (16:1) 2005, pp 3-18.

Bradley, J. "Management-Based Critical Success Factors in the Implementation of Enterprise Resource Planning Systems," *International Journal of Accounting Information Systems* (9) 2008, pp 175-200.

Callon, M. "Actor-Network Theory; The Market Test," *Sociological Review* (46:S) 1998, pp 181-195.

Clegg, C., and Walsh, S. "Change Management: Time For A Change!," *European Journal of Work and Organizational Psychology* (13:2) 2004, p 217.

Cohen, J., Cohen, P., West, S.G., and Aiken, L.S. *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*, (3rd ed.) Lawrence Erlbaum Associates, Mahwah, New Jersey, 2003, p. 703.

Cronan, T.P., Douglas, D.E., Alnuaimi, O., and Schmidt, P.J. "Decision Analytics in an Integrated Business Process Context: Learning Using an ERP Simulation Game," *Decision Sciences Journal of Innovative Education* (forthcoming) 2011.

Cronan, T.P., Douglas, D.E., Schmidt, P., and Alnuaimi, O. "Using an ERP Simulation Game: Learning and Attitudes toward SAP (Draft Report - ERP Student Sample)," *Information Technology Research Institute - Working Paper Series* (ITRI-WP123-1008), Sept. 2008a.

Cronan, T.P., Douglas, D.E., Schmidt, P., and Alnuaimi, O. "Using an ERP Simulation Game: Learning and Attitudes toward SAP (Draft Report Company A)," *Information Technology Research Institute - Working Paper Series* (ITRI-WP122-1008) 2008b, pp 1-14.

Dearholt, D.W., and Schvaneveldt, R.W. "Properties of Pathfinder Networks," in: *Pathfinder Associative Networks: Studies in Knowledge Organization*, Ablex Publishing Corp., New Jersey, 1990, pp. 1-30.

Dery, K., Hall, R., and Wailes, N. "ERPs as 'Technologies-in-Practice': Social Construction, Materiality and the Role of Organisational Factors," *New Technology Work and Employment* (21:3), Nov 2006, pp 229-241.

DeSanctis, G., and Poole, M.S. "Capturing the Complexity in Advanced Technology Use - Adaptive Structuration Theory," *Organization Science* (5:2), May 1994, pp 121-147.

Drach-Zahavy, A., and Erez, M. "Challenge Versus Threat Effects On The Goal-Performance Relationship," *Organizational Behavior and Human Decision Processes* (88:2) 2002, p 667.

Elmes, M.B., Strong, D.M., and Volkoff, O. "Panoptic Empowerment and Reflective Conformity in Enterprise Systems-Enabled Organizations," *Information and Organization* (15:1), January 2005, pp 1-37.

Feldman, M.S., and Pentland, B.T. "Reconceptualizing Organizational Routines as a Source of Flexibility and Change," *Administrative Science Quarterly* (48:1) 2003, p 94.

Folkman, S., and Lazarus, R.S. "If It Changes It Must Be a Process - Study of Emotion and Coping During 3 Stages of a College-Examination," *Journal of Personality and Social Psychology* (48:1) 1985, pp 150-170.

Folkman, S., Lazarus, R.S., Dunkelschetter, C., Delongis, A., and Gruen, R.J. "Dynamics of a Stressful Encounter - Cognitive Appraisal, Coping, and Encounter Outcomes," *Journal of Personality and Social Psychology* (50:5), May 1986a, pp 992-1003.

Folkman, S., Lazarus, R.S., Gruen, R.J., and Delongis, A. "Appraisal, Coping, Health-Status, and Psychological Symptoms," *Journal of Personality and Social Psychology* (50:3), Mar 1986b, pp 571-579.

Fornell, C., and Larcker, D.F. "Evaluating Structural Equation Models With Unobservable Variables and Measurement Error," *Journal of Marketing Research* (18) 1981, pp 39-50.

Frederick, D.M. "Auditors' Representation and Retrieval of Internal Control Knowledge," *The Accounting Review* (66:2) 1991, p 240.

Frederick, D.M., Heiman-Hoffman, V.B., and Libby, R. "The Structure of Auditors' Knowledge of Financial Statement Errors," *Auditing* (13:1) 1994, p 1.

Garris, R., Ahlers, R., and Driskell, J., E. "Games, Motivation, and Learning: A Research and Practice Model," *Simulation & Gaming* (33:4) 2002, p 441.

Gerard, G.J. "The REA Pattern, Knowledge Structures, and Conceptual Modeling Performance," *Journal of Information Systems* (19:2) 2005, p 57.

Gibson, C.F. "IT-Enabled Business Change: An Approach to Understanding and Managing Risk," *Management Information Systems Quarterly Executive* (2:2) 2003, pp 104-115.

Giddens, A. *The Constitution of Society: Outline of the Theory of Structuration* University of California Press, 1984.

Goldsmith, R.E., and Davenport, D.M. "Assessing Structural Similarity of Graphs," in: *Pathfinder Associative Networks: Studies in Knowledge Organization,* Ablex Publishing Corp., New Jersey, 1990, pp. 75-87.

Goldsmith, R.E., and Johnson, P.J. "A Structural Assessment of Classroom Learning," in: *Pathfinder Associative Networks: Studies in Knowledge Organization,* Ablex Publishing Corp., New Jersey, 1990, pp. 241-255.

Gowan, M.A., Riordan, C.M., and Gatewood, R.D. "Test of a Model of Coping With Involuntary Job Loss Following a Company Closing," *Journal of Applied Psychology* (84) 1999, pp 75-86.

Grabot, B.E., Mayère, A.E., and Bazet, I.E. *ERP Systems and Organisational Change: A Socio-technical Insight* Springer-Verlag London Limited, 2008.

Grabski, S.V., Leech, S.A., and Schmidt, P.J. "A Review of ERP Research: A Future Agenda for Accounting Information Systems," *Journal of Information Systems* (25:1) 2011, pp 37-78.

Grant, D., Hall, R., Wailes, N., and Wright, C. "The False Promise of Technological Determinism: The Case of Enterprise Resource Planning Systems," *New Technology, Work, and Employment* (21:1) 2006, pp 2-15.

Hackman, J.R., and Oldham, G.R. "Motivation Through Design of Work - Test of a Theory," *Organizational Behavior and Human Performance* (16:2) 1976, pp 250-279.

Haerem, T., and Rau, D. "The Influence Of Degree Of Expertise And Objective Task Complexity On Perceived Task Complexity And Performance," *Journal of Applied Psychology* (92:5) 2007, p 1320.

Harter, S. "Effectance Motivation Reconsidered Toward a Developmental Model," *Human development* (21:1) 1978, pp 34-64.

Humphrey, S.E., Nahrgang, J.D., and Morgeson, F.P. "Integrating Motivational, Social, and Contextual Work Design Features: A Meta-Analytic Summary And Theoretical Extension Of The Work Design Literature," *Journal of Applied Psychology* (92:5) 2007, p 1332.

Ignatiadis, I., and Nandhakumar, J. "The Effect of ERP System Workarounds on Organizational Control: An Interpretivist Case Study," *Scandinavian Journal of Information Systems* (21:2) 2009, pp 59-90.

Interlink "Pathfinder 6.3 Manual ", Interlink, Inc. http://interlinkinc.net/ (Last Accessed Sept. 12, 2007), Las Cruces, NM, 2007.

Jacobson, S., Shepherd, J., D'Aquila, M., and Carter, K. "The ERP Market Sizing Report, 2006–2011," 2007, pp. 1-34.

Joseph, D., Kok-Yee, N., Koh, C., and Soon, A. "Turnover of Information Technology Professionals: A Narrative Review, Meta-Analytic Structural Equation Modeling, and Model Development," *Management Information Systems Quarterly* (31:3) 2007, pp 547-577.

Judge, T.A., Thoresen, C.J., Bono, J.E., and Patton, G.K. "The Job Satisfaction-Job Performance Relationship: A Qualitative and Quantitative Review," *Psychological Bulletin* (127:3), May 2001, pp 376-407.

Kang, D., and Santhanam, R. "A Longitudinal Field Study of Training Practices in a Collaborative Application Environment," *Journal of Management Information Systems* (20:3), Win 2003, pp 257-281.

Kappas, A. "Appraisals Are Direct, Immediate, Intuitive, and Unwitting… and Some Are Reflective…," *Cognition & Emotion* (20:7) 2006, pp 952-975.

Karuppan, C.M., and Karuppan, M. "Resilience Of Super Users Mental Models Of Enterprise-Wide Systems," *European Journal of Information Systems* (17) 2008, pp 29-46.

Kellogg, W.A., and Breen, T.J. "Using Pathfinder to Evaluate User and System Models," in: *Pathfinder Associative Networks: Studies in Knowledge Organization*, Ablex Publishing Corp., New Jersey, 1990, pp. 179-195.

Kim, H.-W., and Kankanhalli, A. "Investigating User Resistance to Information Systems Implementation: A Status Quo Bias Perspective," *Management Information Systems Quarterly* (33:3) 2009, pp 567-582.

King, S., and Burgess, T. "Understanding Success and Failure in Customer Relationship Management," *Industrial Marketing Management* (37:4) 2008, p 421.

Klein, K.J., Conn, A.B., and Sorra, J.S. "Implementing Computerized Technology: An Organizational Analysis," *Journal of Applied Psychology* (86:5), Oct 2001, pp 811-824.

Latour, B. "On Actor-Network Theory," *Soziale Welt* (47:4) 1996, pp 369-381.

Law, J. "Notes on the Theory of the Actor-Network: Ordering, Strategy and Heterogeneity," *Systems Practice* (5:4) 1992, pp 379-393.

Lazarus, R.S. "From Psychological Stress to the Emotions: A History of Changing Outlooks," *Annual Review of Psychology* (44) 1993, p 1.

Lazarus, R.S. "Psychological Stress in the Workplace," in: *Occupational Stress: A Handbook,* R. Crandall and P.L. Perrewé (eds.), CRC Press, 1995, pp. 3-14.

Lazarus, R.S., and Folkman, S. "Transactional Theory and Research On Emotions and Coping," *European Journal of Personality* (1:3) 1987, pp 141-169.

Léger, P.M. "Using a Simulation Game Approach to Teach Enterprise Resource Planning Concepts," *Journal of Information Systems Education* (17:4) 2006, p 441.

Liang, H., Saraf, N., Hu, Q., and Xue, Y. "Assimilation of Enterprise Systems: The Effect of Institutional Pressures and the Mediating Role of Top Management," *Management Information Systems Quarterly* (31:1) 2007, pp 59-87.

Loher, B.T., Noe, R.A., Moeller, N.L., and Fitzgerald, M.P. "A Meta-Analysis of the Relation of Job Characteristics to Job-Satisfaction," *Journal of Applied Psychology* (70:2) 1985, pp 280-289.

MacKinnon, D.P., Fairchild, A.J., and Fritz, M.S. "Mediation Analysis," *Annual Review of Psychology* (58) 2007.

Major, B., Richards, C., Cooper, M.L., Cozzarelli, C., and Zubek, J. "Personal Resilience, Cognitive Appraisals, And Coping: An Integrative Model Of Adjustment To Abortion," *Journal of Personality and Social Psychology* (74:3) 1998, p 735.

Maor, D., and Fraser, B.J. "An Online Questionnaire for Evaluating Students' and Teachers' Perceptions of Constructivist Multimedia Learning Environments," *Research in Science Education* (35) 2005, pp 221-244.

Markus, L.M., and Tanis, C. "The Enterprise System Experience – From Adoption to Success," in: *Framing the Domains of Information Technology*, R.W. Zmud (ed.), Pinnaflex Education Resources, Inc., 2000, pp. 173-207.

Markus, M.L. "Technochange Management: Using IT to Drive Organizational Change," *Journal of Information Technology* (19:1) 2004, pp 4-21.

Markus, M.L., and Grover, V. "Consolidating Knowledge on the Journey of Business Process Transformation," in: *Business Process Transformation, in Advanced Management Information Systems,* M.L.M. Varun Grover (ed.), ME Sharpe, 2007, pp. 1 - 19

Martocchio, J.J., and Dulebohn, J. "Performance Feedback Effects In Training - The Role of Perceived Controllability," *Personnel Psychology* (47:2), Sum 1994, pp 357-373.

Montgomery, D.C., Peck, E.A., and Vining, G.G. *Introduction to Linear Regression Analysis*
(Third ed.) John Wiley & Sons., New York, New York, 2001.

Moon, Y.B. "Enterprise Resource Planning (ERP): A Review of the Literature," *International Journal of Management and Enterprise Development* (3:4) 2007, pp 235 - 264

Morris, M., and Venkatesh, V. "Job Characteristics and Job Satisfaction: Understanding the Role of Enterprise Resource Planning System Implementation," *Management Information Systems Quarterly* (34:1) 2010, pp 143-161.

Nah, F.F., Tan, X., and Teh, S.H. "An Empirical Investigation on End-Users' Acceptance of Enterprise Systems," *Information Resources Management Journal* (17:3) 2004, pp 32-53.

Ngai, E.W.T., Law, C.C.H., and Wat, F.K.T. "Examining the Critical Success Factors in the Adoption of Enterprise Resource Planning," *Computers in Industry* (59:6) 2008, pp 548-564.

Nunnaly, J.C. *Psychometric Theory,* (second ed.) McGraw-Hill, New York, 1978.

Orlikowski, W.J. "Improvising Organizational Transformation Over Time: A Situated Change Perspective," *Information Systems Research* (7:1) 1996, p 63.

Orlikowski, W.J., and Gash, D.C. "Changing Frames: Understanding Technological Change in Organizations," *Center for Information Systems Research, MIT Sloan School of Management* (WP No. 3368-92), April 1992.

Orlikowski, W.J., and Yates, J. "ICT and Organizational Change: A Commentary," *The Journal of Applied Behavioral Science* (42:1) 2006, p 127.

Pentland, B.T., and Feldman, M.S. "Organizational Routines as a Unit of Analysis," *Industrial and Corporate Change* (14:5) 2005, p 793.

Peslak, A.R., Subramanian, G.H., and Clayton, G.E. "The Phases of ERP Software Implmentation and Maintenance: A Model For Predicting Preferred ERP Use," *The Journal of Computer Information Systems* (48:2) 2007, p 25.

Peterson, W.J., Gelman, L., and Cooke, D.P. "ERP Trends, Report Number: R-1292-01-RR ", The Conference Board, /www.conference-board.org, pp. 1-31.

Ragu-Nathan, T., Tarafdar, M., Ragu-Nathan, B., and Tu, Q. "The Consequences of Technostress for End Users in Organizations: Conceptual Development and Empirical Validation," *Information Systems Research* (19:4) 2008, pp 417-433.

Reber, A.S. "Implicit Learning and Tacit Knowledge," *Journal of Experimental Psychology-General* (118:3), Sep 1989, pp 219-235.

Riketta, M. "The Causal Relation Between Job Attitudes and Performance: A Meta-Analysis of Panel Studies," *Journal of Applied Psychology* (93:2) 2008, pp 472-481.

Robey, D., Ross, J.W., and Boudreau, M.C. "Learning To Implement Enterprise Systems: An Exploratory Study of the Dialectics of Change," *Journal of Management Information Systems* (19:1), Sum 2002, pp 17-46.

Santhanam, R., Seligman, L., and Kang, D. "Postimplementation Knowledge Transfers to Users and Information Technology Professionals," *Journal of Management Information Systems* (24:1), Sum 2007, pp 171-199.

Schvaneveldt, R.W. *Pathfinder Associative Networks: Studies in Knowledge Organization* Ablex Publishing, NJ, 1990, pp. 1-315.

Scott, J. "The FoxMeyer Drugs' Bankruptcy: Was it a Failure of ERP?," *Proceedings of the Americas Conference on Information Systems (AMCIS)* (Paper 80) 1999, pp 223-225.

Scott, J.E., and Vessey, I. "Implementing Enterprise Resource Planning Systems: The Role of Learning from Failure," *Information Systems Frontiers* (2:2) 2000, pp 213-232.

Seethamraju, R. "Enterprise Systems (ES) Software in Business School Curriculum - Evaluation of Design and Delivery," *Journal of Information Systems Education* (18:1) 2007, p 69.

Seger, C.A. "Implicit Learning," *Psychological Bulletin* (115:2), Mar 1994, pp 163-196.

Sein, M.K., and Bostrom, R.P. "Individual Differences and Conceptual Models in Training Novice Users," *Human-Computer Interaction* (4:3) 1989, p 197.

Sein, M.K., Bostrom, R.P., and Olfman, L. "Rethinking End-User Training Strategy: Applying a Hierarchical Knowledge-Level Model," *Journal of End User Computing* (11:1) 1999, pp 32-39.

Skinner, E.A. "A Guide to Constructs of Control," *Journal of Personality and Social Psychology* (71) 1996, pp 549-570.

Sobel, M.E. "Effect Analysis and Causation in Linear Structural Equation Models," *Psychometrika* (55:3) 1990, pp 495-515.

Somers, T.M., and Nelson, K. "The Impact of Critical Success Factors Across the Stages of Enterprise Resource Planning Implementations," *Proceedings of the 34th Annual Hawaii International Conference on System Sciences* (HICSS-34), 3-6 Jan. 2001, pp 1-10.

Somerville, I. "Agency Versus Identity: Actor-Network Theory Meets Public Relations " *Corporate Communications: An International Journal* (4:1) 1999, pp 6-13.

Spector, P. *Job Satisfaction* Sage Publications, Thousand Oaks, CA, 1997.

Spector, P.E. "Measurement of Human-Service Staff Satisfaction - Development of the Job-Satisfaction Survey," *American Journal of Community Psychology* (13:6), Dec 1985, pp 693-713.

Spector, P.E. "Perceived Control by Employees: A Meta-Analysis of Studies Concerning Autonomy and Participation at Work," *Human Relations* (39:11), Nov. 1986, pp 1005-1017.

Srivardhana, T., and Pawlowski, S.D. "ERP Systems as an Enabler of Sustained Business Process Innovation: A Knowledge-Based View," *Journal of Strategic Information Systems* (16:1), Mar 2007, pp 51-69.

Swanson, E.B. "Information-Systems Innovation among Organizations," *Management Science* (40:9), Sep 1994, pp 1069-1092.

Tomaka, J., Kibler, J., Blascovich, J., and Ernst, J.M. "Cognitive and Physiological Antecedents of Threat and Challenge Appraisal," *Journal of Personality & Social Psychology* (73:1) 1997, pp 63-72.

Tsui, A., Egan, T., and O'Reilly, C., III "Being Different: Relational Demography and Organizational Attachment," *Administrative Science Quarterly* (37:4) 1992, p 549.

Umble, E.J., Haft, R.R., and Umble, M.M. "Enterprise Resource Planning: Implementation Procedures and Critical Success Factors," *European Journal of Operational Research* (146:2) 2003, p 241.

Venkatesh, V. "Determinants of Perceived Ease of Use: Integrating Control, Intrinsic Motivation, and Emotion into the Technology Acceptance Model," *Information Systems Research* (11:4) 2000, p 342.

Walsham, G., Lee, A.S., Liebenau, J., and DeGross, J.I. "Actor-Network Theory and IS Research: Current Status and Future Prospects," 1997, pp. 466–481.

Wastell, D.G. "Learning Dysfunctions In Information Systems Development: Overcoming The Social Defenses With Transitional Objects," *Management Information Systems Quarterly* (23:4) 1999, pp 581-600.

Wen, M.L., Tsai, C.-C., Lon, H.-M., and Chuang, S.-C. "Cognitive – Metacognitive and Content-Technical Aspects of Constructivist Internet-Based Learning Environments: A LISREL Analysis," *Computers and Education* (43) 2004, pp 237–248.

White, R.W. "Motivation Reconsidered: The Concept of Competence," *Psychological review* (66:5) 1959, pp 297-333.

CHAPTER 3 (Essay 2)

The Influence of Simulation-Based IT Education on Enterprise System Business-Motivational Knowledge and User Satisfaction

Abstract

Enterprise systems (ES) implementations are high cost and high risk with many companies failing to achieve their targeted business objectives. Prolonged decreases in individual job satisfaction and productivity frequently occur following an ERP implementation. At the individual level, a contributing factor is inadequate knowledge of enterprise systems leading to counter-productive adaptations to enterprise systems use and reduced job satisfaction. To address these issues, more effective enterprise change management interventions are needed. In particular, enterprise system education should teach more than application skills by also conveying an understanding of business context in the form of business motivational knowledge. Business motivational knowledge (BMK) is an understanding of what the application can do for user and the organization along with appreciating how the application enables consistent transactions across the organization. In this essay, simulation-based educational methods are compared to traditional educational methods to determine their relative effectiveness at developing enterprise systems business motivational knowledge. REA (resource-event-agent) accounting theory is used to describe economic events as core concepts in the business motivational knowledge structure. The organization of this knowledge is assessed using concept relatedness measures and established Pathfinder network graph analysis techniques.

Essay 2 focuses on two research questions regarding enterprise systems economic knowledge acquisition: Is simulation-based education more effective than traditional education in developing accurate accounting and economic oriented *business motivational knowledge*, and does accurate *business motivational knowledge* influence ES stress coping reactions and job satisfaction?

In summary, this research explicates enterprise systems business motivational knowledge refines its conceptualization and provides an initial operationalization for use in ES empirical research. The newly defined BMK knowledge structure (KS) measurement contributes to predicting primary cognitive appraisal and job satisfaction, but do not capture differential impacts from different educational interventions. Results suggest that ERP business motivational knowledge influences primary cognitive appraisals of enterprise systems (i.e. perceptions of opportunity and threat) which in turn influences ES job satisfaction. This work adds to our understanding of the ES knowledge hierarchy and contributes to enterprise change management research, offering valuable insights on how to leverage BMK to improve user adaptation to ES.

Introduction

In recent years, enterprise systems (ES) have had a significant financial impact on business organizations (Davenport 1998; Nicolaou 2004; Liang et al. 2007). Total ERP market revenue grew to over $28B in 2006 and is expected to reach $47.7B by 2011 (Jacobson et al. 2007). ES such as enterprise resource planning (ERP) systems are extensive integrated software systems composed of a centralized database and a comprehensive set of integrated software modules supporting major corporate functions (such as accounting, finance, human resources, materials management, manufacturing production, sales and distribution) (Robey et al. 2002). Enterprise systems support a broad range of integrated functions, enforce standard business practices (Park and Kusiak 2005) and reduce work procedure flexibility (Davenport 1998).

At the organizational level, ES implementation is a major strategic investment with impacts spanning many functional areas. By 2002, ES penetration in mid to large firms had reached 67 percent with another 21 percent considering implementation (Liang et al. 2007). Estimates place the proportion of failed ES implementations from 40 percent to 60 percent with failures ascribed to the complexity of ES and the extent of change assimilation required before ES usage matures throughout the organization (Liang et al. 2007). Even in successful ES implementations, severe productivity declines occur in 75% of firms, a fourth of these lasting over one year (Peterson et al. 2001). This productivity decline is due in part to individual user’s learning curve with ES and their adjustment to related job role changes and interdependencies.

At the individual level, ES research has yet to sufficiently explore the complex knowledge required for individual level productivity (Sein et al. 1999; Kang and Santhanam 2003; Santhanam et al. 2007) and its influence on job satisfaction (Markus et al. 2000; Robey et al. 2002; Markus 2004; Markus and Grover 2007). The introduction of enterprise systems often represents massive and stressful change to employees who must adapt and use ES in daily work tasks. This research focuses on two primary research questions regarding enterprise systems economic knowledge acquisition at the individual level: 1) is simulation-based education more effective than traditional education in developing accurate accounting and economic oriented *business motivational knowledge*, and 2) does accurate *business motivational knowledge* influence ES stress coping reactions and job satisfaction?

ES introduction requires several types of learning to address a) new technology skills, b) revised work processes, c) overall business context knowledge and d) distributed decision-making (Hitt et al. 2002; Kang and Santhanam 2003; Santhanam et al. 2007). Increased strain results not only from the introduction of the technology itself, but from changes to job characteristics and psychological aspects of the work (Nelson 1990; Clegg and Walsh 2004). Inadequate knowledge leads to non-productive use of the ES and can even result in user resistance and avoidance (Beaudry and Pinsonneault 2005; Kim 2009). Emotional reactions such as uncertainty and worklife strain in reaction to technology are also common (Clegg and Walsh 2004). ES knowledge requirements and emotional stress both represent major challenges to enterprise change management (Robey et al. 2002; Beaudry and Pinsonneault 2005; Cohen 2005). The introduction of an

ES has severe impacts on job characteristics as employees must develop new technical skills, change work procedures due to reengineered business processes (Markus 2004; Markus and Grover 2007) and gain cross-functional business knowledge (Sein et al. 1999). The job characteristics model (Hackman and Oldham 1975; Hackman and Oldham 1976; Loher et al. 1985) is valuable in determining impacts to job definitions and the resulting affects on personnel in areas of job satisfaction and job performance (Judge et al. 2001). Because of ES's pervasive impact on employees, employee education and change management are consistently identified as important success factors for enterprise systems (Markus and Tanis 2000; Markus et al. 2000; Ip et al. 2002; Ip et al. 2004). Due to their unique requirements, enterprise systems require continued investigation into individual level impacts of ES adoption (Markus and Tanis 2000; Markus et al. 2000), particularly seeking improvements in ES knowledge acquisition (Park and Kusiak 2005; Santhanam et al. 2007), and change management (Robey et al. 2002; Markus 2004; Markus and Grover 2007).

A primary contributor to organizational ES success is individual level productivity. Yet, ES training is not addressed adequately in many enterprise system implementation and integration (Markus et al. 2000; Ip et al. 2004). While much is known about education and training in general (Arthur et al. 2003; Taylor et al. 2005), little is known about the enterprise systems' unique educational needs. Most IT education focuses on learning single user desktop applications (Davis 1989; Davis and Bostrom 1993; Venkatesh 2000; Venkatesh et al. 2003; Yi and Davis 2003). Compared with an enterprise system, desktop applications have far less feature variety, interface complexity, degree of integration, task interdependencies and end-to-end business impact.

Use of an ES presents greater complexity than typical single task applications for many reasons. The individual must learn unfamiliar and complex ES user interface, deal with many new cross-organizational interdependencies and must operate within newly reengineered business processes (Hitt et al. 2002). Because the ES user interface differs from familiar applications, users lack appropriate interface skills and IT procedural knowledge to draw from (Davis and Bostrom 1993; Satzinger and Olfman 1998). Also, ES's enforce a greater degree of collaboration and interdependence. This requires the individual to understand a broader business context because ES transactions can directly affect distant functions, reflecting tighter linkages and greater controls across the enterprise. ES introductions include business process change in the form of best practices or adaptations to past processes. For this reason, jobs must be redefined, often substantially. Traditional IT training is not adequate preparation for collaborative enterprise systems because it mainly focuses on user interface commands and IT procedures (Sein et al. 1999; Kang and Santhanam 2003). In their ERP post-implementation study of user problems, Kang and Santhanam (2003) identified negative outcomes from a lack of training on business context, specifically in conveying business-motivational knowledge (BMK). BMK is an understanding of what can the application do for learner and the organization along with an appreciation for how the application enables consistent transactions across organizational functions (Sein et al. 1999). An example of BMK is having an understanding of how an operational transaction impacts accounting information and facilitates business decisions. The need for BMK has not been sufficiently addressed in ES education. New interventions are needed to convey BMK with a full range of knowledge necessary in enterprise environments.

The research model builds on a well-accepted end user education model where education experiences and IT characteristics influence formation of knowledge structures, attitudes and performance (Bostrom et al. 1990; Davis and Bostrom 1993). In Bostrom's model (1990), knowledge structures (KS) perform a central role as mediator between education approaches and the outcomes of user perception of the system and learning performance. An important benefit of doing knowledge assessment using a KS is that it captures both implicit and explicit knowledge. In the current research, two different learning models are compared in an ES context – the more traditional 'objectivist' learning model focusing on conveying factual application usage knowledge to learners and the 'constructivist' learning model which facilitates learners in constructing their own knowledge through experience (Leidner and Jarvenpaa 1995). These two learning methods are compared to determine their influence on enterprise systems' business-motivational knowledge and its resulting impact on the job-related outcomes of cognitive appraisal and enterprise systems job satisfaction. It is postulated the two learning models will differ in their effect on enterprise BMK and on user satisfaction with ES, with the 'constructivist' learning model proving more effective at conveying the complex relationships within an ES.

Theoretical Background

Enterprise Systems Knowledge Hierarchy

Enterprise systems such as ERP's are categorized as collaborative workflow systems which are complex applications that span a wide set of functionalities, support cross-functional business processes and enforce a high degree of task interdependence (Swanson 1994). Sein (1999) and Kang and Santhanam (2003) explicate a knowledge hierarchy for collaborative applications such as ERPs and other enterprise systems consisting of three main knowledge categories of a) application knowledge, b) business context knowledge, and c) collaborative task knowledge. Application knowledge focuses on the user interface and the specific commands used in an ES task. Business context knowledge is a broad understanding of the policies, procedures and impacts related to using the application. Collaborative task knowledge is understanding the interdependencies of using the ES to make business decisions and solve problems. Figure 1 depicts the enterprise systems knowledge hierarchy. The business context category contains two distinct knowledge types, namely, business-motivational knowledge (BMK) and business-process knowledge (BPK) (Sein et al. 1999; Kang and Santhanam 2003).

This essay focuses on BMK which is an understanding of what can the tool do for learner and the organization along with an appreciation for how the tool enables consistent transactions across organizational functions ((2003). An example of BMK is having an understanding of how an operational transaction impacts accounting information and facilitates business decisions.

Change Management and Education

Change management is a critical challenge identified in enterprise systems literature. The goal of change management is to address the many risks of a project so as to mitigate problems and achieve successful outcomes. A recent review of risk management in ERP projects found that, after the early conceptual phase, the most risky problems were inadequate change management and inadequate education of users (Aloini et al. 2007). Investigations of critical success factors often identify education as an important antecedent to user acceptance and ES implementation success (Markus and Tanis 2000). Without effective education and change management, common ES personnel problems include lack of developer expertise, resistance to change, and impacts from reengineering business processes (Sumner 2000). The sociotechnical systems design approach to change management strives to jointly optimize technology and people when redesigning organizational structures and work processes. This approach motivates participants to embrace change by providing a clear strategic purpose and addressing work life quality (Taylor 1998; Clegg and Walsh 2004). To diminish user resistance, functional barriers of use, value and risk along with the psychological barriers of tradition and image must be overcome (Ram and Sheth 1989). Change management can be conceptualized from an educational or knowledge-based perspective. Such change practices have long utilized education to address both knowledge acquisition and behavioral change as in Lewin's phased pattern of change involving unfreezing, moving and refreezing (Schein 1996). Education and education are consistently found to be critical success factors in ES implementations (Ip et al. 2004; Moon 2007). Enterprise change initiatives would benefit from leveraging sociotechnical and educational approaches to reduce resistance and encourage more effective ES usage.

In spite of the widespread acknowledgement of education as a critical success factor, in depth research is limited, especially with respect to the higher levels of ES knowledge hierarchy. ES education can not merely rely on traditional IT education methods because effective ES usage requires gaining technology, operations, managerial, strategic and organizational knowledge (Yu 2005). In addition to technical skills, ES users also need business-process knowledge, cross functional problem-solving skills and an understanding of task interdependence (Sein et al. 1999; Kang and Santhanam 2003). In a field study of industrial firms using ES's, Robey et al. (2002) found that providing education on both technology and business processes overcame user assimilation knowledge barriers. New approaches to ES education are needed due to ERP's complex, integrated and dynamic nature. To better address ES's demanding educational requirements, recent innovations include simulated ERP-like systems (Parush et al. 2002) and simulation game-based education on live ERP systems ((Draijer and Schenk 2004; Léger 2006). Simulations provide experiential learning which can occur prior to actual work experience and help develop expertise in problem solving (Sein and Santhanam 1999) and handling novel situations (Orlikowski and Hoffman 1997) in a dynamic and complex environment.

In summary, the introduction of an ES brings extensive change that is unsettling, even revolutionary, to individuals who must use it. ES's demand new technical skills, extensive work design changes (such as implementing ERP best practices) and increased cross-functional collaboration. User education is widely accepted as a critical success factor in ES adoption but only recently has the complexity of ES's knowledge hierarchy been articulated. Education and change management interventions must be identified that address the broad scope and complexity of the enterprise systems knowledge hierarchy.

Knowledge Acquisition and Learning Theory

Business context knowledge, made up of business-motivational knowledge and business-procedural knowledge, consists of conceptual and procedural knowledge (Sein et al. 1999; Kang and Santhanam 2003). Conceptual knowledge is defined as the interrelatedness of primary elements that support their functionality and interaction, such as generalization, categorization, and theoretical knowledge, and procedural knowledge includes the processes, methods, and criteria used in a domain, such as domain specific techniques, algorithms, and evaluations used to select processes (Anderson et al. 2001). Procedural knowledge is mainly considered tacit, that is, knowledge that cannot be verbalized as the individual is not consciously aware of it. Tacit knowledge contrasts with declarative knowledge which is conscious, factual knowledge that can be verbalized. Tacit procedural knowledge can be the hardest knowledge to assess using direct questions (Goldsmith and Johnson 1990), but many prior studies successful utilized KS (Kellogg and Breen 1990; Curtis and Davis 2003; Gerard 2005; Rose et al. 2007). Prior research shows that KS are an effective measure of knowledge and predictor of performance. The use of KS in evaluating expertise has been validated across many domains including cognitive psychology (Dearholt and Schvaneveldt 1990), information technology

(Bostrom et al. 1990; Satzinger and Olfman 1998; Yi and Davis 2003) and accounting (Curtis and Davis 2003; Rose et al. 2007).

According to the ACT system of cognition and knowledge acquisition (Anderson 1982; Anderson 1993), after a declarative learning stage, individuals enter a procedural knowledge growth stage as they gain experience. Knowledge compilation processes rely on practice, exposure to new situations and feedback to proceduralize tacit knowledge. Experiencing novel situations arise in pursuit of goals and user experimentation creates refined productions tuned to various situations. *Productions* are defined as condition and action pairs such that when a given condition occurs then a related, subsequent mental or physical action needs to occur. Refined productions result in improved task performance because the actions are precisely targeted to more efficiently address specific conditions (Anderson 1982; Anderson 1993). Outcome feedback allows participants to directly observe the results of their actions and prompts creation of more precise, refined knowledge productions addressing ever more specific situations. Knowledge compilation increases when feedback is perceived as being within one's control (Martocchio and Dulebohn 1994). Self-assessment of outcome feedback also helps develop tacit understanding of complex causal relations through implicit learning. Implicit learning is the act of learning complex information in an incidental manner, without explicit focus or conscientious awareness (Reber 1989; Seger 1994). Dynamic simulation-based learning has been shown to facilitate learning about hidden relations even when such relationships are not explicit. In a factory simulation study, implicit learning allowed individuals to gain an understanding of hidden cross relationships between business elements (Berry and Broadbent 1987).

REA (Resource-Event-Agent) Accounting Theory

This research applies Resource-Event-Agent (REA) accounting theory to build the KS underlying an individual's ES knowledge. This is a novel approach to assessing educational models and an innovative use of REA accounting theory. REA is a good candidate for creating an 'ontology-based' model of business-motivational knowledge concepts. An ontology explicitly specifies a conceptualization (Gailly et al. 2008). From the start, the purpose of the REA ontology was to describe the business domain in terms that both non-accountants and accountants could also understand, in contrast to the less widely known concepts of debit credit accounting (McCarthy 1979; McCarthy 1982; Geerts and McCarthy 1999).

Since its introduction, the REA ontology has been continually enhanced to expand its applications. Extensions supporting the enterprise environment include commitments, types and custody (Geerts and McCarthy 2002) and policy-level abstractions of typification and grouping (Geerts and McCarthy 2006). REA modeling has been most heavily utilized in accounting information systems education (Gerard 2005) with recent REA extensions addressing management issues such as balanced scorecard (Church and Smith 2007)and strategic planning(Church and Smith 2008). Church and Smith (2008) utilized the REA ontology to simulate enterprise strategy more broadly than in strictly quantitative accounting terms and in a more complex manner than is viable using qualitative methods. This supports the use of REA as an enterprise ontology which is viable to broadly model enterprise-wide strategy. In design science, REA schemas are used to generate reference architectures, describe business transaction cycles and to improve the business systems design process (Gailly et al. 2008). While design science researchers work towards greater formalization of REA modeling to improve its machine-processability, a continuing goal is to maintain its understandability. Dunn and Grabski (2000)found empirical evidence showing REA models are more semantically expressive than debit credit accounting models at describing both accounting information and business transactions. Semantic expressiveness means that a model represents the reality of its domain well. The same study also provided evidence of REA's use leading to greater task accuracy. Given this evidence that REA models are semantically expressive, useful in defining reference architectures and are well-suited to describe enterprise transactions; it is likely that REA models would be useful in capturing business knowledge gained from experiences using enterprise systems. A valuable and understandable business ontology, REA modeling is a natural candidate for capturing ES mental models. Therefore, REA modeling is applied here in a novel manner to assess the acquisition of BMK structures. Basically, economic concepts are defined in REA modeling terms and used to capture a learner's business-motivational knowledge structure.

Hypothesis Development

Research Model

The research model is represented in figure 2 in this essay. It builds on the end user education model introduced by Bostrom, et al. (1990) wherein education experiences and IT characteristics influence formation of knowledge structures. Knowledge structures mediate between the antecedent factor of educational approach and the outcomes of user perception of the system and learning performance. The current research investigates how different enterprise education methods affect business-motivational knowledge structures, part of the business context knowledge category in the ES knowledge hierarchy. The outcomes of interest are cognitive appraisal, from the user adaptation and coping literatures (Folkman and Lazarus 1988a; Folkman and Lazarus 1988b; Beaudry and Pinsonneault 2005) and job satisfaction (Loher et al. 1985; Spector 1985). The two learning models compared are traditional ES hands-on lessons (the objectivist learning model) and ES simulation-based exercises (the constructivist learning model). Both methods provide interaction with the same commercial enterprise system and address a similar set of business processes and transactions. It is postulated that simulation-based learning will be more effective in developing BMK and improving ES job satisfaction. Empirical research has provided support for a multilayered approach to ES user knowledge acquisition (Kang and Santhanam 2003; Santhanam et al. 2007). Kang and Santhanam's (2003) study of enterprise technical support identified the lack of business-motivational knowledge and business-procedural as two major ES user education deficiencies. They recommend that user education be done in a realistic business context. Business simulations have been found effective in providing a dynamic, real-world context while also limiting the context and complexity to facilitate learning situation (Berry and Broadbent 1987; Anderson and Lawton 2009).

Business-Motivational Knowledge

This paper focuses on BMK which is a form of business context knowledge. BMK is defined as knowing what the application can do for the individual and the organization as well as understanding its role in enabling consistent transactions across the organization (Kang and Santhanam 2003). This business context knowledge is also categorized as *know-why* knowledge which is understanding the business rules incorporated into the system or adjustments to system usage to meet a business need (Santhanam et al. 2007). During ES post-implementation use, *know-why* knowledge was the most frequently communicated during system-related knowledge transfers between peer ES users, as well as between ES users and technical support staff (Santhanam et al. 2007). One example of BMK is to understand how a production order transaction relates to financial results by affecting inventory sub-accounts. Because economic gain is the primary objective for businesses, BMK is conceptualized as understanding relations among economic events, both indirect effects from operations transactions and direct events from accounting transactions. Selected for its semantic expressiveness, REA accounting modeling (McCarthy 1982; Geerts and McCarthy 1999) is used to describe economic events and to assess the organization of BMK. The REA ontology is used extensively in accounting literature to describe economic relationships and facilitate accounting education (Dunn and McCarthy 1997; McCarthy 2003; Gerard 2005). Figure 3 illustrates how REA model rules conceptually describe business activities such as ERP transactions. Figure 4 depicts an REA example defining concepts that are used to assess the business-motivational knowledge structure.

Knowledge can be described in terms of its quantity or its structure. Experts don't only have more knowledge content, but their knowledge is organized in ways that make it easier to retrieve, functional, and efficient (Bedard and Chi 1993). Well-formed domain knowledge structures are associated with higher expertise. Per ACT knowledge theory (Anderson 1982; Anderson 1993), practice allows for refinement of knowledge productions which leads to new relationships among knowledge concepts. Haerem and Rau (2007) differentiate between surface structure and deep structures in problems or tasks. *Surface structures* are perceivable elements related to a problem or task which are visible input or output characteristics. *Deep structures* refer to the underlying principles or hidden processes related to the problem or task. In the ES knowledge hierarchy (Sein et al. 1999), application knowledge is about ES surface structure while business-motivational knowledge pertains to deep structure. Such business context knowledge is difficult to learn as it is tacit and consists of relationships that are not directly evident from the user interface. Haerem and Rau (2007) found that experts approach tasks differently, performing better than novices on deep structure tasks. Without deep structure knowledge, novices perform procedures with repetitiveness, failing to fully adapt their task approach under dynamic business conditions. While novices may perform well on routine surface structure tasks, they are less capable of handling novel situations or diagnosis task needs in dynamic environments. In contrast, experts are aware of deep structure relationships and find deep structure attributes to be less complex and more analyzable. This supports the large differences in the organization of knowledge between experts and novices.

Auditing is a domain where strong differences exist between novices and experts, where experience is necessary to develop higher levels of expertise and where the organization of knowledge is extensively studied. Literature on auditing expertise in accounting literature provides strong precedent for the importance of knowledge organization and for differential performance outcomes based on the individual's organization of a set of domain knowledge. Early research by Davis and Davis (1998) and Frederick (1991) showed audit knowledge could be organized by transaction cycle or control objective. Frederick et al. (1994) found that experienced auditors used audit objective knowledge structure more frequently than a transaction cycle knowledge structure. Nelson et al. (1995) found that a mismatch between knowledge structure and task structure reduced auditor performance on conditional probability judgments. Studying EDP (electronic data processing, aka information systems) auditors, Curtis and Viator (2000) discovered a preference for a transaction flow structure. Borthick, Curtis and Sriram (2006) also found that transaction flow was a knowledge structure type that reflects greater detail than are found in the transaction cycle structure. This body of audit research supports both the value of understanding how accounting knowledge is structured and its related to task structure.

Hypotheses

Economic outcomes are the primary motivator of business; therefore business-motivational knowledge (BMK) involves relationships among economic events (accounting and financial transactions). A major benefit of integrated ES's is how operational transactions internally execute accounting entries to automate business processes. Such accounting entries are often invisible to the user. For example, an operational transaction that records a raw materials movement from storage to production would internally record changes to raw material inventory and a production cost accounts. The invisible nature of these accounting entries positions them as hidden cross relationships within a dynamic system. Therefore, BMK knowledge is not acquired directly from ES surface features. It is based on hidden process relationships and is primarily conceptual in nature. For example, a production planner with high BMK would perform better because they understand their processes causal linkages with the sales commitment process (such as shipment lead time guarantees, product reservation policies for contracted shipments, safety stock planning factors or product availability assumptions). Higher BMK enables better production planning to effectively support customer sales. BMK is contains deep structure knowledge about company policy, business rules and process inter-dependencies. In general, deep structure knowledge is the understanding of underlying principles or hidden processes related to a task (Berry and Broadbent 1987; Haerem and Rau 2007). Deep structure knowledge of complex systems is a candidate for implicit learning. Implicit learning is defined as the act of learning complex information in an incidental manner, without explicit focus or conscientious awareness (Seger 1994). Dynamic simulation-based learning has been shown to facilitate learning about hidden relations even when such relationships are not explicit. In a production factory simulation study, implicit learning allowed individuals to gain an understanding of hidden cross relationships between business elements (Berry and Broadbent 1987). The tacit knowledge gained from implicit learning is evident from decisions and actions, even when such knowledge cannot be verbalized (Reber 1989; Seger 1994).

Traditional ES learning models focus on scripted procedures emphasizing application surface level knowledge without exposing the dynamics (deep structure) supporting business process interactions. Santhanam and Sein (1994) showed that users with a strictly rote procedural knowledge performed poorly compared to individuals with more accurate conceptual knowledge structures. Traditional education methods focus on application interface knowledge without encouraging experimentation, adaptation and innovation in ES task execution. Santhanam and Sein (1994) found that individuals experiencing a high amount of system interaction developed better knowledge structures than those with little interaction. ES simulation exercises provide experiential learning through several cycles of novel system interaction with outcome feedback. The learner selects strategies and specific transactions, learning how system interactions influence salient economic outcomes. Heavy users gain tacit knowledge of internal causal relationships from experience with the dynamic system that engages working memory in unconscious processes and reveals underlying business processes such as indirect accounting transactions (Berry and Broadbent 1987; Hassin et al. 2009). Experiencing linkages between surface and deep structures promotes developing more accurate BMK.

In summary, simulation learning methods present learners with a more realistic and dynamic business environment offering exposure to both deep and surface structure aspects of the ES. Users gain tacit knowledge through implicit learning by interacting with a dynamic simulation and reviewing financial feedback. Effectively, business experience is accelerated by using the ES through multiple simulated business cycles. In this way, the simulation speeds up acquisition of BMK that individuals would typically acquire through extended work experience. As such, business-motivational knowledge is best conveyed through dynamic simulation-based learning rather than by traditional learning methods.

> *H1a: Compared with traditional learning, simulation-based learning has a greater positive influence on business-motivational knowledge.*

As in other educational treatments, the instructor's management of the educational experience has a strong influence on how a learning method is delivered. To account for variations in the execution of the treatments, a variant similar to hypothesis H1a is formulated below. This hypothesis captures the degree to which the educational method actually implements a constructivist, experiential educational experience versus a more objectivist experience. In this hypothesis, the categories of traditional or simulation treatment is replaced with a broader learning categorization based on the degree of experiential, constructivist learning.

> *H1a': Compared with traditional learning methods, constructivist learning has a greater positive influence on the business –motivational knowledge.*

ES transactions automatically record accounting entries as hidden side-effects that are made visible in outcome feedback such as financial reports. Individuals with accounting and financial expertise will routinely monitor the economic impacts of ES operations. Individuals without accounting and finance expertise are not as aware of accounting side-effects nor do they proactively consult financial reports. In simulation-based learning, operational success is clearly associated with economic gains as measured by quarterly financial results. In a complex learning situation, learners will selectively focus on any of a number of factors, so increasing the salience of a specific factor increases its probability of becoming the focus of attention (Berry and Broadbent 1987). Financial outcomes become extremely salient when they serve as the primary measure of success. Focusing on economic measures of success increases their salience, raising higher growth of awareness among non-accountants. High salience motivates non-accountants to proactively monitor financial indicators. In the simulation context, non-accountants perceive financial indicators as a means of 'keeping score' rather than as accounting information. The financial measures provide learners new business information and implicitly convey economic information during the learning process. As financials start being monitored and analyzed, the impact of ES transactions on accounting information is unconsciously learned. The non-accountant gains BMK by implicitly learning linkages between operational transactions and accounting impacts. It takes *salience* (the importance of financial outcomes), *awareness* of new causal factors (ES transactions cause accounting side-effects), and *action* (executing transactions to view pertinent accounting information) to observe the deep structure relations making up BMK. Exposure to diverse information promotes implicit learning about complex relationships. Unexpected results will challenge existing mental models of business operations, prompting the reorganization and refinement of BMK. In summary, accounting and financial expertise is expected to have a moderating effect on the influence of simulation-based learning on BMK. Based on their expertise, accounting and financial experts always focus on economic indicators across all education conditions. Individuals with little accounting and financial background are typically less mindful of accounting side-effects of ES transactions. These individuals will gain more BMK through the implicit learning that occurs while experiencing the dynamic simulation as aided by the increased salience of accounting measures.

> *H1b: When compared with traditional learning methods, simulation-based learning methods have a greater positive influence on business-motivational knowledge for individuals without accounting and finance expertise.*

Integration and cross-functional collaboration are central to the purpose and functioning of an enterprise system. Such business context knowledge is contained in both business-process knowledge and business-motivational knowledge, the latter of which is defined as an understanding of what the tool can do for the user and the organization and how it maintains consistent enterprise-wide transactions. Kang and Santhanam (2003) found that business-motivational knowledge is absent from many ES education programs resulting in users who lack a broader enterprise context for making business decisions and executing work tasks. Without BMK, the user is likely unaware of accounting and financial ramifications of their operational transactions and unaware of the impact on the firm's economic outcomes. Failure to understand the broader business context leaves the ES user unable to operate effectively in an integrated environment and at a loss to understand broader implications of their ES activities. In *primary cognitive appraisal,* the user evaluates what they have at stake in the encounter with new IT from two aspects, the evaluation of opportunity and of threat (Folkman et al. 1986a; Folkman et al. 1986b; Major et al. 1998). The lack of BMK reduces the user's ability to operate effectively using the ES which causes them to see the ES introduction as a threat to their job. A deficiency in BMK leads to sub-optimal task performance, completing tasks routinely and considering a localized perspective. Users lacking BMK will overlook cross-functional efficiencies which the ES is designed to exploit. Failing to understand broader impacts of the ES, users will be fearful because their actions can have far reaching impacts than they can not anticipate. As such, the individual with low BMK will view the ES as a threat. BMK includes a broad understanding of how the ES contributes to firm value and it enables a user to leverage inter-dependent functions to achieve efficiencies. Understanding business context, including process inter-dependencies and their impact on economic outcomes helps the user understand how their role impacts economic results. This equips users to find improvements and efficiencies to contribute more to the value of the firm. High BMK results in a higher awareness of opportunities to contribute to firm value via ES use.

> *H2a: Business-motivational knowledge has a positive influence on primary cognitive appraisal of opportunity.*

> *H2b: Business-motivational knowledge has a negative influence on primary cognitive appraisal of threat.*

A user's *secondary cognitive appraisal* is an evaluation of what resources, options or abilities they possess or can obtain to prevent harm, overcome barriers or to improve the possibilities for benefits (Folkman et al. 1986a; Folkman et al. 1986b; Major et al. 1998). The foundational levels of the ES knowledge hierarchy, application interface skills and business process knowledge, provide control over performing job functions with the ES (Sein et al. 1999; Kang and Santhanam 2003). Business-motivational knowledge provides a conceptual understanding of the business economic context, but it does not provide the knowledge needed to utilize and control the ES. BMK consists of important economic relationships but not the procedures needed to perform business functions using the ES that ultimately impact economic measures. It does not make the user more confident about making good decisions regarding occasions and extent of ES use, so individuals with high BMK are not more likely to productively adapt to directly controlling the ES. While BMK enables the user to see more opportunities and potential threats from using the ES, but this knowledge does not impart a greater sense of control over the ES application itself. In sum, BMK provides business context about economic interactions as measured by accounting functions, but not the ability to operate the ES to achieve specific outcomes. Therefore, BMK does not enhance the user's efficacy and it should not influence secondary cognitive appraisal of perceived controllability.

H2c: Business-motivational knowledge has no significant influence on secondary cognitive appraisal of perceived controllability.

The study of job satisfaction has a rich tradition in organizational behavior literature because of its relationship with key personnel variables including job performance (Judge et al. 2001), job commitment (Riketta 2008) and job turnover (Joseph et al. 2007). In IT literature, Joseph et al. (2007) points out key gaps in organizational behavior and turnover research, calling for a better understanding of how IT professionals respond to factors that trigger turnover, such as the 'shock' experienced when an enterprise system is introduced. This indicates a need for further research into the loss of critical IT workers and, with the growth in ES implementations, highlights the need for effective interventions to improve job satisfaction when an ES event occurs. In a business environment, success is determined by economic measures based on a complete and accurate recording of accounting and financial transactions. Business-motivational knowledge (BMK) is an understanding of what the application can do for the organization and for the user, along with an appreciation for how it enables consistent transactions across organization (Sein et al. 1999; Kang and Santhanam 2003). Thus, higher BMK includes understanding how the ES provides the firm's economic status through business operations metrics and financial accounts summaries. Higher BMK provides an understanding of how the ES collects, calculates and provides access to accounting measures that enable visibility and self-assessed feedback about how one's job impacts the firm's economic outcomes.

An ES provides immediate, pervasive access to the economic status of business operations through real-time updating of accounting and financial status representing the firm's economic status. ES attributes of cross-functional integration, real-time transaction recording, and the availability of aggregated financial data, provide more complete and timely business economic performance *feedback*. As individual job tasks are recorded in the ES, economic impacts are automatically calculated. Thus, individual job performance is linked to economic measures in real-time, providing access to individual performance feedback. Feedback is defined as the degree to which doing one's assigned job tasks results in the individual obtaining direct and clear information about the effectiveness of his/her performance (Hackman and Oldham 1976). To access better timely feedback on their own performance, the individual needs BMK to understand what job related accounting and financial information is available and how to interpret it. Therefore, higher BMK allows an individual to obtain performance feedback reflecting the impact of one's job role. Knowing what economic data is available and how to interpret it will situate one's job in a more meaningful context, enabling self-accessed feedback of how an individual's job tasks contribute to firm economic goals. Understanding the broader economic context assists decision making autonomy because financial ramifications of actions can be better anticipated. Of the five job factors identified by Hackman and Oldham (1976) as influencing job satisfaction, the two most influential job factors are autonomy and feedback (Loher et al. 1985; Humphrey et al. 2007). Individuals with higher business-motivational knowledge have the ability to seek feedback from economic and operational measures. Similarly, increased ability to access and assess economic information enhances decision making autonomy. Three distinct dimensions of autonomy have been identified as a) work methods autonomy, b) work scheduling autonomy, and c) decision making autonomy, with the later having the greatest impact on job satisfaction (Humphrey et al. 2007). Decision making autonomy is defined as the freedom to make decisions at work (Humphrey et al. 2007). An ES provides timely access current operational and financial information. Direct access to a broad range of real-time economic information is expected to move decision making closer to the individual worker level. BMK is essential to using ES accounting and financial information in support of decision making. With BMK, individual decision making utilizes company-wide economic data to better inform decisions. With BMK, the individual has a greater understanding of economic impacts, financial inter-dependencies, and how task alternatives impact accounting results. BMK is an understanding of economic interdependencies and broader business context and enabling more effective and independent contributions based on ES-provided information. Thus, BMK supports greater decision making autonomy. With increased autonomy and access to more timely feedback, individuals should achieve greater job satisfaction.

H3: Business-motivational knowledge has a positive direct influence on ES job satisfaction.

An ES changes the work environment which can bring on stress and coping reactions. Assessing job or life impacts like using an ES initiates a cognitive appraisal, i.e. a mental projection of the degree of change in job role and the future outcomes of ES use. This cognitive appraisal of job impacts in turn influences an individual's expected job satisfaction. When an individual foresees benefits from ES use, then primary cognitive appraisal of opportunity is high and the expectation of positive outcomes for job satisfaction should also be high. Stress reactions perceived during primary cognitive appraisals of threat often lead to failure (Tomaka et al. 1997; Drach-Zahavy and Erez 2002). Threat appraisals of IT events lead to non-productive emotion-focused coping strategies such as self-preservation, disturbance-handling or avoidance, rather than the productive problem-oriented coping strategies of benefits-maximizing or exploration-to-innovate or exploitation (Beaudry and Pinsonneault 2005; Bala 2008). Non-productive, emotion-focused coping based on a lack of important ES knowledge can cause avoidance of the ES. Energy is expended addressing emotional responses to the ES rather than on learning and using the technology effectively to solve business problems. Therefore, projection of increased threat should have negative impact on job satisfaction. In summary, when an individual anticipates possible benefits (i.e. new opportunities) and a low degree of negative consequences (i.e. low threat) then primary cognitive appraisal is high and the expectation of positive outcomes for job satisfaction should also be high.

H4a: Primary cognitive appraisal of opportunity positively influences ES job satisfaction.

H4b: Primary cognitive appraisal of threat negatively influences ES job satisfaction.

Secondary cognitive appraisal is an evaluation of the resources, options or abilities an individual possesses or can obtain to prevent harm, overcome barriers or to improve the possibilities for benefits (Folkman et al. 1986a; Folkman et al. 1986b; Major et al. 1998). Perceptions of control are needed to achieve possible benefits or to overcome barriers presented, so high secondary appraisal of control is a recognition of having the mechanisms and abilities to maximize the potential presented in various situations. In this way, perceptions of control influence satisfaction and overall well-being by contributing to the mastery needed to achieve benefits (Folkman et al. 1986a). When a individual feels out of control of a situation, this leads to energy spend on emotion-focused coping (Lazarus 1993), greater passivity, helpless and can even lead to depression (Folkman et al. 1986b). So, low perceptions of control over the ES would increase emotion-focused reactions, diminish job-related problem-focused activities, lead to passivity on the job and avoidance of the ES which lowers satisfaction and overall well-being. The secondary cognitive appraisal of perceived controllability is essential to feeling competent to use the ES to complete job tasks, which in turn positively influences ES job satisfaction.

H4c: Secondary cognitive appraisal of perceived control positively influences ES job satisfaction.

BMK provides the understanding needed to access economic business relationships and outcomes, but does not provide the ES application skills or operation process knowledge to control the ES to perform job functions. BMK is hypothesized to positively influence opportunity (H4a) and negatively influence threat (H4b) but not to significantly influence control (H4c). Stress and coping literature has identified cognitive appraisal as one of the basic processes mediating the relationship between stressful person-environment relationships (such as ES adoption and use) and their short-term or long-term outcomes (Folkman et al., 1986a, 1986b). Therefore, BMK's influence on job satisfaction is expected to operate through primary cognitive appraisal but not through secondary cognitive appraisal of controllability. An accurate understanding of business motivation provides a context for business decision making and assessing the impact of job tasks *leading to improved job satisfaction*. Introduction of an ERP is a disruption to the job situation and has a sizable impact on an individual's job role and needed job skills. The stress and coping literature has established the value of cognitive appraisals of projected benefits (primary cognitive appraisal of opportunity) and projected risks or negative consequences (primary cognitive appraisal of threat) in assessing stressful situations (Folkman et al. 1986a; Folkman et al. 1986b; Lazarus and Folkman 1987). Accurate BMK contributes to utilizing the ES for advancing one's job role and achieving more advanced and autonomous job performance (Sein et al. 1999; Kang and Santhanam 2003). Job satisfaction is a summary assessment of current and future expectations of happiness with one's job situation (Spector 1997; Judge et al. 2001).When primary cognitive appraisal assesses the ES as high opportunity and low threat, then the ES is seen as providing opportunities for increased job success and job enrichment. Job enrichment can improve both employee performance and satisfaction by building greater scope for personal achievement and recognition on the job (Judge et al. 2001). This is especially true for individuals with high 'growth needs strength' (Loher et al. 1985).

Several studies by Tomaka et al. (1997) support the importance of cognitive appraisal processes in capturing challenge (opportunity) and threat responses to stressful situations. These cognitive appraisal assessments then contribute significantly to an overall assessment of job satisfaction. In the ES context, findings support perceived fit fully operating through attitude to influence ES symbolic adoption (Nah et al. 2004). In that study, cognitive appraisals are essentially perceptions of fit between the ES and the individual's job role which influence the job attitudes, conceptualized in this study as job satisfaction. In summary, it is expected that business motivational knowledge will influence primary cognitive appraisal (opportunity and threat) which act as mediators in carrying this influence through to influence ES job satisfaction.

> *H5a: The influence of business-motivational knowledge on ES job satisfaction is mediated by primary cognitive appraisal of opportunity.*
>
> *H5b: The influence of business-motivational knowledge on ES job satisfaction is mediated by primary cognitive appraisal of threat.*

Secondary cognitive appraisal of perceived control is the projected expectation of having or gaining the ability to manage and operate effectively in a situation or use a technology (Major et al. 1998). Literature has long established that a high degree of perceived control is associated with high levels of job satisfaction and low levels of role stress (Spector 1986). However, given H4c which hypothesizes that BMK would not contribute the necessary ES application skills or business process knowledge needed to influence appraisals of control, therefore there could be no mediation of BMK to influence overall job satisfaction.

> *H5c: The influence of business-motivational knowledge on ES job satisfaction is not mediated by secondary cognitive appraisal of perceived controllability.*

Methodology

Technology

SAP is the ES technology selected for this study. SAP is the leading commercial ERP system and has historically held over a third of the ERP market for large enterprises. As a collaborative workflow application, SAP presents the individual user with a vast array of business transactions and interdependent functions. Learning to use SAP is a challenge due to its rich feature set and unfamiliar user interface. Characteristics of SAP's user interface reflect the complexity of the ES knowledge hierarchy. Key SAP interface characteristics include:

- Extensive main menu with submenus that can be four or more levels deep.
- Unfamiliar menu icons rather than the de facto standard of desktop PC applications.
- Hundreds of transactions accessed at the command line by entering transaction codes.
- Transactions dependent on centralized information populated by other functional areas.
- A dense interface screen with data entry sequencing constraints and strict data validation.

IT skills are not easily transferable from previous IT systems when user interface styles differ substantially (Satzinger and Olfman 1998). Empirical research has shown that user interface style substantially impacts user performance (Davis and Bostrom 1993) so major differences in user interface style are problematic to new users.

Learning Models

Traditional IT learning methods typically include lectures and hands-on ES lessons covering procedural knowledge in a static ES environment. The ES simulation learning methods include introductory instructions, a simulation participant manual[1] and hands-on interaction with a dynamic ES situated in a real-time simulated marketplace. In both education conditions, participants interface directly with SAP the enterprise system and execute a standard set of ES business processes. Major ERP capabilities in support of core business processes include procurement, production and sales, often emphasizing the cash-to-cash cycle in a manufacture to stock business environment. The SAP system and education materials are available through the SAP University Alliances program[2]. The simulation environment consists of a functional SAP[3] system and the ERP business simulation[4] (Léger 2006). The role of the simulation system is to emulate a realistic business marketplace of suppliers and customers external to the hypothetical manufacturing firms. Teams of approximately four learners operate a cereal production

---

[1] Information about ERPsim learning materials is available at http://erpsim.hec.ca/.
[2] Information about the SAP University Alliances program is available at https://www.sdn.sap.com/irj/scn/uac.
[3] Information about the commercial SAP enterprise resource planning system can be found at http://www.sap.com.
[4] The simulation environment (ERPsim) system was made available for use in this research by Baton Simulations, http://batonsimulations.com/

company in a made-to-stock manufacturing supply chain requiring them to interact with suppliers and customers to complete the cash-to-cash cycle. Participants operate within production constraints to implement operational business decisions using the commercial SAP system. The business goal is to maximize company revenues and return on investment (ROI) while maintaining a high credit rating. The educational objectives are to maximize knowledge acquisition across the ES knowledge hierarchy. The simulation compresses three months of business operations into about an hour, offering repeated opportunities for decision-making and problem-solving. Outcome feedback is provided hourly through quarterly financial results.

Data Collection

Study participants are graduate and under-graduate students in ES courses in several universities across the US and Canada. The sample size is 176 respondents who are learning by using targeted SAP lessons in an ERP course at SAP University Alliance member universities. The specific traditional SAP lessons are Fitter-Snacker, Fly a Kite and Global Bike. Data collection took place in the summer and fall of 2009.

Business-Motivational Knowledge Instrument

As knowledge structures have proven very effective for assessing tacit and procedural knowledge (Goldsmith and Johnson 1990), Pathfinder knowledge structure analysis is chosen for assessing BMK. BMK has been conceptualized as critical knowledge for the ES environment (Sein et al. 1999) and its existence is empirically confirmed as a type of business context knowledge (Kang and Santhanam 2003). Its existence was further supported as 'know-why' ES knowledge (Santhanam et al. 2007).

However, no prior survey instrument was found for assessing BMK structures, so BMK survey design was initiated. As the investigation of BMK is nascent, BMK measurement development is fairly exploratory in nature. First, key economic events within the ES BMK domain were identified by reviewing traditional and simulation education materials as well as by interviewing several SAP experts. Particular focus was placed on identifying both surface features (user interface) and deep structure (master data or configuration) concepts to ensure coverage of hidden relationships within the business context. Next, a preliminary REA system model (McCarthy 1982; Geerts and McCarthy 1999) was created based on education materials and confirmed with ERP experts. Prior research has validated use of network models of IT systems for assessing a user's understanding of the IT system (Kellogg and Breen 1990). REA model segments were then identified as BMK concepts for possible use in the survey instrument. Figure 4 gives an example of how an REA model was segmented to identify BMK concepts. For practical considerations, a full REA model representing the complete enterprise system is not feasible means of determining knowledge structures. For the broadest coverage, economic event concepts from 3 main business processes (sales, procurement and production) were selected. To reduce the size and complexity of the instrument, a few representative concepts were selected from each two processes and counter-balanced with a concept from the third area to maintain the breadth of the KS coverage. This helps achieve greater variation across instrument responses, an essential characteristic for good measurement. Two experts tested the initial survey; range suppression was discovered so the BMK concepts were slightly revised to ensure greater variability of relatedness measures. Based on a small student pilot, the survey instructions and relatedness question format were updated to improve readability and understandability.

REA models are used to define ES economic events that are organized within a BMK structure. Then Pathfinder data reduction and analysis methods are used to assess knowledge. As such, business-motivational concepts are defined as single economic events or transactions with the accompanying inflows and outflows of resources along with the associated agents. Knowledge structure assessment uses relatedness comparisons of all possible pairs of concepts within the knowledge domain. For ‘n’ concepts, this requires (n*(n-1))/2 survey items per knowledge structure. The knowledge structure is obtained from participant’s ratings of relationships between all possible concept pairs. This study uses eight BMK concepts requiring 28 relatedness questions. The measurement scale for concept relatedness data is collected using a 7-point Likert scale from 1 = “Not all related” to 7=”Very highly related”. Appendix D, table 1 in contains BMK survey instructions, concepts, and sample items. Other items are from pre-existing validated scales as listed in appendix D, table 2.

The importance of developing internal conceptual models (i.e. knowledge structures) is well accepted (Anderson 1982; Frederick 1991; Frederick et al. 1994). Accurate knowledge structures withstand the passage of time, facilitate far-transfer tasks and result in superior task performance (Karuppan and Karuppan 2008). Evidence shows that the learners with incorrect conceptual models, aka weak methods problems, (Anderson 1987) are unable to perform effectively in tasks such as accounting IS database design (Gerard 2005). Well-formed task-appropriate knowledge structures improve the identification of control deficiencies (Frederick 1991; Bonner and Walker 1994; 1994; Curtis and Viator 2000). Network structural models, such as the Pathfinder technique employed here, have been used extensively to assess knowledge structures in many areas of cognitive science, education and computing (Dearholt and Schvaneveldt 1990). Recently, accounting and auditing studies have begun to embrace the Pathfinder technique (Curtis and Viator 2000; Curtis and Davis 2003; Rose et al. 2007). Curtis and Davis (Curtis and Davis 2003) used the technique in studies on the effectiveness of accounting education finding that it predicted additional variance in performance. Rose et al. (2007) used Pathfinder analysis in their extension of Bonner and Walker's (Bonner and Walker 1994) research on acquiring procedural knowledge. Rose et al. (2007) determined that knowledge structure measurement is especially valuable in decision domains where traditional knowledge measures are often insufficient or infeasible. Accounting and auditing literature have extensively assessed knowledge structures using cophenetic correlation, a method that captures a simpler dichotomous measure of relatedness (Choo and Curtis 2000). Other knowledge structures research in accounting have used multidimensional scaling (MDS) and clustering methods. A valuable review and comparison of using these techniques in accounting literature is found in Choo and Curtis (2000). Pathfinder offers advantages including its ability to capture a wider range of relationship values, reduce the network graph using selectable parameters based on research goals and to provide an understandable visual representation of the relationship map. Pathfinder's advanced data reduction and structural analysis capabilities are shown superior to cluster analysis and multi-dimensional scaling techniques (Dearholt and

Schvaneveldt 1990; Goldsmith and Johnson 1990). Many researchers consider Pathfinder analysis to be the most effective method to assess knowledge structures (Schvaneveldt 1990; Karuppan and Karuppan 2008). Pathfinder network graph analysis is described in essay 1, appendix B.

Other Measurement Scales

Scales for other latent variables utilized previously published and validated scales which were measured using a 7-point Likert scale from 1='Strongly Disagree' to 7= 'Strongly Agree'. Two independent variables measured the learning model – a binary variable (Trad0_Sim1) identifies the traditional (coded 0) and simulation-based (coded 1) education intervention and an eight item scale measures the degree to which the intervention displayed constructivist characteristics of being experiential, discovery-based education under the control of the participant. The constructivist scale is a parsimonious reduction of a prior constructivist learning scales as validated in multimedia online contexts by Wen et al. (2004), Maor and Fraser (2005) and Den Brok et al. (2004). The content scale was a subset of a scale from Johnson and McClure (2004) which based on the revised Constructivist Learning Environment Survey CLES 2 (20 items). Two binary variables captured the effect of having no accounting and finance expertise within each of the two treatments (Non-Acct_Trad and Non-Acct_Sim). The three forms of cognitive appraisal (opportunity, appraisal and control) were assessed using measurement scales from Bala (2008) based on Major et al. (1998) with opportunity measures also based on Drach-Zhavy and Erez (2002). ES job satisfaction used accepted scales for job satisfaction about the work itself from Spector (1985) augmented by a items from Tsui et al. (1992). Two control variables were also used. A single item measure captures perceptions of training length (Train_Not_Long). A sixteen item ES pre-knowledge measure captures prior knowledge of ES application transactions (TS), business processes (BK and PK), and enterprise systems management (ES) as used in Cronan et al. (2011) and adapted from Seethamraju (2007). Appendix D contains all survey measurement items.

Results

Participants in this study were graduate and undergraduate students participating in either traditional or simulation-based ES education at one of several large North American universities with membership in the SAP University Alliance. Data collection took place in two semesters, the fall of 2009 and spring of 2010. Pre and post treatment survey responses including the full set of 28 BMK relatedness items (post) were obtained from 205 participants (excluding incomplete and invariant responses). Invariant BMK response sets were identified using Pathfinder network analysis because a minimum threshold of relatedness variation must be exceeded in order to be able to assess a network graph. In Pathfinder analysis, invariant responses for BMK resulted in a very low or non-computable coherence metric which rendered the response unusable. The Pathfinder coherence metric could not be computed when most pairwise relatedness responses were rated as the same value, such as when variation occurred in only four or fewer responses out of the 28 pairwise comparisons. It is possible that the large number of incomplete and invariant responses may be due to the length and complexity of the

BMK relatedness measures. A usable sample size of N=176 complete pre and post matched responses remained after outlier responses were identified and removed.

Of the usable responses, 40% experienced the traditional education treatment while 60% experienced the simulation treatment. The mean participant age was 23 years old (standard deviation of 5.182) with ages ranging from 17 to 63 years of age. Participants consisted of 65% males (coded 1) and 35% female (coded 2). The sample has a mean full time work experience of 2.4 years (standard deviation of 5.5) and mean part time work experience of 3.8 years (standard deviation of 2.7). 31% of participants have accounting or financial expertise and 26% of participants have information systems technical expertise. Descriptive statistics are presented in table 1. The dataset was checked to verify the standard assumptions required for linear regression methods. The assumptions for linearity, normally distributed error terms and homoscedasticity were verified using data plots and normal distribution graphs. Data independence is a concern when data has a natural time sequence characteristic so the Durbin-Watson statistic was used to verify that successive residuals are not correlated. The Durbin-Watson statistic was mostly over 2.0 with the lowest value of 1.85 exceeding the D_U =1.76 requirement (Montgomery et al. 2001). All Durbin-Watson statistical values exceed the D_U upper critical value required to accept the null hypothesis that error terms are not autocorrelated. To address the concern that some variables may display multicolinearity, variance inflation factors (VIF) were checked. Traditionally, VIF's below 10 were considered evidence of acceptable minimal multicolinearity. However, Cohen et al.

(2003) advises use of much stricter criteria and a common rule of thumb it to seek VIFs below 4. In this study, all VIFs were below 2.0 and are within acceptable limits.

Construct validity and reliability were assessed using guidelines by Fornell and Larcker (1981) and Nunnally (1978). Factor analysis using principal component analysis (PCA) identified seven factors by using the Varimax rotation method with Kaiser Normalization (table 2). For retained items, the factor loadings were greater than .70 for most constructs and all were greater than .60 as used in exploratory factor analysis with all cross-loadings below 0.40. Some items for the *job satisfaction* latent variable were slightly below the 0.70 level with very small cross-loadings. The four items above 0.65 were retained (two items dropped) to capture the breadth of the construct. All summative variables had Cronbach Alpha's above 0.865 (ICR column in correlation matrix, table 3). The variance shared between the constructs and their measures is determined by the square roots of the average variance extracted (AVE) (diagonal elements in table 3). All proved higher than the correlations with other constructs. These findings support convergent and discriminant validity of the measures (Fornell and Larcker 1981).

The *constructivist* variable was given special consideration because of its role in differentiating educational approaches. To ensure the constructivist variable discriminates across a wide range of educational methods, its factor loadings were initially observed across the two datasets for essay 1 and essay 2 to consider this factor across as many educational treatments as available. In this study, five of the eight constructivist items loaded on the same factor, along with one item from the *content* items which said "The ERP lesson instructions left room for me to make innovative business decisions." This item’s face validity and factor loadings place it with other *constructivist* items so all these six items were included in the summative *constructivist* variable. With six items, the constructivist variable has a Cronbach Alpha of 0.869.

BMK Measurement and Results

The 28 BMK pairwise relatedness survey items are reduced to a single BMK accuracy variable for use in linear regression analysis. The BMK variable represents the accuracy of the network graph depicting the organization of an individual’s business motivational conceptual knowledge. The accuracy of BMK is determined using Pathfinder network graph analysis (Dearholt and Schvaneveldt 1990; Schvaneveldt 1990) by computing the similarity between the participant BMK and an expert referent’s BMK knowledge structure. Pathfinder analysis provides two individual measures of the individual’s knowledge structure, namely its internal consistency (coherence metric) and accuracy (closeness or similarity metric). C*oherence* is the Pathfinder statistic indicating the internal consistency of the individual’s network graph representing the BMK knowledge structure (Goldsmith and Davenport 1990; Interlink 2007). *Similarity* (also called the C or closeness metric) is the Pathfinder statistic indicating the accuracy of the participant’s BMK network graph as determined in comparison to an expert referent’s BMK network graph. Similarity values (ranging between 0 and 1) of 1 represent a completely accurate BMK knowledge structure exactly matching the expert referent’s reduced network graph. Prior to comparison with participant graphs, Pathfinder analysis of experts BMK knowledge structures was undertaken to establish an expert referent BMK knowledge structure as the basis on which to evaluate the accuracy of participant’s

BMKS. Appendix E summarizes the method for establishing the expert referent BMK knowledge structure. Each participant's BMK (accuracy or similarity) metric provides the BMK variable used in linear regression tests.

Linear Regression Results

The hypotheses in the research model (figure 2 and table 7) were tested with a series of linear regression analyses using PASW/SPSS Version 17 (results in table 4a and 4b, figures 5 and 6). First, the influence of traditional and simulation-based ES educational treatments on BMK was tested in H1a and H1a' in the presence of two control variables of 'training not too long' and self-reported prior ES knowledge. H1a was not supported as the binary indicator (*Trad0_Sim1)* indicating the intervention type did not predict BMK (Trad0_Sim1 has a beta coefficient of -0.019 at a non-significant p-value of 0.806). The model was only marginally significant with an R-squared of 0.04 and a p-value of 0.076. The only significant predictor was the control variable of *Training not long* with a significant beta coefficient of 0.165 at a p-value of 0.031. The alternative hypothesis of H1a' substituted the *content* and *constructivist* variables to replace the binary indicator (Trad0_Sim1) in order to capture a higher resolution of the intervention's characteristics. H1a' was a significant model with an R-square of .058 and p-value of .039. However, the *constructivist* variable was non-significant so the any differences between traditional versus simulation education methods are still not evident. The *content* variable indicating general quality of instruction and the instructor was a marginally significant predictor of BMK with beta coefficient of 0.149 and p-value of 0.075. Next, hypothesis H1b was tested to determine whether individual's with no accounting and financial expertise benefited more in forming accurate BMK based on educational treatment. The direct effects of non-accounting expertise and for the treatment condition were non-significant as well as the interaction term (table 4a, column H1b). Therefore, there was no support for moderation by non-accounting expertise.

In H2a and H2b, BMK is hypothesized to influence the two forms of primary cognitive appraisal, specifically opportunity and threat. H2a is supported by regression results finding that BMK is a significant influence on *opportunity* with a beta coefficient of 0.162 with a p-value of 0.034 and a significant R^2 of 0.026 with a p-value of 0.034 (column H2a(1) in table 4a). H2b is also supported given that BMK has a highly significant negative influence on the *threat* variable with a beta coefficient of -0.246 at a p-value of 0.001 with a highly significant R^2 of 0.061 at a significance level of 0.001 (column H2b(1) in table 4a). In H2c, the null hypothesis predicts that BMK has no influence on secondary cognitive appraisal of control. Hypothesis H2c is supported, with BMK having a non-significant beta coefficient of -0.004 with a p-value of 0.956 and a non-significant R^2 of 0.000 (column H2c(1) in table 4a). Regression analysis does not support H3 (Column H3 in table 4b) as BMK has no significant direct effect on *job satisfaction* (beta coefficient of 0.044 with a p-value of 0.570 in a non-significant model with R^2 of 0.027 and a p-value of .203). Tests of H4a, H4b and H4c show that both the opportunity and control variables have significant direct effects on job satisfaction but the *threat* variable is not a significant predictor (column H4(1) in table 4b). This supports hypotheses H4a and H4c with the cognitive appraisal of *opportunity* (with a beta coefficient of 0.329, p-value < 0.000) and *control* (with a beta coefficient of 0.435, p-value < 0.000) each having a highly significant positive effect on ES job satisfaction. H4b fails as the appraisal of *threat* is not significant (beta coefficient of -0.061, p-value of 0.902). The contribution of cognitive appraisal (significant predictors of opportunity and control) to variance in job satisfaction has a highly significant highly R^2 of 0. 435 with a model p-value of 0.000. These findings are consistent and robust having been additionally tested in the presence of model's other variables. Testing with all variables direct effects continues to support significant relations opportunity and control as antecedents of job satisfaction (column H4(3 and 4) in table 4b). With full direct effects of all model variables (column H4(3) in table 4b, excluding prior non-significant binary variables) the results show no meaningful change. This regression has a highly significant highly R^2 of 0.571 with a p-value <0.000.

Mediation Hypothesis Results

In H5a, H5b and H5c, accurate BMK is hypothesized to operate on job satisfaction mediated through primary cognitive appraisal (opportunity and threat), but not mediated through the secondary cognitive appraise of perceived control. Mediation testing followed guidelines established by Baron and Kenny (1986) which require establishing direct relationships before testing for mediation in the presence of all variables. The Sobel mediation test (Sobel 1990; MacKinnon et al. 2007) was also used to calculate the indirect effects for each mediation variable. H3 failed given BMK's non-significant direct effect on job satisfaction. Finding a direct effect like H3 is a critical pre-condition for mediation hypotheses using the Baron and Kenny (1986) method, so H5a and H5b are not supported. However, lack of support for H3 provides evidence supporting H5c’s null hypothesis that control is not a mediator of BMK on job satisfaction. Table 5 shows the direct effects used in Baron and Kenny mediation testing and table 6 gives the Sobel Test calculations of the indirect effects of BMK on job satisfaction. Figure 7 shows both direct effects and the Sobel calculations done for BMK’s indirect influence on job satisfaction through opportunity, threat and control. Sobel results support H5a and H5b finding significant indirect effects of BMK operating through opportunity (Sobel indirect effect of 0.895 with a p-value of .0393) and through threat (Sobel indirect effect of 0.719 with a p-value of 0.0109). Sobel tests support H5c with findings that there is no significant indirect effect of BMK operating through control (Sobel indirect effect of -0.025 with a p-value of 0.956).

In summary, BMK did not appear to be influenced by the educational method or degree of constructivism, but was marginally influenced by educational content, instructor and length of training. BMK did influence primary cognitive appraisals of opportunity and threat but not control. Consequently, opportunity and control influence job satisfaction. Using Baron and Kenny’s (1986) analysis, no mediation was supported given that BMK had no direct effect on job satisfaction. Sobel mediation calculations (Sobel 1990; MacKinnon et al. 2007) determined a significant indirect effect of BMK on job satisfaction through opportunity and threat, but not through control (table 6). A summary of the hypotheses and findings are contained in table 7.

Discussion

This study is a initial attempt to capture and analyze ES economic knowledge, based on the definition of BMK (Sein et al. 1999; Kang and Santhanam 2003) and utilizing Pathfinder network graph analysis (Dearholt and Schvaneveldt 1990; Schvaneveldt 1990) of the newly defined measures for the BMK knowledge structure. This measure was created for this essay based REA accounting model for an ES (McCarthy 1979; McCarthy 1982; Geerts and McCarthy 2002). The BMK measurement approach was to use REA model segments (containing all three entities of economic resource, economic event and economic agent) to define each concept in the BMK knowledge structure. This resulted in concepts consisting of phrases of about 10 to 15 words which were then pairwise compared in the measurement scale. This approach deviates somewhat from the more typical form of relatedness measures using single or double word concepts. As a result, this measure was significantly longer and more demanding, burdening survey respondents with a greater cognitive load and increased demands on working memory. The scale complexity likely lowered the scale's usefulness in capturing BMK and may have resulted in missing some educational interventions effects hypothesized in H1a, H1a' and H1b. The BMK measure did demonstrate some ability to detect knowledge of economic relationships because BMK coherence has a significant correlation with expertise in accounting and finance with a significant r = 0.172. It was expected that accounting and finance expertise provides an existing framework for understanding economic relationships. Given lack of support for H1a, H1a' and H1b, either the BMK measurement was not effective in capturing effects of different educational interventions or different educational approaches had no discernable effect on BMK. Future research should refine and improve on these REA-based BMK measure, using more narrowly focused concepts by separating event, resource and agents as individual concepts in the relatedness measures. Such a measure would more closely follow KS research tradition and place less cognitive burden on survey participants. With simplification and refinement of the BMK measure, future research may hope to discern differential effects of educational methods.

It is interesting that the *Training not long* variable is the only significant predictor of BMK in the regression tests of H1a' and H1b. It is also significantly correlated with both BMK coherence (r = 0.179 with p-value of 0.018) and BMK similarity (r =167 with a p-value of 0.027) indicating that the perception of a not overly long training length positively influences the BMK knowledge structure (column H1a' in table 4a). Perhaps this variable is capturing a side effect of constructivist education, that of temporal dissociation occurring during cognitive absorption. As the participant becomes absorbed in the learning experience, temporal dissociation occurs and training is not perceived as overly lengthy. Cognitive absorption promotes the intention to use information systems (Agarwal and Karahanna 2000) and this stronger usage intention may increase educational ES use, creating conditions for increasing BMK. Those finding training too long are not experiencing temporal disassociation, indicating less engagement in the ES educational experience; leading to greater sensitivity to training length and less accurate BMK. Future research should investigate perceptions of training length, the relation with cognitive absorption along with the resulting efforts on BMK.

H2a, H2b and H2c were supported, indicating that BMK influences appraisal of ES opportunities and threats. A major benefit of ES use is the ability to capture, share and analyze a complete set of current, real-time accounting and financial information. Knowledge of economic benefits, reflected in BMK, gives insight into firm-level benefits of ES use, but also reveals threats to individual users as ES economic information can reveal poor performance and inefficient task execution. Per H2c, BMK does not improve perceptions of ES control, as it does not convey application usage skills or business process knowledge. H3 is not supported, indicating that job satisfaction is not directly influenced by simply understanding economic relationships, but such knowledge must translate into ES opportunities or threats on the job.

Appraising information systems (IS) as a threat is often identified in research literature (Nah et al. 2004; Beaudry and Pinsonneault 2005; Kim and Kankanhalli 2009; Beaudry and Pinsonneault 2010) **,** especially in light of many large and highly visible ES implementation failures (Scott 1999; Scott and Vessey 2000; King and Burgess 2008)**.** So, it is surprising to find support for hypotheses H4a (opportunity influencing job satisfaction) and H4c (control influencing job satisfaction), but not for H4b (threat influencing job satisfaction). An interpretation is that both these forms of primary cognitive appraisal operate similarly but in different directions such that the larger effect (opportunity) is attenuated as it cancels out the smaller effect (threat). This interpretation is supported by the correlations of cognitive appraisal variables with job satisfaction, as all are significantly higher than the regression coefficients. Pearson correlations of the three cognitive appraisal variables with *job satisfaction* are all highly significant (all with p-values of 0.000) with specific correlations as *opportunity* with r = 0.543, *threat* with r = -0.232 and *control* with r = 0.579. Effectively, a much higher level of opportunity appears to have counteracted the opposing and weaker influence of threat. With the degree of opportunity greater than the degree of threat, then threat became non-significant as the effect of opportunity is also attenuated. The presence of significant threat may have also diminished the influence of perceived control because of a need to apply some degree of control to address concerns about managing the threat. Some of control's influence (significant correlation with job satisfaction of 0.579) was also eroded, perhaps due to the significant correlation of threat to job satisfaction (significant correlation of -0.293). Effectively, threat may be reducing confidence in perceptions of control to a significant coefficient of 0.435 in the regression even as threat's coefficient became an insignificant -0.061. A final observation is that the direct effects model (column H4(4) in table 4b) indicates that constructivist education is a significant predictor of job satisfaction, though not operating via BMK. The type of educational intervention has a only has a direct effect, with the constructivist educational method having a positive direct effect on the job satisfaction outcomes (beta coefficient of 0.342 with p-value of 0.000).

Overall, although this study did not find differential effects on BMK between traditional and constructivist educational methods, but does support the important role of BMK in affecting primary cognitive appraisals of ES. BMK captures both implicit and explicit economic knowledge which effects cognitive appraisal of opportunity and threat from using an ES which leads to higher ES job satisfaction. While BMK helps the user identify beneficial economic opportunities as well as negative threats, the strength of benefits fully counteract the cognitive appraisal of threat while in the presence of perceptions of ES control. These results are encouraging as it suggests that business motivational knowledge is an effective means to increase perceptions of opportunity and counteract the negative perceptions of ES threat, as a possible means to improving ES job satisfaction. BMK offers promise to address the prevalent problems of user resistance to enterprise systems and reduction in job satisfaction at the use of ES. Future research should research what BMK reveals about ES opportunities and threats to identify how BMK can be leveraged in ES change management.

Limitations

BMK is the only knowledge type from the ES knowledge hierarchy (Kang and Santhanam 2003) addressed in this essay due to the complexity of using Pathfinder analysis of knowledge structures. As is common in knowledge structure research, the concept relatedness instrument contains only a subset of the possible BMK concepts (Schvaneveldt 1990). Existing knowledge structure literature supports the effectiveness of using condensed knowledge maps to assess domain specific knowledge. The study's sample size limits the power of the statistical tests, however, the sample size of 176 is actually quite large compared with most Pathfinder knowledge structure and other mental model studies (Schvaneveldt 1990; Curtis and Viator 2000; Curtis and Davis 2003; Gerard 2005; Schmidt et al. 2011). Participants are graduate and undergraduate college students with few years of prior work experience, so this research generalizes best to new hires becoming ES users, limiting its generalizability for experienced employees.

In spite of these constraints, valuable insights offer a step towards understanding the important role of BMK in affecting job satisfaction and impacting ES adaption and use.

Contribution

This essay answers calls to address gaps in ES research regarding change management (Grabski et al. 2011); stress, coping and emotional responses (Beaudry and Pinsonneault 2005; Beaudry and Pinsonneault 2010); and to understand the ES knowledge hierarchy (Kang and Santhanam 2003; Santhanam et al. 2007). Research literature has not yet sufficiently investigated the antecedents of individual level ES job satisfaction. Some of the most challenging change management issues are sociotechnical in nature, requiring a dual focus on technical and human social change (Taylor 1998; Markus 2004; Joseph et al. 2007). Support is found for BMK as a viable means to improve stress and coping reactions by improving cognitive appraisals of opportunity, threat and control, and thereby increase ES job satisfaction. Findings support expanding ES educational to include developing BMK in addition to the current primary focus on ES application interface knowledge. These insights into the nature and value of BMK reveal that knowledge of ES-supported economic relations helps overcome perceptions of ES threats and enhances perceptions of the opportunities offered by ES use. Through its influence on the primary cognitive appraisal of opportunity and of threat, BMK appears to enhance ES job satisfaction. More investigation is needed into the complex interactions among opportunity, threat and control in the presence of different levels of the ES knowledge hierarchy.

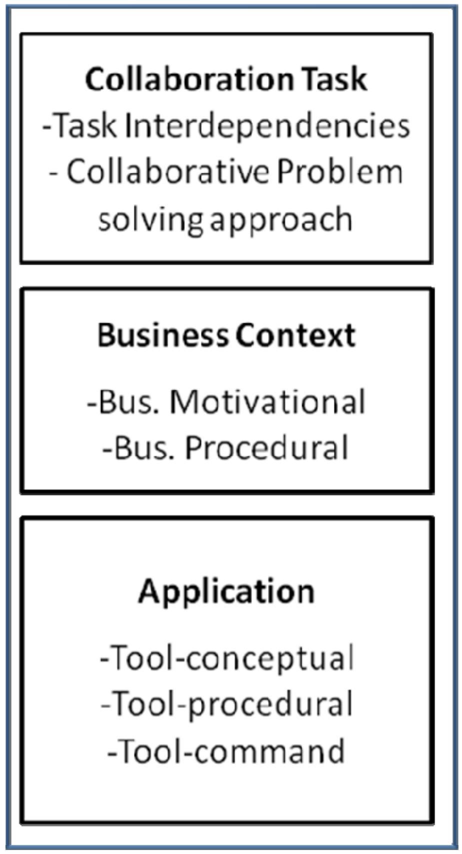
This paper contributes to accounting research by presenting an innovative application of REA (resource-event-agent) modeling, utilizing the REA ontology to define and assess knowledge structures. This research leverages accounting theory to contribute to ES research by creating an REA accounting 'ontology-based' measure for BMK as an innovative means to evaluate ES-related economic knowledge. REA modeling is widely used in accounting information systems education and design science but this is a novel attempt to directly use the ontology to describe and assess the enterprise business knowledge. Knowledge acquisition and ES literature should be enriched by BMK instrument and research insights, as BMK is a type of enterprise knowledge recently indentified and not yet well understood (Kang and Santhanam 2003). BMK is a type of ES business context knowledge which enables the understanding of ES economic relationships and accounting business rules. This study is a useful first step in refining the understanding of BMK within the multi-level enterprise knowledge hierarchy. Building on these findings, future research should investigate which types of economic knowledge are most influential on ES cognitive appraisals and on improving ES job satisfaction.

In IT literature, Joseph (2007) points out the need to better understand how IT professionals respond to job factors that reduce job satisfaction such as the 'shock' experienced when an ES is introduced. For practitioners, these findings strongly suggest the need to impart BMK to new users to ensure that individuals foresee the economic advantages offered by ES at both the organizational and individual level. The resulting positive cognitive appraisals from BMK serve to increase perceived opportunities and mitigate perceived threats, thereby mitigating negative coping reactions to the ES change. Prior research shows that early emotional reactions to new IT have important longer term effects on IT use (Beaudry and Pinsonneault 2010), so early ES interventions imparting BMK could have lasting beneficial impacts. Much work remains to overcome individual resistance to ES and to achieve the organizational level benefits from efficient and effective operations using ES. These results highlight the value of BMK and supports including BMK education into ES educational and change management initiatives.

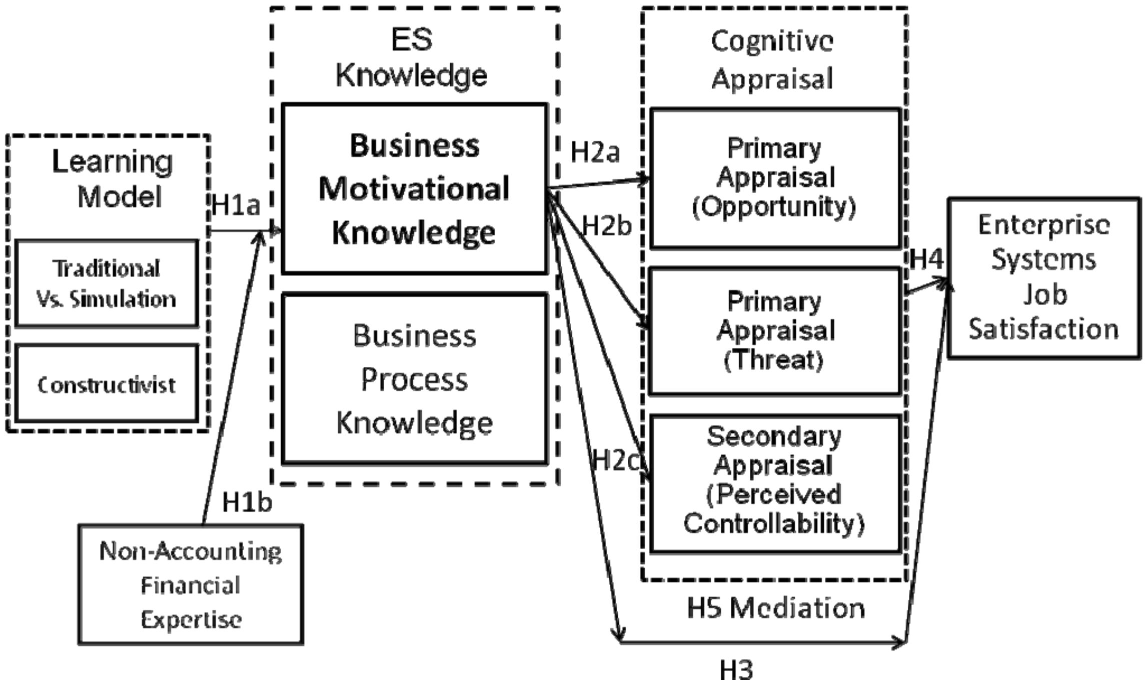
In summary, this research explicates BMK, refines its conceptualization and provides an initial operationalization for use in ES empirical research. It provides an initial operationalization of BMK based on knowledge structure theory and analyzed using Pathfinder network graph techniques. Results suggest that BMK strongly influences appraisals of enterprise systems and job satisfaction. This work adds to our understanding of the ES knowledge hierarchy and contributes to enterprise change management research by offering valuable insights on how to leverage BMK to improve user adaptation to ES.

Research Model, Figures and Tables

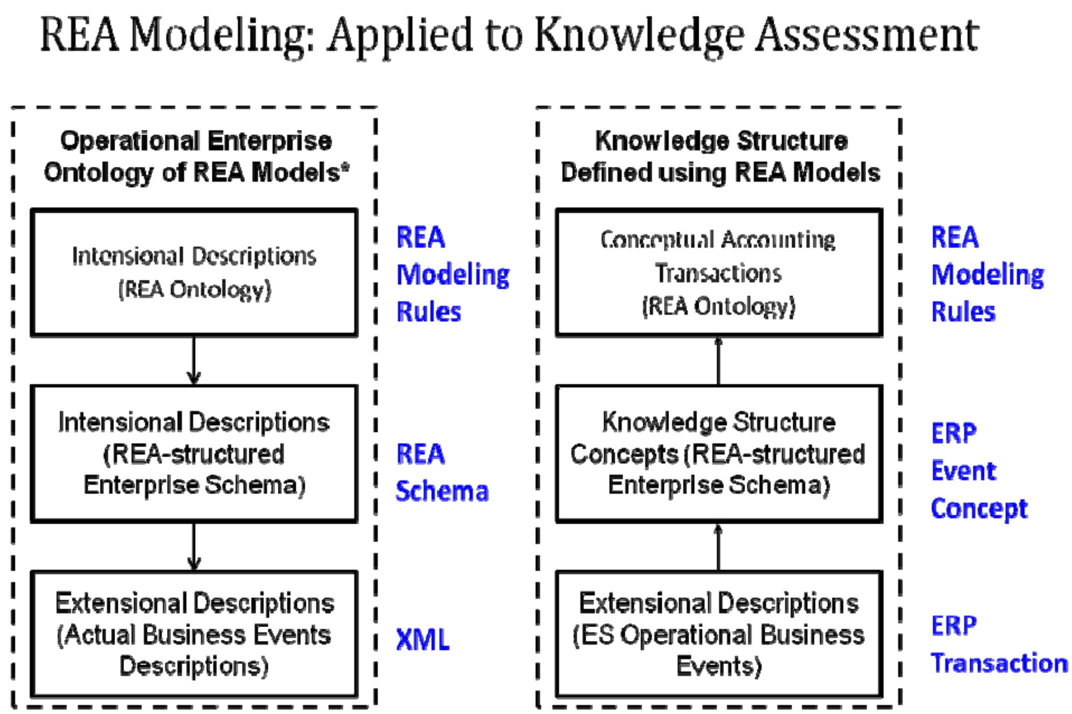
Essay 2 - Figure 1. Enterprise Systems Knowledge Hierarchy



Essay 2 - Figure 2. BMK Knowledge Research Model (control variable not shown)



Essay 2 – Figure 3. REA Modeling Applications in Research



* Reference: Geerts, G. L. "XML Support for an Operational Enterprise Ontology," European Information Systems Conference 2002.

Essay 2 - Figure 4. REA Modeling of Business Motivational Knowledge (BMK) Concepts

Figure 4 (a). REA Representation of an Economic Event (ERP Transaction)

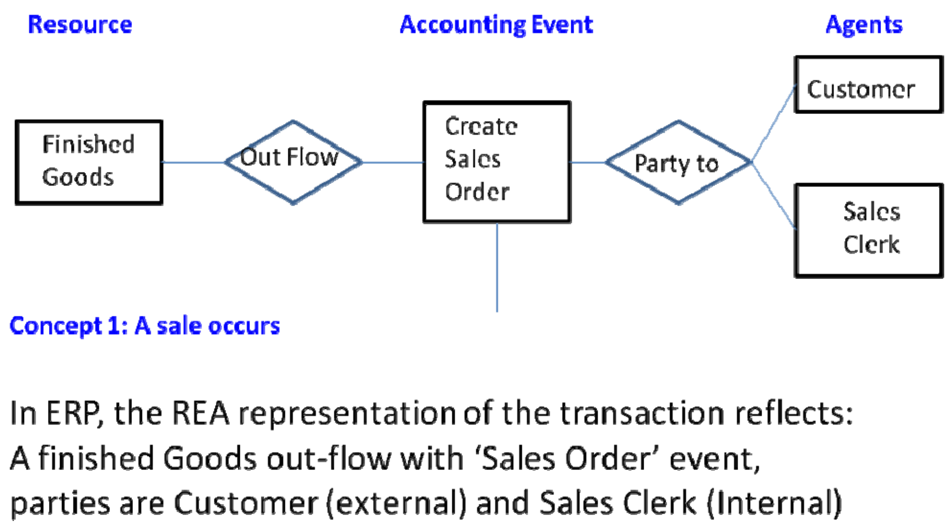


Figure 4 (b). REA Duality: Depicting Two Highly Related BMK Concepts

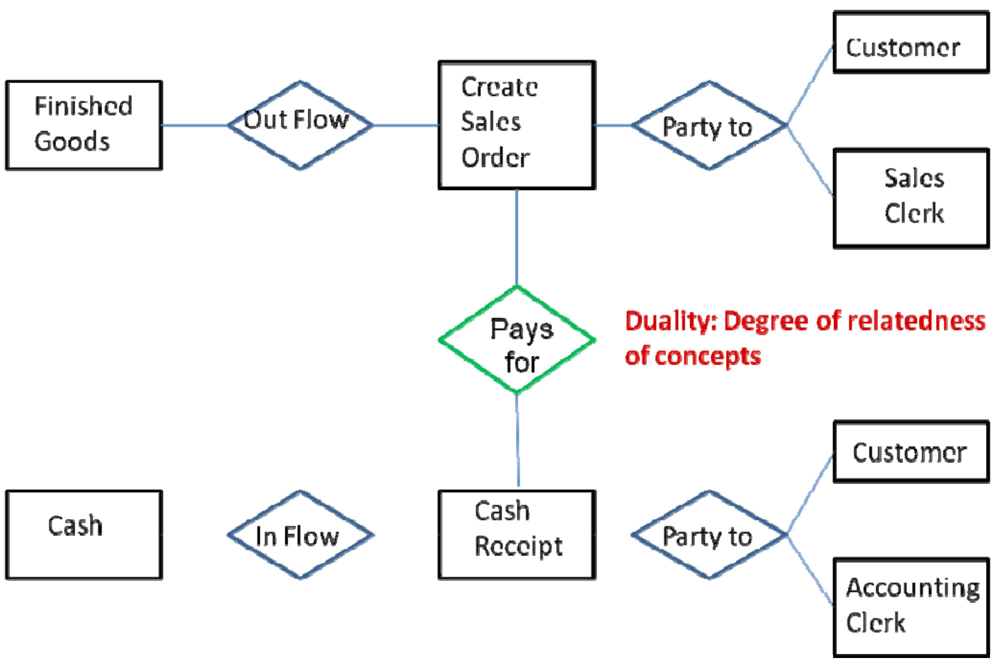
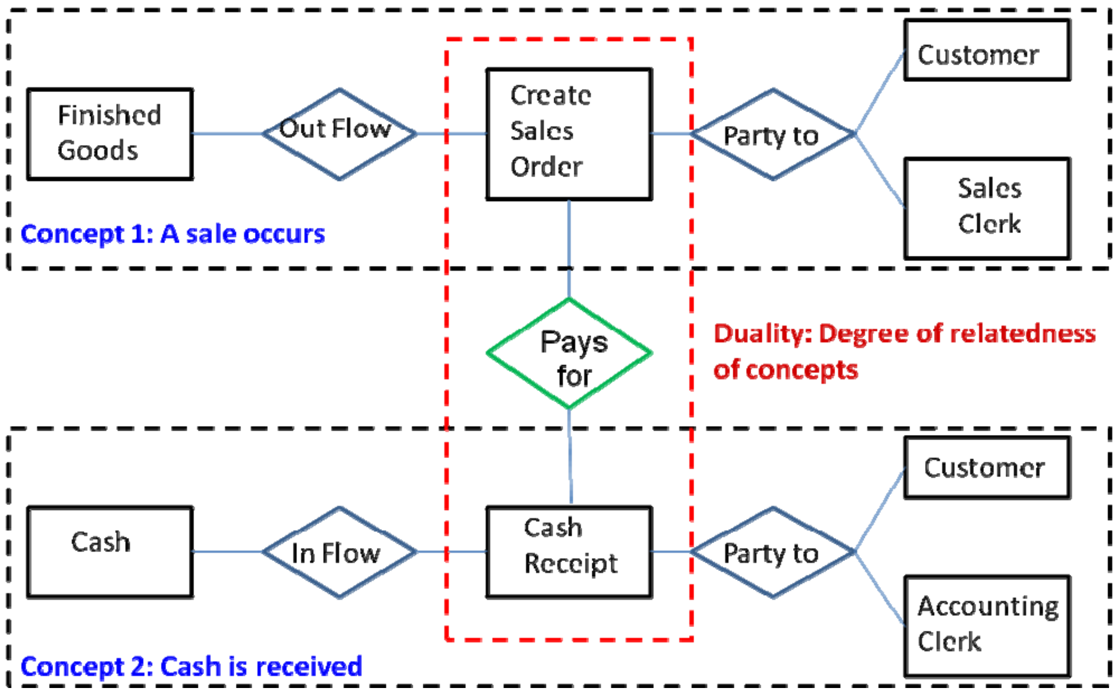
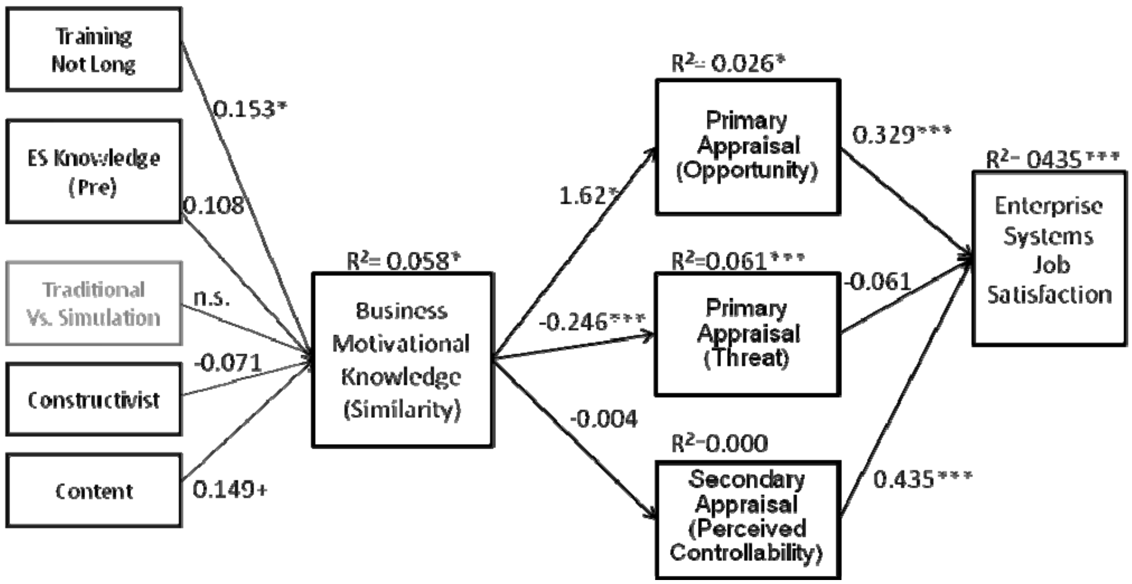


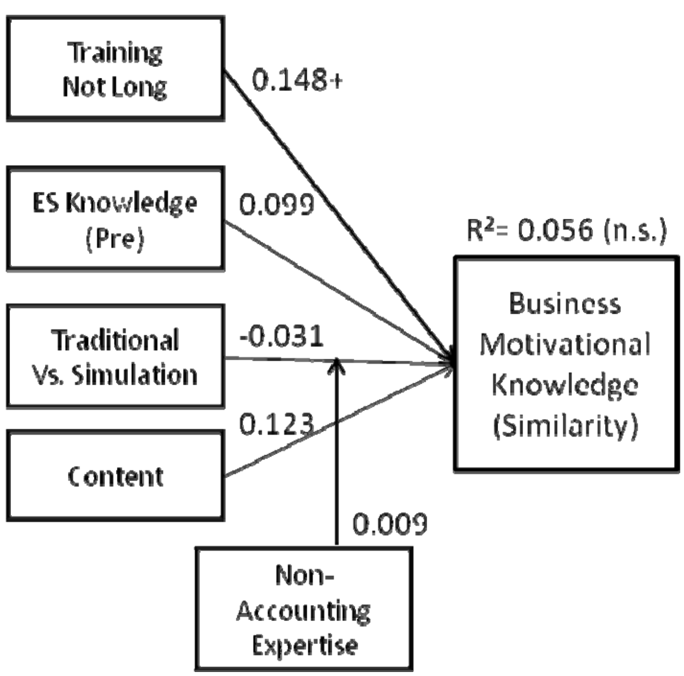
Figure 4 (c). Knowledge Structure Concepts and Their Relatedness: Overlay on REA Model



Essay 2 - Figure 5. Linear Regression Test Results



Essay 2 – Figure 6. Non-Accounting and Finance Expertise Effects on BMK



Essay 2 – Figure 7. BMK Mediation: Direct and Indirect Effects

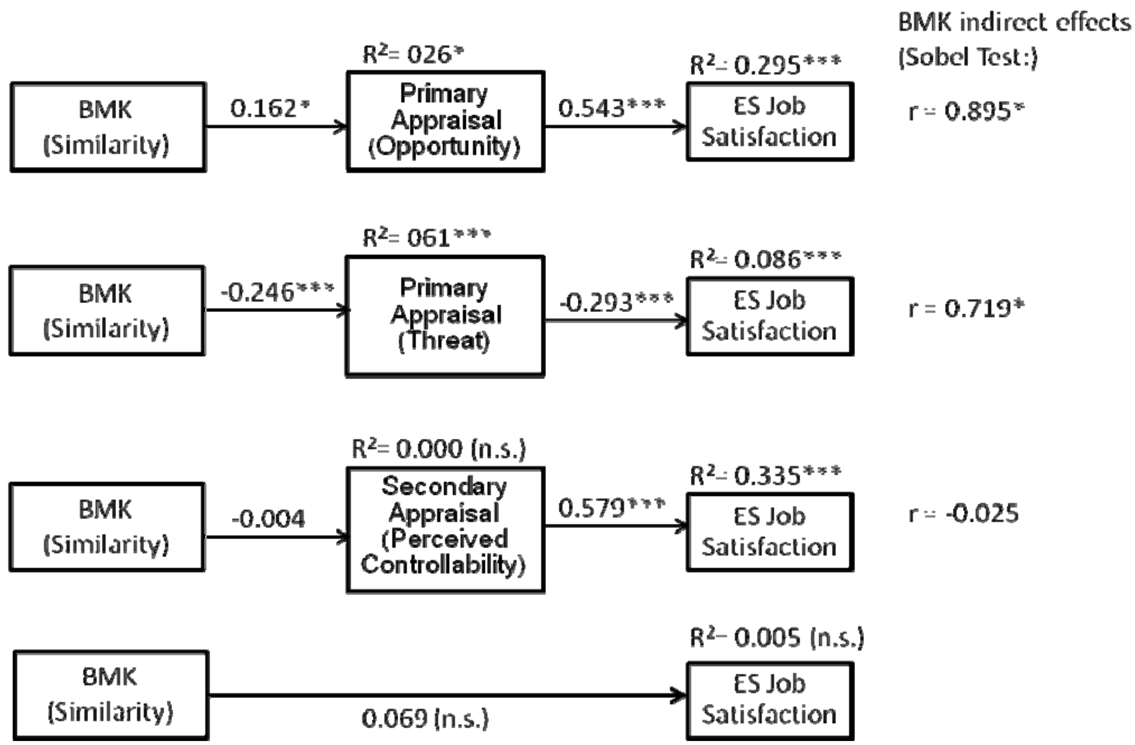


Table 1. Descriptives						
	Min.	Max.	Mean	SE	Std.	Variance
Demographics						
Gender	1	2	1.35	0.036	0.48	0.23
Marital	1	3	1.91	0.025	0.326	0.107
Level	2	5	3.82	0.052	0.684	0.468
Age	19	63	23.36	0.392	5.182	26.852
GPA	1	6	3.201	0.038	0.502	0.252
Experience: Full Time	0	50	2.412	0.422	5.489	30.128
Experience: Part-Time	0	18	3.795	0.205	2.691	7.241
Expert_Acct	0	1	0.31	0.035	0.463	0.215
Expert_Tech	0	4	0.26	0.039	0.514	0.264
Latent Variables						
Train_Not_Long	2	7	5.0511	0.08689	1.15274	1.329
ES Knowledge (pre)	1	7	4.1289	0.08278	1.09505	1.199
Trad (0)/Simulation (1)	0	1	0.60	0.037	0.491	0.241
Content	2	7	5.6591	0.08288	1.09947	1.209
Constructivist	1.83	7	5.0426	0.08507	1.12853	1.274
Non-Acct (Traditional)	0	1	0.2045	0.03049	0.40452	0.164
Non-Acct (Simulation)	0	1	0.4857	0.03789	0.50123	0.251
BMK_Coherence	-0.29999	0.87042	0.19476	0.01946	0.25669	0.066
BMK_Similiarity	0.052632	0.6	0.25737	0.00790	0.10432	0.011
CA_Opportunity	3	7	5.6267	0.07444	0.98471	0.97
CA_Threat	1	6	2.92687	0.10893	1.44523	2.089
CA_Control	2.25	7	4.8608	0.07807	1.03569	1.073
Job Satisfaction	2.25	7	5.0838	0.07879	1.04527	1.093

Key to Demographics Measures

Gender: 1=Male, 2=Female

Marital Status: 1=married, 2=single, 3=divorced.

Level: University Rank as 1=Freshman, 2=Soph, 3=Junior, 4=Senior, 5=Graduate

Age in years

GPA (4.0=A scale)

ExpFT: Years of full time work experience

ExpPT: Years of part-time work experience

Expert_Acct: No Accounting/financial expertise=0, Accounting financial expertise =1

Expert_Tech: No IS technical expertise=0, IS technical expertise =1

Table 2. Factor Analysis: Factor Loadings and Cross-Loadings (Italicized items dropped)

Items	1	2	3	4	5	6	7	8	Factor Name
Know2 PK3	**.832**	.182	.000	-.054	-.100	.042	.011	.100	Know ledge (Pre)
Know3 PK4	**.841**	.027	.017	-.034	-.132	.096	-.109	.087	Know ledge (Pre)
Know4 PK5	**.760**	-.194	.197	-.021	-.044	.083	.098	-.010	Know ledge (Pre)
Know5 PK6	**.822**	.080	.147	-.021	-.042	.105	.011	.120	Know ledge (Pre)
Know6 PK7	**.753**	-.035	.239	-.097	.052	.055	-.040	.101	Know ledge (Pre)
Know7 BK2	**.789**	-.013	.285	-.099	.005	.016	.081	.128	Know ledge (Pre)
Know8 BK3	**.770**	-.014	.245	-.057	-.036	.094	.039	.197	Know ledge (Pre)
Know10 BK5	**.784**	-.171	.248	-.064	-.015	.011	.117	.041	Know ledge (Pre)
Know11 ES1	**.786**	.068	-.001	-.061	.123	-.200	.275	-.067	Know ledge (Pre)
Know12 ES3	**.745**	.022	.057	-.105	.078	-.050	.226	-.089	Know ledge (Pre)
Know13 ES5	**.768**	-.016	.123	-.065	.064	-.089	.117	-.070	Know ledge (Pre)
Know14 TS2	**.862**	.154	-.188	-.086	.105	.025	.048	-.067	Know ledge (Pre)
Know15 TS3	**.862**	.171	-.172	-.020	.083	.078	.024	-.052	Know ledge (Pre)
Know16 TS4	**.866**	.155	-.188	.012	.066	.057	.043	.007	Know ledge (Pre)
Know17 TS5	**.876**	.211	-.149	-.044	.037	.040	.056	-.015	Know ledge (Pre)
Know18 TS6	**.867**	.200	-.196	.007	.101	.042	.036	-.043	Know ledge (Pre)
Construct1	-.047	.375	.489	-.072	.274	-.141	-.050	.045	(*dropped*)
Construct2	.074	.512	.165	-.063	.277	.067	.262	.256	(*dropped*)
Construct3	-.022	**.688**	.115	-.006	.253	.149	.251	.157	Constructivist
Construct4	.021	**.619**	.208	-.152	-.147	.170	.172	.238	Constructivist
Construct5	.062	**.656**	.363	-.088	.294	.146	.002	.146	Constructivist
Construct6	-.169	-.207	.078	.134	-.464	-.239	-.112	-.142	(*dropped*)
Construct7	.141	**.780**	.054	.015	.015	.138	.094	.226	Constructivist
Construct8	.121	**.706**	.113	-.002	.058	.212	.129	-.080	Constructivist
Content1	.075	.191	-.253	.101	-.594	-.252	-.028	-.172	(*dropped*)
Content2	.142	**.742**	-.016	.162	.088	.249	.011	.125	Constructivist
Content3	.005	.141	.096	-.131	**.811**	.238	.077	.198	Content
Content4	.057	.282	.207	-.170	**.723**	.132	.080	.156	Content
Content5	.024	.301	.495	-.205	.553	.003	.040	.064	(*dropped*)
JobS13	.096	.357	.337	-.182	.182	.476	.102	.096	(*dropped*)
JobS14	-.005	.313	.242	-.142	.242	**.688**	.203	.077	JobSatisfaction
JobS15	.050	.340	.145	-.116	.286	**.681**	.182	-.102	JobSatisfaction
JobS16	.000	.380	.108	-.045	.242	**.673**	.303	.020	JobSatisfaction
JobS17	.096	.249	.240	-.107	.210	**.650**	.202	.334	JobSatisfaction
JobS18	.072	.173	.362	-.163	-.034	.410	.096	.424	(*dropped*)
Appraisal1 B	.157	.162	**.621**	-.254	.175	.252	.158	.193	Opportunity
Appraisal2 B	.074	.090	**.727**	-.317	.106	.296	.146	.107	Opportunity
Appraisal3	.050	.164	**.750**	-.209	.167	.220	.194	.144	Opportunity
Appraisal4	.162	.277	.603	-.149	.075	.245	.275	-.081	(*dropped*)
Appraisal5	-.124	-.085	-.200	**.897**	-.135	-.050	-.028	-.056	Threat
Appraisal6	-.117	-.055	-.257	**.885**	-.158	-.070	.015	.011	Threat
Appraisal7	-.136	.053	-.229	**.885**	-.082	-.013	-.004	-.015	Threat
Appraisal8	-.095	.036	-.006	**.766**	-.111	-.235	-.187	-.097	Threat
Appraisal9	.201	.111	.339	-.135	.010	.084	**.737**	.030	Control
Appraisal10	.152	.274	.196	-.105	.084	.211	**.683**	.223	Control
Appraisal11	.139	.365	.207	-.094	.172	.311	**.634**	.012	Control
Appraisal12	.182	.127	-.053	.056	.086	.218	**.799**	.185	Control

Table 3. Correlations Matrix with Items per Variable, ICR and AVE

	No.Items	ICR	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Train Not Long	1	NA	**1**												
2. ES Knowledge	16	0.967	0.026	**0.813**											
3. Trad_Sim (0/1)	1	NA	-0.055	0.092	**1**										
4. Content	2	0.870	0.061	0.094	.160*	**0.768**									
5. Constructivist	6	0.869	-0.057	.194*	.548**	.415**	**0.700**								
6. Non_Acct_Trad	1	NA	-0.096	-0.126	-.624**	-.202**	-.184*	**1**							
7. Non_Acct_Sim	1	NA	-.162*	0.115	.793**	0.137	.448**	-.495**	**1**						
8.BMK Coherence	28 #	NA	.179*	0.026	-.163*	-0.039	-0.124	0.06	-.211**	**1**					
9.BMK Similarity	28 #	NA	.167*	0.109	-0.028	0.141	0.003	-0.039	-0.043	0.087	**1**				
10. Opportunity	3	0.905	.197**	.192*	.153*	.426**	.386**	-0.142	0.075	0.015	.162*	**0.701**			
11. Threat	4	0.925	-.175*	-.203**	-0.049	-.335**	-0.113	0.057	-0.029	-0.044	-.246**	-.493**	**0.860**		
12. Control	4	0.865	0.133	.311**	0.121	.348**	.479**	-0.054	0.049	0.077	-0.004	.483**	-.232**	**0.716**	
13. Job Satisf.	4	0.896	0.071	0.14	.260**	.528**	.603**	-.176*	.176*	-0.013	0.069	.543**	-.293**	.579**	**0.673**

Notes:

1. #: single measure calculated by Pathfinder Network Analysis
2. ICR: Internal consistency reliability (Cronbach's Alpha)
3. Diagonal elements are the square root of the shared variance (AVE: Average Variance Extracted) between the constructs and their measures.
4. Off-diagonal elements are correlations between constructs.
5. Definitions of abbreviations: ES Knowledge (Pre) = knowledge of ES a) application, b) business processes and enterprise systems management, prior to treatment; Trad/Sim (0/1) = a binary variable indicating treatment of traditional or simulation education method; Non_Acct_Trad is a binary variable for individuals with no accounting and finance expertise who were given the tradition treatment; Non_Acct_Sim is a binary variable for individuals with no accounting and finance expertise who were given the simulation treatment.
6. BMK Coherence and BMK Similarity measures are analyzed using Pathfinder Network Graph Analysis. BMK coherence is an internal reliability measure of the knowledge structure. BMK Similarity is an accuracy measure of BMK knowledge.
7. +p<0.10, *p < 0.05, **p < 0.01, ***p < 0.001.

Table 4a. Linear Regression Results

Hypotheses	H1a	H1a'	H1b	H2a(1)	H2a (2)	H2b(1)	H2b (2)	H2c (1)	H2c (2)
Dep. Variable	**BMK**	**BMK**	**BMK**	**Opportunity**	**Opportunity**	**Threat**	**Threat**	**Control**	**Control**
Controls:									
Train Not Long	0.165	0.153*	0.148+		0.149*		-0.127+		0.149*
Knowledge-pre	0.107	0.108	0.099		0.131+		-0.144*		0.23***
Stage 1									
Trad0_Sim1	-		-0.031						
Content		0.149+	0.123		0.251***		-0.298***		0.175*
Constructivist		-0.071			0.291***		0.029		0.367***
Non-Acct			-0.042						
Non-AcctxSim1			0.009						
Stage 2									
BMK				0.162*	0.048 (n.s.)	-	-0.158*	-0.004	-0.078
Model									
R-Sq	0.04+	0.058*	0.056	0.026*	0.277***	0.061**	0.179***	0.000	0.325***
Adjusted R-Sq	0.023	0.035*	0.022	0.020*	0.255***	0.055**	0.154***	-0.004	0.305***
Model Signif.	0.076	0.039	0.136	0.034	0.000	0.001	0.000	0.956	0.000

Notes: Columns give regression results for each hypothesis, with dependent variable specified in top row.

Titles: column heading: dependent variable; Row leftmost label: independent variables. Row contents: Standardized Beta Coefficients

+ $p<0.10$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table 4b. Linear Regression Results

Hypotheses	H3	H4(1)	H4(2)	H4(3)	H4(4)
Dep. Variable	**JobSat.**	**Job Sat.**	**Job Sat.**	**Job Sat.**	**Job Sat.**
Controls:					
Training Not	0.056	-0.061		-0.007	-0.019
Knowledge	0.139+	-0.072		-0.071	-0.07
Stage 1					
Trad0_Sim1				0.003	0.013
Content				0.220***	0.209***
Constructivist				0.317***	0.342***
Non-Acct_Trad					-0.014
Non-Acct_Sim					0.062
Stage 2					
BMK	0.044		0.017	0.021	0.019
Stage 3					
CA_Opportunity		0.329***	0.317***	0.182**	0.175*
CA_Threat		-0.061	-0.048	-0.056	-0.062
CA_Control		0.435***	0.413***	0.271***	0.266***
Model					
R-Sq	0.027	0.435***	0.425***	0.571***	0.575***
Adjusted R-Sq	0.01	0.418***	0.411***	0.548***	0.546***
Model Signif.	0.203	0.000	0.000	0.000	0.000

Notes: Columns give regression results for each hypothesis, with dependent variable specified in top row.
Titles: column heading: dependent variable; Row leftmost label: independent variables. Row contents: Standardized Beta Coefficients.
H4(a to d) are regression tests for the influence of cognitive appraisal (3 types) on the outcome variable of job satisfaction, the latter columns include other model variables as direct relationships with job satisfaction.
+ p<0.10; *p < 0.05; **p < 0.01; ***p < 0.001

Table 5a. Baron and Kenny (1986) Mediation Tests: BMK Effects on Job Satisfaction through Opportunity

	Depend. Var.	R^2	Model p-value	Indep. Var.	Beta Coeff.	SE(B)	t	PValue
Step 1:	Opportunity	0.026*	0.034	(Constant)		0.199	26.361	0.000
				REA Similarity	0.162*	0.722	2.143	0.034
Step 2:	Job Satisfaction	0.295***	0.000	(Constant)		0.388	4.732	0.000
				Opportunity	0.543***	0.068	8.516	0.000
Step 3: FAILS	Job Satisfaction	0.005	0.367	(Constant)		0.212	23.165	0.000
				REA Similarity	0.069	0.763	0.905	0.367
Step 4:	Job Satisfaction	0.292***	0.000	(Constant)		0.41	4.489	0.000
				REA Similarity	-0.008	0.671	-0.119	0.905
				Opportunity	0.541***	0.07	8.273	0.000

Table 5b. Baron and Kenny (1986) Mediation Tests: REA Similarity Effects on Job Satisfaction through Threat

Step 1:	Threat	0.061***	0.001	(Constant)		0.283	13.363	0.000
				REA Similarity	-0.246***	1.019	-3.329	0.001
Step 2:	Job Satisfaction	0. 0.086***	0.000	(Constant)		0.171	33.354	0.000
				Threat	-0.293***	0.052	-4.044	0.000
Step 3: FAILS	Job Satisfaction	0.005	0.367	(Constant)		0.212	23.165	0.000
				REA Similarity	0.069	0.763	0.905	0.367
Step 4:	Job Satisfaction	0.090***	0.000	(Constant)		0.290	19.771	0.000
				REA Similarity	-0.005	0.755	-0.069	0.945
				Threat	-0.301***	0.055	-3.997	0.000

Table 5c. Baron and Kenny (1986) Mediation Tests: REA Similarity Effects on Job Satisfaction through Control

Step 1: FAILS	Control	0.000	0.956	(Constant)		0.210	23.201	0.000
				REA Similarity	-0.004	0.757	-0.055	0.956
Step 2:	Job Satisfaction	0.335***	0.000	(Constant)		0.310	7.241	0.000
				Control	0.579***	0.062	9.358	0.000
Step 3: FAILS	Job Satisfaction	0.005	0.367	(Constant)		0.212	23.165	0.000
				REA Similarity	0.069	0.763	0.905	0.367
Step 4:	Job Satisfaction	0.336***	0.000	(Constant)		0.353	5.872	0.000
				REA Similarity	0.071	0.625	1.144	0.254
				Control	0.576***	0.063	9.245	0.000

Table 6. Sobel Test for Mediation

Hypo.	Hypothesis Statement	Finding	Indirect Effect (Sobel)	Sobel SE	P-Value (1- tailed)	P-Value (2-tailed)
H5a	The influence of business-motivational knowledge on ES job satisfaction is mediated by primary cognitive appraisal of opportunity.	Supported	0.895*	0.430	0.0197*	0.0393*
H5b	The influence of business-motivational knowledge on ES job satisfaction is mediated by primary cognitive appraisal of threat.	Supported	0.719*	0.279	0.0055**	0.0109*
H5c	The influence of business-motivational knowledge on ES job satisfaction is not mediated by secondary cognitive appraisal of perceived controllability.	Supported	-0.025	0.442	0.478	0.956

+ p<0.10; *p < 0.05; **p < 0.01; ***p < 0.001

Table 7. BMK Model Hypotheses and Findings		
Hypo.	**Hypothesis Description**	**Results**
H1a	Compared with traditional learning, simulation-based learning has a greater positive influence on business-motivational knowledge.	No Support
H1a'	Compared with traditional learning methods, constructivist learning has a greater positive influence on the business process knowledge.	No Support
H1b	When compared with traditional learning methods, simulation-based learning methods have a greater positive influence on business-motivational knowledge for individuals without accounting and finance expertise.	No Support
H2a	Business-motivational knowledge has a positive influence on primary cognitive appraisal of opportunity.	Supported
H2b	Business-motivational knowledge has a negative influence on primary cognitive appraisal of threat.	Supported
H2c	Business-motivational knowledge has a no significant influence on secondary cognitive appraisal of perceived controllability.	Supported
H3	Business-motivational knowledge has a positive direct influence on enterprise systems job satisfaction.	No Support
H4a	Primary cognitive appraisal of opportunity positively influences ES job satisfaction.	Supported
H4b	Primary cognitive appraisal of threat negatively influences ES job satisfaction.	Not Supported
H4c	Secondary cognitive appraisal of perceived control positively influences ES job satisfaction.	Supported
H5a	The influence of business-motivational knowledge on ES job satisfaction is mediated by primary cognitive appraisal of opportunity.	No Support (B&K) Supported (Sobel)
H5b	The influence of business-motivational knowledge on ES job satisfaction is mediated by primary cognitive appraisal of threat.	No Support (B&K) Supported (Sobel)
H5c	The influence of business-motivational knowledge on ES job satisfaction is not mediated by secondary cognitive appraisal of perceived controllability.	Supported (B&K) Supported (Sobel)

Appendix D. Measurement Scales.

Items in italics were dropped from the summative variable based due to low factor loadings.

Table 1. Business-Motivational Knowledge Survey

Instructions: SAP Business-Motivational Knowledge- RELATEDNESS: This section compares two SAP 'accounting transaction' concepts, which are shown separated by arrows (<-->). Indicate how closely each concept is related to the other in the pair by selecting values from: 1="Not Related" to 7="Highly Related".

Examples of concept pairs in a furniture business:
Example 1:
"Ship a lamp" event with finished goods outflow (customer is external agent)
<--related to-->
"Assemble dresser drawer" with raw materials inflow (vendor is external agent)
Answer: select: 1=Not at all Related"

Example 2:
"Ship a dresser" event with finished goods outflow (customer is external agent)
<--related to-->
"Complete a dresser drawer" with finished goods outflow (vendor is external agent)
Answer: select: 6="Highly Related"

To start, find 'highly related' pairs and "not related' pairs to serve as anchors. A rating of 1 or 2 is unrelated; a rating of 6 or 7 is highly related. Give a quick intuitive judgement of relatedness, as you best understand these pairs of ERP concepts.

After you rate each pair, the next pair will appear on the screen.

Business-Motivational Knowledge Items (Ver_2)

1	REA1	'Create Delivery for Sale' event with Finished Goods Inventory Change out-flow; (Transport Company is external agent) **<--relates to-->** 'Create Sales with Order' event with Finished Goods in-flow. (Customer is external agent)
2	REA2	'Create Sales Order' event with Finished Goods in-flow (Customer is external agent) **<--relates to-->** 'Shipment of Goods' event with Finished Goods Inventory Change out-flow. (Transport Company is external agent)
3	REA3	'Post Payment Receipt' **claim** with Accounts Receivable out-flow (Customer is external agent) **<--relates to-->** 'Create Sales Order' event with Finished Goods in-flow. (Customer is external agent)
4	REA14	'Shipment of Goods' event with Finished Goods Inventory Change out-flow. (Transport Company is external agent) **<--relates to-->** 'Post Payment Receipt' **claim** with Accounts Receivable out-flow. (Customer is external

		agent)
5	REA4	‘Create Sales Order’ event with Finished Goods in-flow (Customer is external agent) **<--relates to-->** ‘Cash Receipt’ event with Cash in-flow (Customer is external agent)
6	REA6	‘Create Sales Order’ event with Finished Goods in-flow. (Customer is external agent) **<--relates to-->** ‘Pay Vendor’ event with Cash out-flow. (Vendor is external agent)
7	REA7	‘Create Sales Order’ event with Finished Goods in-flow. (Customer is external agent) **<--relates to-->** ‘Order & Schedule Payment’ event with Accounts Payable in-flow. (Vendor is external agent)
8	REA8	‘Shipment of Goods’ event with Finished Goods Inventory Change out-flow. (Transport Company is external agent) **<--relates to-->** ‘Create Delivery for Sale’ event with Finished Goods Inventory Change out-flow. (Transport Company is external agent)
9	REA9	‘Create Delivery for Sale’ event with Finished Goods Inventory Change out-flow. (Transport Company is external agent) **<--relates to-->** ‘Post Payment Receipt’ **claim** with Accounts Receivable out-flow. (Customer is external agent)
10	REA10	‘Cash Receipt’ event with Cash in-flow. (Customer is external agent) **<--relates to-->** ‘Create Delivery for Sale’ event with Finished Goods Inventory Change out-flow. (Transport Company is external agent)
11	REA11	‘Create Delivery for Sale’ event with Finished Goods Inventory Change out-flow. (Transport Company is external agent) **<--relates to-->** ‘Finished Goods Inventory Increased’ event with Finished Goods Inventory out-flow. (Production Manager is Internal agent)
12	REA12	‘Pay Vendor’ event with Cash out-flow. (Vendor is external agent) **<--relates to-->** ‘Create Delivery for Sale’ event with Finished Goods Inventory Change out-flow. (Transport Company is external agent)
13	REA13	‘Order & Schedule Payment’ event with Accounts Payable in-flow. (Vendor is external agent) **<--relates to-->** ‘Create Delivery for Sale’ event with Finished Goods Inventory Change out-flow. (Transport Company is external agent)
14	REA26	‘Pay Vendor’ event with Cash out-flow. (Vendor is external agent) **<--relates to-->** ‘Finished Goods Inventory Increased’ event with Finished Goods Inventory out-flow. (Production Manager is Internal agent)
15	REA16	‘Shipment of Goods’ event with Finished Goods Inventory Change out-flow. (Transport Company is external agent) **<--relates to-->** 'Finished Goods Inventory Increased’ event with Finished Goods Inventory out-flow. (Production Manager is Internal agent)
16	REA17	‘Pay Vendor’ event with Cash out-flow. (Vendor is external agent) **<--relates to-->** ‘Shipment of Goods’ event with Finished Goods Inventory Change out-flow. (Transport Company is external agent)
17	REA18	‘Shipment of Goods’ event with Finished Goods Inventory Change out-flow. (Transport Company is external agent) **<--relates to-->** ‘Order & Schedule Payment’ event with Accounts Payable in-flow. (Vendor is external

		agent)
18	REA5	‘Finished Goods Inventory Increased’ event with Finished Goods Inventory out-flow. (Production Manager is Internal agent) **<--relates to-->** ‘Create Sales Order’ event with Finished Goods in-flow. (Customer is external agent)
19	REA19	‘Cash Receipt’ event with Cash in-flow. (Customer is external agent) **<--relates to-->** ‘Post Payment Receipt’ **claim** with Accounts Receivable out-flow. (Customer is external agent)
20	REA20	‘Post Payment Receipt’ **claim** with Accounts Receivable out-flow. (Customer is external agent) **<--relates to-->** ‘Finished Goods Inventory Increased’ event with Finished Goods Inventory out-flow. (Production Manager is Internal agent)
21	REA21	‘Pay Vendor’ event with Cash out-flow. (Vendor is external agent) **<--relates to-->** ‘Post Payment Receipt’ **claim** with Accounts Receivable out-flow. (Customer is external agent)
22	REA15	‘Cash Receipt’ event with Cash in-flow. (Customer is external agent) **<--relates to-->** ‘Shipment of Goods’ event with Finished Goods Inventory Change out-flow. (Transport Company is external agent)
23	REA22	‘Post Payment Receipt’ **claim** with Accounts Receivable out-flow. (Customer is external agent) **<--relates to-->** ‘Order & Schedule Payment’ event with Accounts Payable in-flow. (Vendor is external agent)
24	REA23	‘Finished Goods Inventory Increased’ event with Finished Goods Inventory out-flow. (Production Manager is Internal agent) **<--relates to-->** ‘Cash Receipt’ event with Cash in-flow. (Customer is external agent)
25	REA24	'Cash Receipt’ event with Cash in-flow. (Customer is external agent) <--relates to--> ‘Pay Vendor’ event with Cash out-flow. (Vendor is external agent)
26	REA25	‘Order & Schedule Payment’ event with Accounts Payable in-flow. (Vendor is external agent) **<--relates to-->** ‘Cash Receipt’ event with Cash in-flow. (Customer is external agent)
27	REA27	‘Finished Goods Inventory Increased’ event with Finished Goods Inventory out-flow. (Production Manager is Internal agent) **<--relates to-->** ‘Order & Schedule Payment’ event with Accounts Payable in-flow. (Vendor is external agent)
28	REA28	‘Pay Vendor’ event with Cash out-flow. (Vendor is external agent) **<--relates to-->** ‘Order & Schedule Payment’ event with Accounts Payable in-flow. (Vendor is external agent)

Essay 2 - Table 2 – Independent Variables – Measurement Scales

Constructivist Learning Environment - from Wen et al (2004) which was based on measures validated in Maor and Fraser (2005). The last item is from Den Brok et al. (2004).

1. *ERP lessons show that real-life business environments are complex.*
2. *Doing the ERP lessons, I find out answers to questions by investigation.*
3. The ERP lessons get me to think deeply about my own understanding.
4. During ERP lessons, I can ask other students to explain their ideas.
5. The ERP lessons help me think about business results.
6. *At the beginning of the lesson, the ERP lesson materials make clear the exact inputs and outputs of the system.*
7. In the ERP lessons, we make our own business decisions in order to complete the assignments.
8. I learned that business is influenced by people's values and opinions.
9. The ERP lesson instructions left room for me to make innovative business decisions.[5]

Content: Educational content items cover lessons and instructor items. These items use a subset of the educational content scale from Johnson and McClure (2004), which was based on the revised Constructivist Learning Environment Survey CLES 2 (20 items) along with instructor items from Choi et al. (2007).
Content Items:

1. *The ERP lesson instructions precisely spelled out all steps to perform.*
2. The ERP lesson instructions left room for me to make innovative business decisions. [6]

Instructor Items: from Choi et al. (2007).

1. The instructor explained well how to use the ERP system.
2. The instructor handled the ERP technology effectively.
3. *(added) The instructor had a positive attitude towards the ERP system.*

Enterprise Systems Knowledge (Pre): Sixteen ES knowledge self-reported items were previously used in Cronan et al. (2008b; 2008a; 2011) as adapted from Seethamraju (2007).

---

[5] This item (the second item in the content scale) loaded with the constructivist factor and it was included in the constructivist summative variable. The item relates closely to the constructivist construct and has face validity.

[6] This item loaded with constructivist and was therefore included in constructivist factor where it is conceptually consistent.

Business Process Knowledge (BK and PK items):

1. Knowledge of Procurement Business Processes and Activities.
2. Knowledge of Sales and Distribution Business Processes and Activities.
3. Knowledge of Financial Accounting Business Processes and Activities.
4. Knowledge of Production Management Business Processes and Activities.
5. Knowledge of the importance of the integrated nature of the business processes.
6. Knowledge of business terminology in Sales and Distribution (such as Sales order, discounts, freight, transfer goods, good issues etc.).
7. Knowledge of business terminology in Procurement process (such as Purchase Order, invoice verification, goods receipt, material account ,etc.).
8. Knowledge of the interrelationships and interdependencies between various processes (such as accounting, marketing, production, etc.)

Enterprise Systems Management Knowledge (ES items):

1. Ability to analyze the impact of integrated information on managerial decision making
2. Ability to analyze the impact of individual employee actions on the operations of other functional areas
3. Ability to understand the role and complexity of technology in enterprise system software solutions

Application Transaction Knowledge (TS items):

1. Ability to accomplish transactions to procure inventory in SAP
2. Ability to accomplish transactions to set (and change) prices and sell products in SAP
3. Ability to accomplish transactions to collect from customers (accounts receivable) in SAP
4. Ability to accomplish transactions to produce/manufacture goods (set up Production) in SAP
5. Ability to accomplish transactions to pay for purchases (accounts payable) in SAP

Primary cognitive appraisal: Measures for perceived opportunity and perceived threat.

Perceived opportunity - items previously used in Bala (2008) as adapted from Drach-Zahavy and Erez (2002) and Major et al. (Major et al. 1998).

1. I am confident that the system will have positive consequences for me.
2. I feel that the system will open new avenues for success in my job.
3. The system will provide opportunities to improve my job performance.
4. *The system will provide opportunities to gain recognition and praise.*

Perceived threat – items previously used in Bala (2008) as adapted from Major et al. (1998).

1. I am scared that the system will have harmful (or bad) consequences for me.
2. I am worried that the new system may worsen my job performance.
3. I feel that the new system might actually degrade my status in the organization.
4. I feel stressed about having to use the new system to accomplish my job.

Secondary cognitive appraisal:
Perceived controllability – items previously used in Bala (2008) as adapted from (Major et al. 1998).

1. I personally have what it takes to deal with these situations caused by the system.
2. I have the resources I need to successfully use the system.
3. I have the knowledge necessary to use the new system.
4. I so confident that I will be able to use the system without any problems.

Table 4. Dependent Variable Items
Enterprise Systems Job Satisfaction: used existing Job Satisfaction measures below.

Job Satisfaction: items on the work itself were from Spector (1985).

1. *I feel my ERP work is meaningful.*
2. I like doing the work I do with ERP.
3. I feel a sense of pride in doing my ERP work.
4. My work with ERP is enjoyable.

Job Satisfaction: Items from Tsui et al. (1992)

1. I am satisfied with the nature of the ERP work I perform.
2. *I am satisfied with my relations with others in the organization with whom I work (i. e. my peers).*

Appendix E: Expert Referent BMK Knowledge Structure

Experts' knowledge structures are typically used as the accuracy referent in studies of knowledge organization (Goldsmith and Davenport 1990). Averaged composite experts' KS are empirically demonstrated to be a more effective accuracy standard than using a single individual expert's KS (Acton and Johnson 1994). The composite referent for BMKS is formed using a Pathfinder network graph averaging technique based on combining the reduced set of common links among expert KS's. The expert referent BMKS is formed from several ERP experts' knowledge structures obtained using the same BMKS instrument used to gather participant data. Multiple ES expert/instructors (n=13) were surveyed (Pathfinder analysis results in Table E1) as a basis for selecting the most coherent KS and creating an averaged expert referent BMKS. The process used in this study to create the averaged expert referent was 1) select top quartile experts based on highest KS coherence metrics, 2) use Pathfinder to average these top quartile expert KS's and create an initial composite referent KS, 3) determine the Pathfinder similarity metric for each individual expert/instructor's KS in comparison to this initial composite expert referent KS, 4) in a iterative process, consider adding any expert/instructor with a high similarity to initial averaged expert referent KS while maintaining a high coherence (greater than 0.60) for the selected referents and achieving an mean expert referent KS similarity greater than 0.30 (here it is 0.4782). The final composite expert referent BMKS has a coherence of 0.8672 (Table E2). The BMK knowledge structure for the composite expert referent is shown as a Pathfinder network graph in figure E1. For comparison purposes, another participant' BMK Pathfinder network graph is shown in figure E2 where the coherence value was significantly lower.

In this study, individual experts in the top quartile had coherence metrics over 0.65 but had a range of similarity with respect to the final referent. Pathfinder techniques are very robust with respect to variation of individual similarity measures within a composite referent (Acton and Johnson 1994). In Acton (Acton and Johnson 1994), an average similarity of 0.31 for included experts (compared to the averaged expert referent KS) was found acceptable to maintain a robust measure. In this study, the average similarity of selected expert referents is 0.4782, well above Acton's level. In fact, overall the averaged similarity of all surveyed instructors was found to be quite high at 0.3772 indicating a well-established set of experts were obtained for use in the expert referent base. Overall, these metrics indicate that a well-formed and robust composite expert referent was created and used for comparing participants' BMKS in this study.

Table E1. Full Sample of Expert BMK Knowledge Structure Statistics

Business Motivational Knowledge Structure	Coherence	Symmetric Links	Common Links	Similarity
BMK_Expert_u_A	-0.2114	12	6	0.4286
BMK_Expert_u_B	0.2938	8	4	0.3333
BMK_Expert_u_C*	**0.6447**	**8**	**6**	**0.6000**
BMK_Expert_u_E	-0.3084	13	4	0.2353
BMK_Expert_u_G	-0.6697	21	8	0.3810
BMK_Expert_u_H*	**0.8556**	**18**	**7**	**0.3684**
BMK_Expert_u_K	0.4601	18	6	0.3000
BMK_Expert_u_L*	**0.7565**	**15**	**5**	**0.2778**
BMK_Expert_u_M*	**0.8463**	**7**	**7**	**0.8750**
BMK_Expert_u_R	0.3931	14	4	0.2222
BMK_Expert_u_U*	**0.9507**	**22**	**8**	**0.3636**
BMK_Expert_u_V	0.3170	9	2	0.1333
BMK_Expert_u_W*	**0.7974**	**10**	**5**	**0.3846**

* Included in BMK Average Expert Referent (labeled in table below as AVG_BMK_REFERENT) as calculated by Pathfinder Network Graph Analysis.

BMK Expert's mean similarity for all instructors/experts = 0.3772

Table E2. Selected Referent BMK Knowledge Structure Statistics for Composite Expert Referent

Business Motivational Knowledge Structure: Selected Expert Referents	Coherence	Symmetric Links	Common Links	Similarity
BMK_Expert_u_C*	0.6447	8	6	0.6000
BMK_Expert_u_H*	0.8556	18	7	0.3684
BMK_Expert_u_L*	0.7565	15	5	0.2778
BMK_Expert_u_M*	0.8463	7	7	0.8750
BMK_Expert_u_U*	0.9507	22	8	0.3636
BMK_Expert_u_W*	0.7974	10	5	0.3846
AVG_BMK_REFERENT**	**0.8672**	**8**	**8**	**1.00**

** AVG_BMK_REFERENT is a composite network graph calculated by Pathfinder Network Graph Analysis. Expert BMK Referent Instructors' mean similarity is 0.4782

Figure E1. Expert Referent BMK Knowledge Structure

Shorten concept names were used in the network graph of the BMK knowledge structure in order to succinctly represent the longer phrases used in the BMK pairwise relatedness survey items.

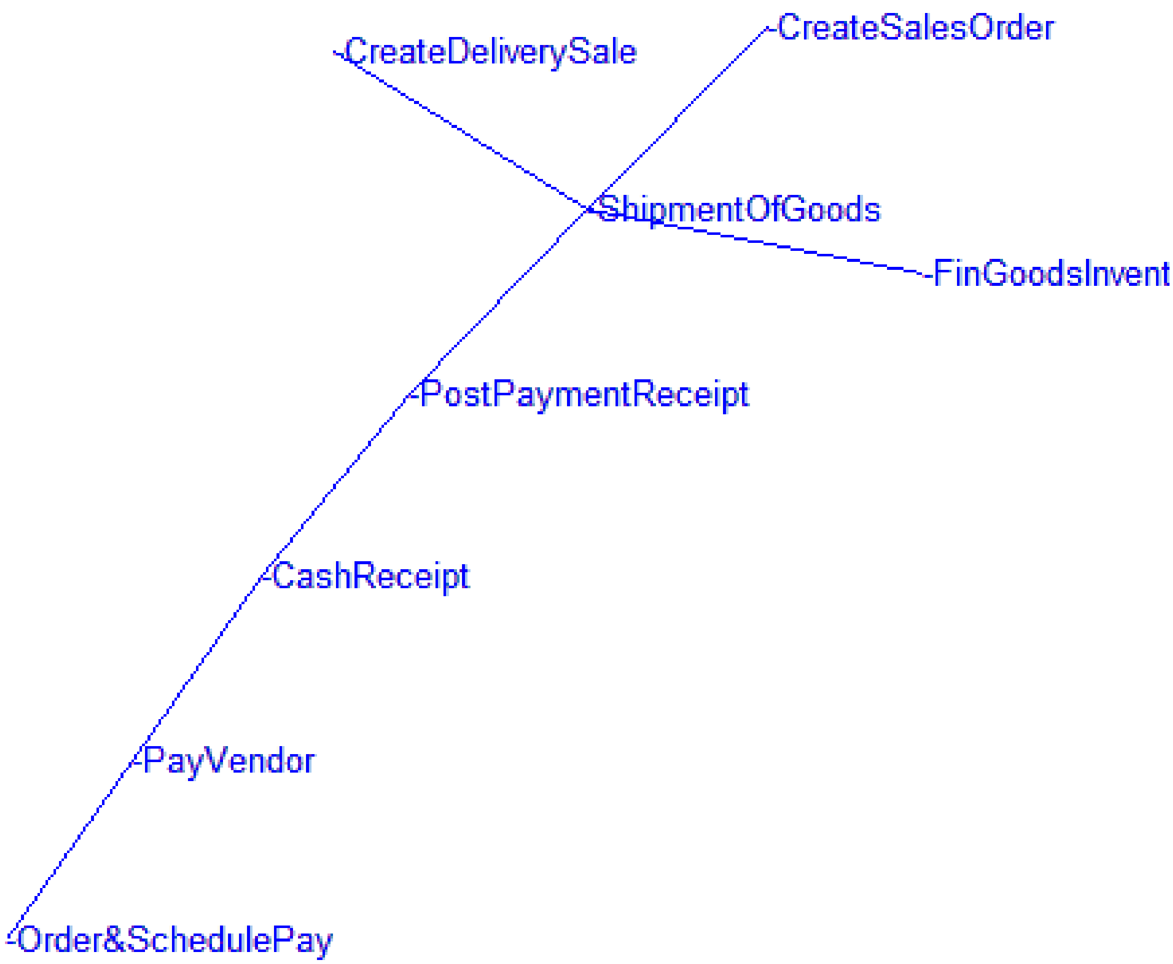
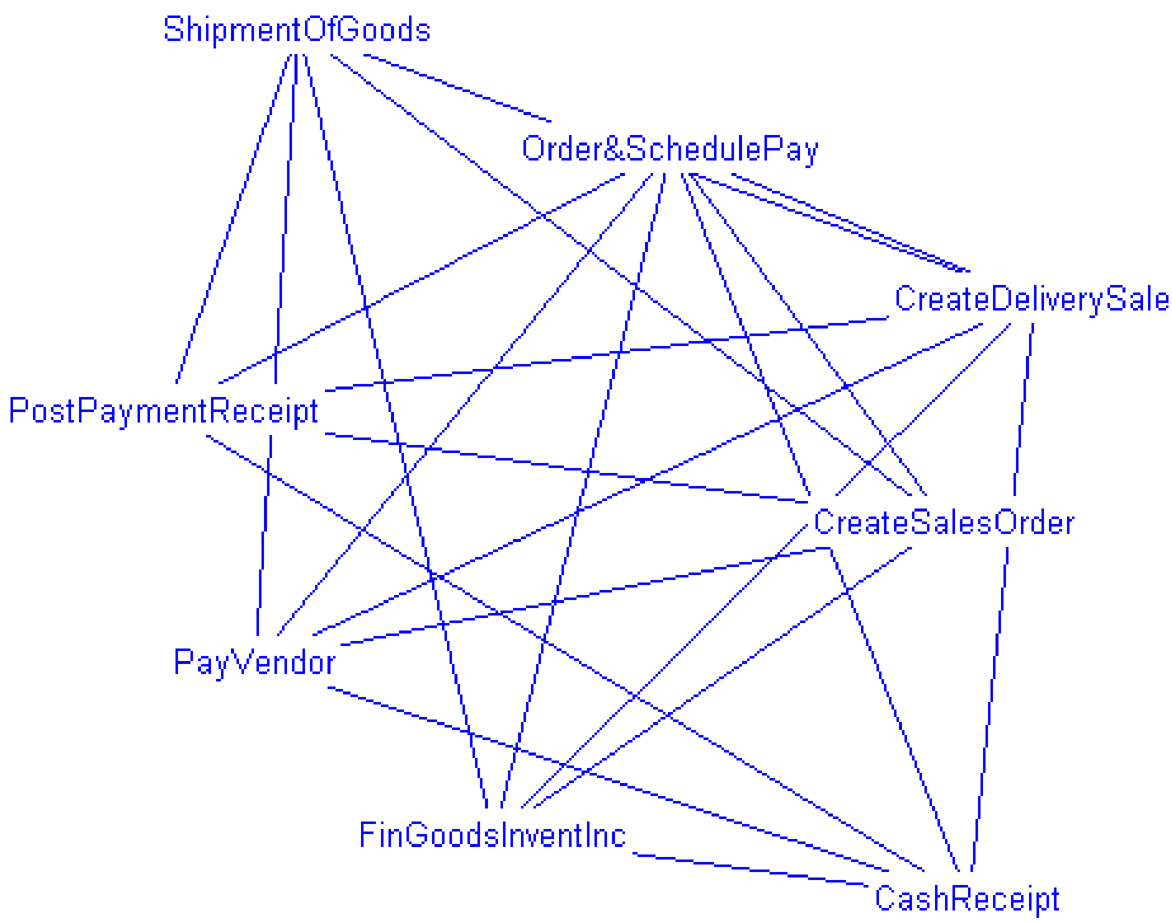


Figure E2. Sample Low Coherence BMK Knowledge Structure

Shorten concept names were used in the network graph of the BMK knowledge structure in order to succinctly represent the longer phrases used in the BMK pairwise relatedness survey items.



REFERENCES

Acton, W.H., and Johnson, P.J. "Structural Knowledge Assessment: Comparison of Referent Structures," *Journal of Educational Psychology* (86:2) 1994, p. 303.

Agarwal, R., and Karahanna, E. "Time Flies When You're Having Fun: Cognitive Absorption and Beliefs About Information Technology Usage," *Management Information Systems Quarterly* (24:4), Dec 2000, pp. 665-694.

Aloini, D., Dulmin, R., and Mininno, V. "Risk Management in ERP Project Introduction: Review of the Literature," *Information & Management* (44:6), Sep 2007, pp. 547-567.

Anderson, J.R. "Acquisition of Cognitive Skill," *Psychological Review* (89:4) 1982, pp. 369-406.

Anderson, J.R. "Skill Acquisition: Compilation of Weak-Method Problem Solutions," *Psych. Review* (94:2) 1987, p. 192.

Anderson, J.R. *Rules of the Mind* Psychology Press, 1993.

Anderson, L.W., Krathwohl, D.R., Airasian, P.W., Cruiskshank, K.A., Mayer, R.E., Pintrich, P.R., Raths, J., and Wittrock, M.C. *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives* Addison Wesley Longman, Inc., New York, 2001.

Anderson, P., and Lawton, L. "Business Simulations and Cognitive Learning: Developments, Desires, and Future Directions," *Simulation & Gaming* (40:2) 2009, p. 193.

Arthur, W., Bennett, W., Edens, P.S., and Bell, S.T. "Effectiveness of Training in Organizations: A Meta-Analysis of Design and Evaluation Features," *Journal of Applied Psychology* (88:2), Apr 2003, pp. 234-245.

Bala, H. "Nothing Endures But Change: Understanding Employees' Responses To Enterprise Systems Implementation and Business Process Change " in: *Information Systems*, University of Arkansas, Fayetteville, Arkansas, 2008, p. 214.

Baron, R.M., and Kenny, D.A. "The Moderator-Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations," *Journal of Personality and Social Psychology* (51:6) 1986, pp. 1173-1182.

Beaudry, A., and Pinsonneault, A. "Understanding User Responses to Information Technology: A Coping Model of User Adaptation," *Management Information Systems Quarterly* (29:3) 2005, pp. 493-524.

Beaudry, A., and Pinsonneault, A. "The Other Side of Acceptance: Studying the Direct and Indirect Effects of Emotions on Information Technology Use," *MIS Quarterly* (34:4) 2010, pp. 689-710.

Bedard, J., and Chi, M.T.H. "Expertise in Auditing," *Auditing - A Journal of Practice & Theory* (12) 1993, pp. 21-45.

Berry, D.C., and Broadbent, D.E. "The Combination of Explicit and Implicit Learning-Processes in Task Control," *Psychological Research-Psychologische Forschung* (49:1) 1987, pp. 7-15.

Bonner, S.E., and Walker, P.L. "The Effects Of Instruction And Experience On The Acquisition Of Auditing Knowledge," *The Accounting Review* (69:1) 1994, p. 157.

Borthick, A.F., Curtis, M.B., and Sriram, R.S. "Accelerating The Acquisition Of Knowledge Structure To Improve Performance In Internal Control Reviews," *Accounting, Organizations and Society* (31:4-5), August 2006, pp. 323-342.

Bostrom, R.P., Olfman, L., and Sein, M.K. "The Importance Of Learning Style In End-User Training," *MIS Quarterly* (14:1) 1990, pp. 101-119.

Choi, D.H., Kim, J., and Kim, S.H. "ERP training with a web-based electronic learning system: The flow theory perspective," *International Journal of Human-Computer Studies* (65:3), Mar 2007, pp. 223-243.

Choo, F., and Curtis, M.B. "Structural Assessment in Accounting Research," *Journal of Accounting Literature* (19) 2000, p. 131.

Church, K., and Smith, R. "REA Ontology-Based Simulation Models for Enterprise Strategic Planning," *Journal of Information Systems* (22:2) 2008, p. 301.

Church, K.S., and Smith, R.E. "An Extension of the REA Framework to Support Balanced Scorecard Information Requirements," *Journal of Information Systems* (21:1) 2007, pp. 1-25.

Clegg, C., and Walsh, S. "Change Management: Time For A Change!," *European Journal of Work and Organizational Psychology* (13:2) 2004, p. 217.

Cohen, D.S. "Why Change Is an Affair of the Heart; In the Drama of Change, Emotions, Not Logic, Impel People to Cast Off the Old and Embrace the New," *CIO* (19:5) 2005, p. 1.

Cohen, J., Cohen, P., West, S.G., and Aiken, L.S. *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*, (3rd ed.) Lawrence Erlbaum Associates, Mahwah, New Jersey, 2003, p. 703.

Cronan, T.P., Douglas, D.E., Alnuaimi, O., and Schmidt, P.J. "Decision Analytics in an Integrated Business Process Context: Learning Using an ERP Simulation Game," *Decision Sciences Journal of Innovative Education* (forthcoming) 2011.

Cronan, T.P., Douglas, D.E., Schmidt, P., and Alnuaimi, O. "Using an ERP Simulation Game: Learning and Attitudes toward SAP (Draft Report - ERP Student Sample)," *Information Technology Research Institute - Working Paper Series* (ITRI-WP123-1008), Sept. 2008a.

Cronan, T.P., Douglas, D.E., Schmidt, P., and Alnuaimi, O. "Using an ERP Simulation Game: Learning and Attitudes toward SAP (Draft Report Company A)," *Information Technology Research Institute - Working Paper Series* (ITRI-WP122-1008) 2008b, pp. 1-14.

Curtis, M.B., and Davis, M.A. "Assessing Knowledge Structure in Accounting Education: An Application of Pathfinder Associative Networks," *Journal of Accounting Education* (21:3) 2003, p. 185.

Curtis, M.B., and Viator, R.E. "An Investigation Of Multidimensional Knowledge Structure And Computer Auditor Performance," *Auditing* (19:2) 2000, p. 83.

Davenport, T.H. "Putting the Enterprise Into the Enterprise System," *Harvard Business Review* (76:4), Jul-Aug 1998, pp. 121-131.

Davis, C.E., and Davis, E.B. "Audit Task and Audit Methodology As Determinants of Auditors' Elicitation of Alternative Knowledge Structures," in: *Advances in Accounting Behavioral Research*, JAI Press Inc., 1998, pp. 101-121.

Davis, F.D. "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," *Management Information Systems Quarterly* (13:3), Sep 1989, pp. 319-340.

Davis, S.A., and Bostrom, R.P. "Training End Users - An Experimental Investigation of the Roles of the Computer-Interface and Training Methods," *Management Information Systems Quarterly* (17:1), Mar 1993, pp. 61-85.

Dearholt, D.W., and Schvaneveldt, R.W. "Properties of Pathfinder Networks," in: *Pathfinder Associative Networks: Studies in Knowledge Organization,* Ablex Publishing Corp., New Jersey, 1990, pp. 1-30.

Den Brok, P., Bergen, T., Stahl, R.J., and Brekelmans, M. "Students' Perceptions Of Teacher Control Behaviours," *Learning and Instruction* (14:4), Aug 2004, pp. 425-443.

Drach-Zahavy, A., and Erez, M. "Challenge Versus Threat Effects On The Goal-Performance Relationship," *Organizational Behavior and Human Decision Processes* (88:2) 2002, p. 667.

Draijer, C., and Schenk, D.-J. "Best Practices of Business Simulation with SAP R/3," *Journal of Information Systems Education* (15:3) 2004, p. 261.

Dunn, C.L., and Grabski, S.V. "Perceived Semantic Expressiveness Of Accounting Systems And Task Accuracy Effects," *International Journal of Accounting Information Systems* (1:2) 2000, pp. 79-87.

Dunn, C.L., and McCarthy, W.E. "The REA Accounting Model: Intellectual Heritage and Prospects For Progress," *Journal of Information Systems* (11:1), Spring97 1997, pp. 31-51.

Folkman, S., and Lazarus, R.S. "Coping as a Mediator of Emotion," *Journal of Personality and Social Psychology* (54:3), Mar 1988a, pp. 466-475.

Folkman, S., and Lazarus, R.S. "The Relationship between Coping and Emotion - Implications for Theory and Research," *Social Science & Medicine* (26:3) 1988b, pp. 309-317.

Folkman, S., Lazarus, R.S., Dunkelschetter, C., Delongis, A., and Gruen, R.J. "Dynamics of a Stressful Encounter - Cognitive Appraisal, Coping, and Encounter Outcomes," *Journal of Personality and Social Psychology* (50:5), May 1986a, pp. 992-1003.

Folkman, S., Lazarus, R.S., Gruen, R.J., and Delongis, A. "Appraisal, Coping, Health-Status, and Psychological Symptoms," *Journal of Personality and Social Psychology* (50:3), Mar 1986b, pp. 571-579.

Fornell, C., and Larcker, D.F. "Evaluating Structural Equation Models With Unobservable Variables and Measurement Error," *Journal of Marketing Research* (18) 1981, pp. 39-50.

Frederick, D.M. "Auditors' Representation and Retrieval of Internal Control Knowledge," *The Accounting Review* (66:2) 1991, p. 240.

Frederick, D.M., Heiman-Hoffman, V.B., and Libby, R. "The Structure of Auditors' Knowledge of Financial Statement Errors," *Auditing* (13:1) 1994, p. 1.

Gailly, F., Laurier, W., and Poels, G. "Positioning and Formalizing the REA Enterprise Ontology," *Journal of Information Systems* (22:2) 2008, p. 219.

Geerts, G.L., and McCarthy, W.E. "An Accounting Object Infrastructure For Knowledge-Based Enterprise Models," *IEEE Intelligent Systems & Their Applications* (14:4) 1999, p. 89.

Geerts, G.L., and McCarthy, W.E. "An Ontological Analysis of the Economic Primitives of Extended-REA Enterprise Information Architecture," *International Journal of Accounting Information Systems* (3) 2002, pp. 1-16.

Geerts, G.L., and McCarthy, W.E. "Policy-Level Specifications in REA Enterprise Information Systems," *Journal of Information Systems* (20:2), Fall2006 2006, pp. 37-63.

Gerard, G.J. "The REA Pattern, Knowledge Structures, and Conceptual Modeling Performance," *Journal of Information Systems* (19:2) 2005, p. 57.

Goldsmith, R.E., and Davenport, D.M. "Assessing Structural Similarity of Graphs," in: *Pathfinder Associative Networks: Studies in Knowledge Organization*, Ablex Publishing Corp., New Jersey, 1990, pp. 75-87.

Goldsmith, R.E., and Johnson, P.J. "A Structural Assessment of Classroom Learning," in: *Pathfinder Associative Networks: Studies in Knowledge Organization*, Ablex Publishing Corp., New Jersey, 1990, pp. 241-255.

Grabski, S.V., Leech, S.A., and Schmidt, P.J. "A Review of ERP Research: A Future Agenda for Accounting Information Systems," *Journal of Information Systems* (25:1) 2011, pp. 37-78.

Hackman, J.R., and Oldham, G.R. "Development of Job Diagnostic Survey," *Journal of Applied Psychology* (60:2) 1975, pp. 159-170.

Hackman, J.R., and Oldham, G.R. "Motivation Through Design of Work - Test of a Theory," *Organizational Behavior and Human Performance* (16:2) 1976, pp. 250-279.

Haerem, T., and Rau, D. "The Influence Of Degree Of Expertise And Objective Task Complexity On Perceived Task Complexity And Performance," *Journal of Applied Psychology* (92:5) 2007, p. 1320.

Hassin, R.R., Bargh, J.A., and Zimerman, S. "Automatic and Flexible: the Case of Nonconscious Goal Pursuit," *Social Cognition* (27:1), Feb 2009, pp. 20-36.

Hitt, L.M., Wu, D.J., and Zhou, X.G. "Investment in Enterprise Resource Planning: Business Impact and Productivity Measures," *Journal of Management Information Systems* (19:1), Sum 2002, pp. 71-98.

Humphrey, S.E., Nahrgang, J.D., and Morgeson, F.P. "Integrating Motivational, Social, and Contextual Work Design Features: A Meta-Analytic Summary And Theoretical Extension Of The Work Design Literature," *Journal of Applied Psychology* (92:5) 2007, p. 1332.

Interlink "Pathfinder 6.3 Manual ", Interlink, Inc. http://interlinkinc.net/ (Last Accessed Sept. 12, 2007), Las Cruces, NM, 2007.

Ip, W.H., Chau, K.Y., and Chan, S.F. "Implementing ERP Through Continuous Improvement," *International Journal of Manufacturing Technology and Management* (4:6) 2002, p. 465.

Ip, W.H., Lai, C.L., and Lau, C.W. "A Web-Based Training Model of Enterprise Resources Planning for the Manufacturing Industry," *International Journal of Engineering Education* (20:5) 2004, pp. 733-741.

Jacobson, S., Shepherd, J., D'Aquila, M., and Carter, K. "The ERP Market Sizing Report, 2006–2011," 2007, pp. 1-34.

Johnson, B., and McClure, R. "Validity and Reliability of a Shortened, Revised Version of the Constructivist Learning Environment Survey (CLES)," *Learning Environments Research* (7:1) 2004, pp. 65-80.

Joseph, D., Kok-Yee, N., Koh, C., and Soon, A. "Turnover of Information Technology Professionals: A Narrative Review, Meta-Analytic Structural Equation Modeling, and Model Development," *Management Information Systems Quarterly* (31:3) 2007, pp. 547-577.

Judge, T.A., Thoresen, C.J., Bono, J.E., and Patton, G.K. "The Job Satisfaction-Job Performance Relationship: A Qualitative and Quantitative Review," *Psychological Bulletin* (127:3), May 2001, pp. 376-407.

Kang, D., and Santhanam, R. "A Longitudinal Field Study of Training Practices in a Collaborative Application Environment," *Journal of Management Information Systems* (20:3), Win 2003, pp. 257-281.

Karuppan, C.M., and Karuppan, M. "Resilience Of Super Users Mental Models Of Enterprise-Wide Systems," *European Journal of Information Systems* (17) 2008, pp. 29-46.

Kellogg, W.A., and Breen, T.J. "Using Pathfinder to Evaluate User and System Models," in: *Pathfinder Associative Networks: Studies in Knowledge Organization*, Ablex Publishing Corp., New Jersey, 1990, pp. 179-195.

Kim, H.-W., and Kankanhalli, A. "Investigating User Resistance to Information Systems Implementation: A Status Quo Bias Perspective," *Management Information Systems Quarterly* (33:3) 2009, pp. 567-582.

Kim, S.S. "The Integrative Framework of Technology Use: An Extension and Test," *Management Information Systems Quarterly* (33:3) 2009, pp. 513-537.

King, S., and Burgess, T. "Understanding Success and Failure in Customer Relationship Management," *Industrial Marketing Management* (37:4) 2008, p. 421.

Lazarus, R.S. "From Psychological Stress to the Emotions: A History of Changing Outlooks," *Annual Review of Psychology* (44) 1993, p. 1.

Lazarus, R.S., and Folkman, S. "Transactional Theory and Research On Emotions and Coping," *European Journal of Personality* (1:3) 1987, pp. 141-169.

Léger, P.M. "Using a Simulation Game Approach to Teach Enterprise Resource Planning Concepts," *Journal of Information Systems Education* (17:4) 2006, p. 441.

Leidner, D.E., and Jarvenpaa, S.L. "The Use of Information Technology to Enhance Management School Education: A Theoretical View," *Management Information Systems Quarterly* (19:3) 1995, pp. 265-291.

Liang, H., Saraf, N., Hu, Q., and Xue, Y. "Assimilation of Enterprise Systems: The Effect of Institutional Pressures and the Mediating Role of Top Management," *Management Information Systems Quarterly* (31:1) 2007, pp. 59-87.

Loher, B.T., Noe, R.A., Moeller, N.L., and Fitzgerald, M.P. "A Meta-Analysis of the Relation of Job Characteristics to Job-Satisfaction," *Journal of Applied Psychology* (70:2) 1985, pp. 280-289.

MacKinnon, D.P., Fairchild, A.J., and Fritz, M.S. "Mediation Analysis," *Annual Review of Psychology* (58) 2007.

Major, B., Richards, C., Cooper, M.L., Cozzarelli, C., and Zubek, J. "Personal Resilience, Cognitive Appraisals, And Coping: An Integrative Model Of Adjustment To Abortion," *Journal of Personality and Social Psychology* (74:3) 1998, p. 735.

Maor, D., and Fraser, B.J. "An Online Questionnaire for Evaluating Students’ and Teachers’ Perceptions of Constructivist Multimedia Learning Environments," *Research in Science Education* (35) 2005, pp. 221-244.

Markus, L.M., and Tanis, C. "The Enterprise System Experience – From Adoption to Success," in: *Framing the Domains of Information Technology*, R.W. Zmud (ed.), Pinnaflex Education Resources, Inc., 2000, pp. 173-207.

Markus, M.L. "Technochange Management: Using IT to Drive Organizational Change," *Journal of Information Technology* (19:1) 2004, pp. 4-21.

Markus, M.L., Axline, S., Petrie, D., and Tanis, C. "Learning From Adopters' Experiences With ERP: Problems Encountered and Success Achieved," *Journal of Information Technology* (15:4), Dec 2000, pp. 245-265.

Markus, M.L., and Grover, V. "Consolidating Knowledge on the Journey of Business Process Transformation," in: *Business Process Transformation, in Advanced Management Information Systems,* M.L.M. Varun Grover (ed.), ME Sharpe, 2007, pp. 1 - 19

Martocchio, J.J., and Dulebohn, J. "Performance Feedback Effects In Training - The Role of Perceived Controllability," *Personnel Psychology* (47:2), Sum 1994, pp. 357-373.

McCarthy, W., E. "The REA Modeling Approach to Teaching Accounting Information Systems," *Issues in Accounting Education* (18:4) 2003, p. 427.

McCarthy, W.E. "An Entity-Relationship View of Accounting Models," *The Accounting Review* (54:4) 1979, pp. 667-686.

McCarthy, W.E. "The REA Accounting Model: A Generalized Framework for Accounting Systems in a Shared Data Environment," *The Accounting Review* (57:3) 1982, p. 554.

Montgomery, D.C., Peck, E.A., and Vining, G.G. *Introduction to Linear Regression Analysis*
(Third ed.) John Wiley & Sons., New York, New York, 2001.

Moon, Y.B. "Enterprise Resource Planning (ERP): A Review of the Literature," *International Journal of Management and Enterprise Development* (3:4) 2007, pp. 235 - 264

Nah, F.F., Tan, X., and Teh, S.H. "An Empirical Investigation on End-Users' Acceptance of Enterprise Systems," *Information Resources Management Journal* (17:3) 2004, pp. 32-53.

Nelson, D.L. "Individual Adjustment to Information-Driven Technologies: A Critical Review," *Management Information Systems Quarterly* (14:1) 1990, pp. 79-98.

Nelson, M.W., Libby, R., and Bonner, S.E. "Knowledge Structure And The Estimation Of Conditional Probabilities In Audit Planning," *The Accounting Review* (70:1) 1995, p. 27.

Nicolaou, A.I. "Firm Performance Effects in Relation to the Implementation and Use of Enterprise Resource Planning Systems," *Journal of Information Systems* (18:2) 2004, pp. 79-105.

Nunnaly, J.C. *Psychometric Theory*, (second ed.) McGraw-Hill, New York, 1978.

Orlikowski, W., and Hoffman, D. "An Imporvisational Model for Change Managment: The Case of Groupware Technologies," *Sloan Management Review*), Winter 1997, pp. 11-21.

Park, K., and Kusiak, A. "Enterprise Resource Planning (ERP) Operations Support System For Maintaining Process Integration," *International Journal of Production Research* (43:19) 2005, pp. 3959–3982.

Parush, A., Hamm, H., and Shtub, A. "Learning Histories in Simulation-Based Teaching: the Effects on Self-Learning and Transfer," *Computers & Education* (39:4), Dec 2002, pp. 319-332.

Peterson, W.J., Gelman, L., and Cooke, D.P. "ERP Trends, Report Number: R-1292-01-RR ", The Conference Board, /www.conference-board.org, pp. 1-31.

Ram, S., and Sheth, J.N. "Consumer Resistance To Innovations: The Marketing Problem And Its Solutions," *The Journal of Consumer Marketing* (6:2) 1989, p. 5.

Reber, A.S. "Implicit Learning and Tacit Knowledge," *Journal of Experimental Psychology-General* (118:3), Sep 1989, pp. 219-235.

Riketta, M. "The Causal Relation Between Job Attitudes and Performance: A Meta-Analysis of Panel Studies," *Journal of Applied Psychology* (93:2) 2008, pp. 472-481.

Robey, D., Ross, J.W., and Boudreau, M.C. "Learning To Implement Enterprise Systems: An Exploratory Study of the Dialectics of Change," *Journal of Management Information Systems* (19:1), Sum 2002, pp. 17-46.

Rose, J.M., Rose, A.M., and McKay, B. "Measurement of Knowledge Structures Acquired Through Instruction, Experience, and Decision Aid Use," *International Journal of Accounting Information Systems* (8:2) 2007, pp. 117-137.

Santhanam, R., and Sein, M.K. "Improving End-User Proficiency - Effects of Conceptual Training and Nature of Interaction," *Information Systems Research* (5:4), Dec 1994, pp. 378-399.

Santhanam, R., Seligman, L., and Kang, D. "Postimplementation Knowledge Transfers to Users and Information Technology Professionals," *Journal of Management Information Systems* (24:1), Sum 2007, pp. 171-199.

Satzinger, J.W., and Olfman, L. "User Interface Consistency Across End-User Applications: The Effects on Mental Models," *Journal of Management Information Systems* (14:4) 1998, p. 167.

Schein, E.H. "Kurt Lewin's change theory in the field and in the classroom: Notes toward a model of managed learning," *Systems Practice* (9:1), Feb 1996, pp. 27-47.

Schmidt, P.J., Davis, F.D., Davis, C.C., and Cronan, T.P. "Acquiring ERP Business Process Knowledge: A Network Structure Analysis," *Proceedings of the 44th Annual Hawaii International Conference on System Sciences (HICSS-44)* (forthcoming), Jan. 2011.

Schvaneveldt, R.W. *Pathfinder Associative Networks: Studies in Knowledge Organization* Ablex Publishing, NJ, 1990, pp. 1-315.

Scott, J. "The FoxMeyer Drugs' Bankruptcy: Was it a Failure of ERP?," *Proceedings of the Americas Conference on Information Systems (AMCIS)* (Paper 80) 1999, pp. 223-225.

Scott, J.E., and Vessey, I. "Implementing Enterprise Resource Planning Systems: The Role of Learning from Failure," *Information Systems Frontiers* (2:2) 2000, pp. 213-232.

Seethamraju, R. "Enterprise Systems (ES) Software in Business School Curriculum - Evaluation of Design and Delivery," *Journal of Information Systems Education* (18:1) 2007, p. 69.

Seger, C.A. "Implicit Learning," *Psychological Bulletin* (115:2), Mar 1994, pp. 163-196.

Sein, M.K., Bostrom, R.P., and Olfman, L. "Rethinking End-User Training Strategy: Applying a Hierarchical Knowledge-Level Model," *Journal of End User Computing* (11:1) 1999, pp. 32-39.

Sein, M.K., and Santhanam, R. "Research Report. Learning From Goal-Directed Error Recovery Strategy," *Information Systems Research* (10:3) 1999, p. 276.

Sobel, M.E. "Effect Analysis and Causation in Linear Structural Equation Models," *Psychometrika* (55:3) 1990, pp. 495-515.

Spector, P. *Job Satisfaction* Sage Publications, Thousand Oaks, CA, 1997.

Spector, P.E. "Measurement of Human-Service Staff Satisfaction - Development of the Job-Satisfaction Survey," *American Journal of Community Psychology* (13:6), Dec 1985, pp. 693-713.

Spector, P.E. "Perceived Control by Employees: A Meta-Analysis of Studies Concerning Autonomy and Participation at Work," *Human Relations* (39:11), Nov. 1986, pp. 1005-1017.

Sumner, M. "Risk factors in enterprise-wide/ERP projects," *Journal of Information Technology* (15:4) 2000, p. 317.

Swanson, E.B. "Information-Systems Innovation among Organizations," *Management Science* (40:9), Sep 1994, pp. 1069-1092.

Taylor, J.C. "Participative design: linking BPR and SAP with an STS approach," *Journal of Organizational Change Management* (11:3) 1998, p. 233.

Taylor, P.J., Russ-Eft, D.F., and Chan, D.W.L. "A Meta-Analytic Review of Behavior Modeling Training," *Journal of Applied Psychology* (90:4) 2005, p. 692.

Tomaka, J., Kibler, J., Blascovich, J., and Ernst, J.M. "Cognitive and Physiological Antecedents of Threat and Challenge Appraisal," *Journal of Personality & Social Psychology* (73:1) 1997, pp. 63-72.

Tsui, A., Egan, T., and O'Reilly, C., III "Being Different: Relational Demography and Organizational Attachment," *Administrative Science Quarterly* (37:4) 1992, p. 549.

Venkatesh, V. "Determinants Of Perceived Ease Of Use: Integrating Control, Intrinsic Motivation, And Emotion Into The Technology Acceptance Model," *Information Systems Research* (11:4), Dec 2000, pp. 342-365.

Venkatesh, V., Morris, M.G., Davis, G.B., and Davis, F.D. "User Acceptance Of Information Technology: Toward A Unified View," *Management Information Systems Quarterly* (27:3), Sep 2003, pp. 425-478.

Wen, M.L., Tsai, C.-C., Lon, H.-M., and Chuang, S.-C. "Cognitive – Metacognitive and Content-Technical Aspects of Constructivist Internet-Based Learning Environments: A LISREL Analysis," *Computers and Education* (43) 2004, pp. 237–248.

Yi, M.Y., and Davis, F.D. "Developing and Validating An Observational Learning Model Of Computer Software Training And Skill Acquisition," *Information Systems Research* (14:2) 2003, pp. 146-169.

Yu, C. "Causes Influencing the Effectiveness of the Post-Implementation ERP System," *Industrial Management and Data Systems* (105:1/2) 2005, p. 115.

CHAPTER 4 (Essay 3)

Realistic Technology Previews:
Simulation-Based Information Technology Education As A Transitional Environment For Enterprise Change Management

Abstract

This study takes a change management perspective in determining the influence of simulation-based education on information technology (IT) adaptation to an enterprise system. Often, failure of a complex IT implementation lies with non-technical issues such as emotional reactions, negative cognitive appraisals to change and resistance to IT use. The goal of this research is to determine if simulation-based IT education is an effective method for improving individual cognitive appraisals and job satisfaction related to enterprise systems. To facilitate change management, simulation-based education is positioned as providing a safe and supportive environment referred to as a 'transitional space' aimed at reducing dependencies on prior routines and on the habitual use of earlier information technology. The concept of realistic technology previews (based on the organization behavior concept of realistic job previews) is introduced as an IT change management concept. The realistic technology preview is facilitated by using the enterprise system in the context of a real-world business simulation. During the transitional education experience, the user develops declarative and tacit knowledge by using the enterprise system in a controlled context with transition support but without the risk of negative consequences often present in the work environment.

This essay demonstrates that simulation-based enterprise systems education provides a safe and supportive transitional environment which appears to reduce user's

dependency needs and facilitate forming a realistic technology preview that influences cognitive appraisals of the enterprise system. A realistic technology preview contains assessments of the systems usefulness and user-friendliness. The usefulness aspects of reports and timeliness directly influenced appraisals of opportunity, while the ease of use aspect, along with attention, influenced appraisal of threat. Results support findings that simulation-based education informs cognitive appraisals of control with realistic technology previews acting as a mechanism for some influences. Jointly, the realistic technology previews aspect of reports (information, format and accuracy) and IT self-efficacy are found to fully mediate the influence of effective simulation education on perceived control of the system. As in the prior two essays, primary and secondary cognitive appraisals are found to strongly influence enterprise system job satisfaction, with the strong influence of opportunity and control apparently attenuating the effects of threat. Based on these findings, a revised model is proposed for future investigation.

Business Problem

Adoption of an enterprise system may be heralded as a business innovation , a transformative information technology (IT) event (Dehning et al. 2003) or viewed as a disruptive service technology (Lyytinen and Rose 2003). Research identifies the proportion of failed ERP implementations from 40 percent to 60 percent (Liang et al. 2007). Measures show that 75% of firms suffered a severe productivity dip following ERP implementation with a quarter of those lasting over a year (Peterson et al. 2001). Per Cohen (2005), getting people to change their behavior is the biggest challenge in any major strategic IT implementation. A major factor contributing to enterprise system (ES) failure is that individuals resist ES adoption (Shih 2006) and may adapt using undesirable behaviors such as shortcuts, workarounds, and avoiding the system altogether (Robey et al. 2002; Boudreau and Seligman 2005).

When an ES is introduced, it can be experienced as a shock to job embeddedness (Mitchell and Lee 2001) if appraised as threatening to the individual's well-being in the workplace. Some change management researchers contend that affective reactions are the biggest barrier to organizational change (Hultman 1998; Beaudry and Pinsonneault 2010) and to learning (Senge 1994). While change management often addresses IT-related knowledge requirements, there is also a need to address affective reactions such as stress reactions and coping strategies. Affective reactions are often unconscious and reflexive and can occur without identifying the source of the reaction (Kappas 2006). Unmet psychological needs are a major reason for unproductive work behaviors, including resistance to IT. A common organizational mistake is reacting to symptoms instead of seeking interventions that proactively deal with underlying psychological needs (Hultman 1998; Wastell 1999).

Research Problem

Recent conceptualizations of IT use recognize that introducing a new IT not only affects the nature of direct IT interactions, but also user adaptation behaviors and task-technology behaviors (Jasperson et al. 2005; Burton-Jones and D. W. Straub 2006; Barki et al. 2007). Recently, IT researchers have addressed IT-related stress and coping strategies as exhibited in user IT adaptation (Beaudry and Pinsonneault 2005), user enactment of information technology (Boudreau and Seligman 2005) and in IT development projects (Wastell 1999). Organizations have an important need to identify methods that promote productive user coping and IT adaption during transitions to an unfamiliar technology. Yet, there has been limited investigation of IT education’s role in influencing the cognitive appraisal (CA) of an IT event that leads to selecting coping strategies. As with any major change in the work environment, the introduction of an ES may be appraised as an opportunity or a threat by users. This assessment is reflected in their primary cognitive appraisal of the situation. In addition, the individual may or may not feel they have the abilities and resources to effectively cope with the situation. This assessment is reflected in their secondary cognitive appraisal of the changing environment (Folkman et al. 1986a; Drach-Zahavy and Erez 2002).

Coping is an individual's cognitive and behavioral efforts to handle stress which is defined as over-taxing demands that are perceived as exceeding the individual’s current abilities and resources (Folkman et al. 1986a; 1986b). Choice in coping strategies has been shown to differentially affect performance outcomes (Drach-Zahavy and Erez 2002). Stress reactions leading to unproductive coping strategies and even resistance to ES may be explained by the high volume of change with which individuals must simultaneously cope. New enterprise systems are accompanied by reengineered business processes requiring simultaneous acquisition of new technology skills, knowledge of new business processes, changing IT-related work practices and redefining job roles. Prior research shows that perceiving stressful events as threats leads to less productive coping strategies and lower performance (Tomaka et al. 1997). Threat appraisals of IT events may lead to emotion-focused coping strategies such as self-preservation, disturbance-handling (Beaudry and Pinsonneault 2005) or avoidance (Bala 2008), rather than the more productive problem-oriented coping strategies of benefits-maximizing (Beaudry and Pinsonneault 2005) or exploration-to-innovate or exploitation (Bala 2008). A crucial opportunity is missed when education focuses on developing user technical skills but fails to address stress reactions and cognitive appraisal of new IT. IT adaptation literature has not yet adequately addressed change management interventions that promote more positive user coping strategies.

This essay proposes shaping IT education as a safe and supportive transitional space which, by providing an interactive experiential preview of the new technology, should improve individual adaptation by promoting production coping strategies in reaction to a new ES. Wastell (1999) introduced the concept of transitional space to IT research when he drew on psychodynamic theory and attachment theory (Peluso et al. 2004; Browne and Shlosberg 2006; Daniel 2006) to recommend creation of a transitional space for addressing the high levels of stress and anxiety produced within IT development environments. *Transitional space* is defined as a safe and supportive psychological climate that is often utilizes transitional objects. *Transitional objects* facilitate affective and cognitive growth by providing temporary support that allows an individual to diminish an existing dependency relationship. The dependency could be on an individual, work practices, a belief system, or other objects. The goal of a transitional space is to provide a safe and supportive environment that promotes openness to change and productive adaptation (Wastell 1999). Results of a pilot study with industry new hires immediately following of simulation-based ES education attributes (table 1) suggest that user of the actual IT, a realistic business context, support materials and consulting along with the safety to experiment are key attributes to a positive IT learning experience. For this research, enterprise systems simulation-based education is considered a *transitional space* for ES adaptation when it provides a safe and engaging, experiential and dynamic initial use of the ES resulting in forming an initial IT assessment referred to as a 'realistic technology preview'. A computer business simulation is utilized as a *transitional object* that provides security and diminishes prior dependencies as it provides the dynamic context to gain ES usage experience in a realistic business context. Computer-based functional simulations, such as business microworlds (Papert 1980; Pufall 1988) have been shown to accelerate organizational learning through experiential learning within dynamic business environments (Berry and Broadbent 1987; Senge 1994). This approach follows the experiential constructivist learning model which allow learners to construct their own knowledge, rather than the traditional objectivist learning model where information is presented to them (Pufall 1988; Leidner and Jarvenpaa 1995). Supporting the use of education for change management, Balogun and Jenkins (2003) re-conceive change management to be a knowledge-based activity. They focus on building tacit knowledge about the way individuals work and interact together. Bala (Bala 2008) identified training as the leading factor influencing cognitive appraisal of enterprise systems and recommended that managers utilize simulations for enterprise education. Therefore, this study focuses on the following research questions:

1. What simulation-based education characteristics are effective in creating a transitional space that leads to improving cognitive appraisals and ES job satisfaction?
2. Does simulation-based education provide a realistic technology preview assessment that is a significant influence on employee cognitive appraisals of new ES applications?
3. What factors mediate the influence of simulation-based transitional education on the cognitive appraisal of control?

In summary, a transitional education environment is intended to create a psychologically safe and supportive learning environment to facilitate ES change. Framed from a change management perspective, this essay evaluates ES simulation education utilizing the theoretical lenses of transitional space (Wastell 1999), psychodynamics and attachment theory (Peluso et al. 2004; Browne and Shlosberg 2006; Daniel 2006). The new concept of realistic technology previews represents an initial ES usage self-assessment formed by interacting with a dynamic ES business simulation in a risk-free, low stress environment which temporarily reduces prior IT dependencies. Viewing simulation-based ES education as a change management ‘transitional space’ positions it as an antecedent to IT adaptive use and contributes to the emerging stream of

IT user adaptation research (Robey et al. 2002; Beaudry and Pinsonneault 2005; Boudreau and Robey 2005; Barki et al. 2007; Beaudry and Pinsonneault 2010).

Theoretical Background

Stress, Coping and IT User Adaptation Research

Stress is defined as a relationship between the individual and the environment that is assessed as over-taxing or exceeding the individual's resources and endangering her/his well-being. *Coping* is defined as an individual's dynamic cognitive and behavioral efforts to handle external or internal demands that are seen as taxing or exceeding the individual's available resources (Folkman et al. 1986a; 1986b). Choice in coping strategies has been shown to differentially affect performance outcomes (Drach-Zahavy and Erez 2002). Stress and coping literature has identified two basic processes, *cognitive appraisal* and *coping processes*, which mediate between stressful person-environment relationships and their short-term or long-term outcomes (Folkman et al. 1986a; 1986b). Two forms of cognitive appraisal are a) *primary cognitive appraisal* where a person evaluates what they have at stake in the encounter and b) *secondary cognitive appraisal* where a person evaluates if anything can be done to prevent harm, overcome barriers or to improve the possibilities for benefits. Secondary cognitive appraisal has been summed up as an assessment of an individual's perceived control in the situation (Major et al. 1998). Tomaka et al. (1997) and Drach-Zahavy and Erez (2002) found that the situational appraisal of goals as being either threatening or challenging has a direct influence on performance of complex tasks and adaptation to change. *Challenges* or *opportunities* are seen as chances for self-growth and to gain benefit by utilizing one's available coping strategies. *Threats* are seen as leading towards failure given one’s lack of adequate abilities or resources. Given the same goal difficulty and the same complex task, perception of a goal as challenging leads to higher performance than when the same goal was appraised as threatening. When the primary cognitive appraisal of an event is assessed as a challenge or opportunity then the individual adapts better to change and achieves higher performance (Drach-Zahavy and Erez 2002). In an IT context, perceptions of an IT event as an opportunity versus threat result in very different user coping strategies (Beaudry and Pinsonneault 2005; Bala 2008). In addition to the perception of threat or challenge (Tomaka et al. 1997; Drach-Zahavy and Erez 2002; Beaudry and Pinsonneault 2005), evidence shows that choices of coping strategies (Lazarus 1993; Major et al. 1998; Gowan et al. 1999) are based on the individual’s perceived level control in the situation.

Lazarus (1993) identifies two main categories of coping strategies directed towards the future: problem-focused, and emotion-focused also called symptom-focused (Leana et al. 1998). Stress and coping researchers avoid placing value judgments on coping mechanisms, but more problem-focused adaptation strategies lead the individual to engage in productive IT use while other symptom or emotion-focused strategies may lead to avoidance or defensive reactions to IT. While emotion-focused strategies may not directly promote engagement in IT use, they may be helpful by addressing affective reactions that inhibit IT engagement. Some purely emotion-focused coping behaviors such as avoidance or distancing (Folkman et al. 1986a) can reduce user’s engagement in learning and using the IT. In the coping model of user adaptation (CMUA) (Beaudry and Pinsonneault 2005), case studies demonstrate that IT events like the introduction of an ES can trigger the IT user adaptation process. IT user adaptation is defined as cognitive and behavioral efforts by which users cope with IT events occurring in their environment. The CMUA model identifies primary and secondary cognitive appraisal are antecedents which influence IT adaptive use (Beaudry and Pinsonneault 2005).

Transitional Environments and Attachment Theory

Wastell (1999) drew on psychodynamic theory and attachment theory (Peluso et al. 2004; Daniel 2006) to recommend creation of a *transitional space* for addressing the high levels of stress and anxiety produced within information systems (IS) development environments. Transitional space is defined as a safe and supportive psychological climate which can be implemented using transitional objects. *Transitional objects* facilitate affective and cognitive growth by providing temporary support that allows an individual to diminish an existing dependency relationship. The dependency could be on individuals, work practices, a belief system, or other objects. In attachment theory, the main role of an attachment bond (i.e. a dependency) is to provide security, operating as a secure base from which to explore as well as a retreat in times of stress (Browne and Shlosberg 2006). The basis for patterns of attachment throughout life was initially discovered in studies of infant-mother interactions and dependencies. The form of the attachment influenced a child’s exploratory behaviors and often transitional objects were employed to facilitate growth and discovery beyond the direct presence of the parent (Daniel 2006).

Wastell (1999) found that transitional objects can be used to break down dependencies and defenses in IS development environments. Insights for IT change management can be gained by understanding the characteristics of successful transitional spaces utilized in Wastell's case studies. Beneficial transition attributes identified in Wastell's Bellflower case included: the shared production process model, acknowledging member's shared responsibility for production results and creating a work climate that allows role variation and risk-taking. The shared production process served as a transitional object and the support for role variation and risk-taking created a transitional space for more productive IT development. Other key transitional space attributes include creating a) a safe psychological environment conducive to learning, b) experimenting with a streamlined process using vignettes of reduced scope and complexity, c) using empirical measures as a basis to resolve conflict and reduce defective beliefs. In Wastell's (1999) study, individuals stepped out of their normal social roles at work and were able to used objective, measureable results outside of threatening job situations to revise their existing mental models.

Realistic Technology Preview

The construct of realistic technology previews (RTP) is proposed here and is based on the organizational behavior concept of realistic job previews (Popovich and Wanous 1982; Hom et al. 1998). Realistic job previews provide a valuable model to emulate because research evidence predominantly reports that it increases job satisfaction and subsequent job performance. Hom et al. (1998) found that post-entry realistic job previews also increased problem-focused coping and perceived employer altruism. A realistic job preview is described as a type of persuasion process meant to provide realistic information and informed attitudes about the job and organization (Popovich and Wanous 1982). Although some studies indicate that realistic job previews can decrease initial job expectations (Krausz and Fox 1981; Premack and Wanous 1985), consistent findings support increases in job acceptance, job satisfaction, performance and job survival rates (Krausz and Fox 1981; Premack and Wanous 1985; Breaugh and Starke 2000). *Realistic technology previews* (RTP) are defined as the result of an IT transitional environment persuasion process meant to provide a realistic experiential introduction to the IT system in order to inform appraisals and attitudes about IT system use and related practices. Unlike realistic job previews, where information is conveyed through verbal or written communication, realistic technology previews are formed by direct interaction or by demonstration with the IT system. A goal of realistic technology previews to capture an open-minded and well-information assessment about the new technology prior to its actual use on the job. The user is introduced to the IT in a transitional education context outside of work to avoid direct comparison with existing IT skills and practices that may be threatened. The context change is meant to reduce dependency anxiety about the current job role by substituting a separate context which is simplified and internally consistent. By providing a distinct context to shape the RTP, transitional education makes current work roles are less salient thereby reducing their stress producing influence on cognitive appraisals. To form a more objective RTP, roles in the transitional experience can be shaped to effectively use the new IT, to perform the new business processes and be facilitated by guided interactions providing more positive initial experiences with the system. Conceptual overviews of the system, interactive scenarios, instructor assistance and detailed documentation should provide extensive support as the user initially interacts with the new IT. The list below compares and contrasts RTP with the management construct of realistic job previews.

Comparison of Realistic Technology Previews and Realistic Job Previews

<u>Similarities:</u>

1. A priori assessments preceding actual job performance
2. Goal of enabling individual to make an early informed assessment of performing a job function.
3. Meant to inform attitudes about the job to be performed, skills needed and fit in the organization.
4. Proposed as antecedents to job satisfaction

<u>RTP Differences from RJP:</u>

1. Actual performance and/or observed performance of tasks in realistic if limited job context.
2. Experiential direct personal assessment (contrasted to RJP's approach of gaining information from another individual who performs a similar job.
3. Informs attitudes about the technology in addition to learning of the business context in which IT is used.

Constructs

This study investigates the value of a *transitional education environment* which brings the attributes of a transitional space into the IT education and change management. The idea of transitional space was developed for organizational change and management consulting by the Tavistock Institute of Human Relations (Miller 1993) and built on attachment theory's use of transitional objects to reduce existing dependencies (Peluso et al. 2004; Daniel 2006). A transitional IT education environment is intended to ease the adaptation from existing technology to a new ES technology by reducing dependencies on past IT-related behaviors and providing an environment conducive to more objective appraisals of IT. The transitional IT education environment's espoused goal is acquiring IT application knowledge with an underlying goal of facilitating IT adaptation through productive coping strategies. The attributes distinguishing a transitional education environment include being non-threatening, enjoyable, engaging, reflecting authentic work dynamics, stepping outside normal work roles, providing immediate results to use in self-assessed feedback and plentiful learning support.

A transitional IT education environment is shown in the research model (figure 1) and is defined to include the constructs of: a) a positive and engaging psychological climate represented by the flow-related constructs of *attention* (Agarwal and Karahanna 2000; Webster and Ahuja 2006) and *enjoyment* (Hoffman and Novak 1996; Igbaria et al. 1996; Agarwal and Karahanna 2000), b) computer simulation education effectiveness as a measure of the transitional space created during training and c) realistic technology previews as a means to capture initial assessments of the ES technology. Realistic technology previews are based on the organizational behavior concept of realistic job previews (Popovich and Wanous 1982; Breaugh and Starke 2000). A realistic technology preview is an initial assessment of a technology capturing impressions formed during a transitional persuasion process meant to provide an independent, objective and realistic introduction to the IT system. RTP is based on an early interactive exposure to the IT in an authentic and dynamic business situation.

Computer simulation-based education is a type of virtual learning environment where technology emulates a phenomenon so that users can learn its dynamics through direct interaction. Simulations allow learners to interact experimentally with an environment rather than merely observe it (Pufall 1988; Ruben 1999; Anderson and Lawton 2009). *Computer simulation education effectiveness* is based on prior literature on computer-based education (Piccoli et al. 2001; Workman 2004), computer game-based education (Malone 1981; Randel et al. 1992; Venkatesh 1999; Garris et al. 2002; Winn 2002) and microworlds (Papert 1980; Pufall 1988; Senge 1994)**.** Microworlds are defined as conceptual systems that embody rather than explain knowledge and that facilitate construction of knowledge by the learner through interactions with the simulated environment (Pufall 1988). Computer-based microworlds have been used in childhood education (Papert 1980) and for IT user interface theory development and empirical tests (Wastell 1999). *Computer simulation education effectiveness* is defined as the level of satisfaction with the computer-based simulation education experience. Table 2 describes the dimensions of ES computer simulation education environment based on the framework for virtual learning environments (Piccoli et al. 2001).

Computer Self-efficacy: General *self-efficacy* is defined as beliefs about one's own ability to perform a particular behavior. It affects choices about 1) what behaviors to perform, 2) the persistence and effort to exert when faced with barriers to performance, and 3) it predicts eventual development of mastery (Bandura 1977). Computer self-efficacy reflects an individual's confidence in their ability to perform with the IT and varies based on the familiarity and type of IT investigated (Compeau and Higgins 1995b; Marakas et al. 2000).

Cognitive appraisal (primary and secondary): *Cognitive appraisal* is one of two processes which mediate between stressful person-environment relationships and their short-term or long-term outcomes. Two forms of cognitive appraisal are a) *primary appraisal* whereby a person evaluates what they have at stake in the encounter and b) *secondary appraisal* where a person evaluates if anything can be done to prevent harm or overcome barriers or to improve the possibilities for benefits (Folkman et al. 1986a; 1986b). Figure 1 shows the research model.

Hypothesis Development

Flow literature espouses the view that individuals seek different types of challenges as opportunities to learn different aspects of self, as well as to test and further develop one's own abilities. Csiksznetmihayli (1990) describes intrinsically motivated flow activities as having an achievable challenge and clear performance criteria enabling both self-evaluation and activity-provided feedback. The experience of flow represents the extent of pleasure and high involvement in an activity. Attention is closely related to the flow state's attribute of high involvement in an activity (Csikszentmihalyi and LeFevre 1989), the constructs of engagement (Webster and Ahuja 2006), and focused immersion (Agarwal and Karahanna 2000). *Attention* is defined as the experience of complete engagement where other demands on one's attention are basically ignored (Agarwal and Karahanna 2000)**.** Users are engaged in a system when it captures their attention and they seek intrinsic rewards by engaging in system use (Webster and Ahuja 2006). Agarwal and Karahanna's (2000) found that focused immersion (i.e. attention focus) positively influenced perceptions of ease of use, usefulness and the behavioral intention to use IT. Webster & Ahuja (2006) showed that engagement results in higher performance and intentions to use IT. In the transitional education environment, attention should be held by the real-time dynamic business simulation and the focus on measurable outcomes providing performance feedback. When all attention resources are focused on a task, then more cognitive resources are engaged so IT learning and use is perceived as easier. Attention is interrupted when one cannot complete the task and lacks immediate support to overcome obstacles. Frequent or prolonged IT task interruptions cause frustration with the IT and concern over negative impacts of IT. If support and resources are immediately available then interruptions are short-lived and provide a situated learning opportunity. During transitional education, attention is further supported by instructional aides, instructor consultation and other resources. These factors should lead to a cognitive appraisal of IT event as an achievable challenge or opportunity for growth and benefit. In contrast, if attention is frequently interrupted, then motivation decreases and task goals appear less achievable. When this occurs, the individual's abilities and resources are inadequate and overly high challenge is experienced as a threat. Thus, attention will negatively influence appraisal of the IT event as threat.

H1a: Attention during education positively influences primary cognitive appraisal of perceived opportunity.

H1b: Attention during education negatively influences primary cognitive appraisal of perceived threat.

Enjoyment is an intrinsic motivator which is present in the flow experience along with high involvement in an activity (Csikszentmihalyi and LeFevre 1989). Simulation education's game-oriented, exploratory environment positions technology interaction as being an interesting, fun and achievable opportunity for growth. Game-based training (Venkatesh 1999) as well as positive mood before and during training (Venkatesh et al.

2002) leads to greater behavioral intention to use IT. While such effects have been shown to be short-lived, they reveal the presence of intrinsic motivation during IT use. When intrinsically motivated, individual's view change as a challenge to be met rather than as a threat to be avoided. IT research shows that enjoyment with microcomputers increases future computer usage (Igbaria et al. 1996) and enjoyment while web browsing increases perceived ease of use, perceived usefulness and behavior intention to use IT (Hoffman and Novak 1996; Agarwal and Karahanna 2000). In summary, high enjoyment with IT indicates the presence of intrinsic motivation and may signal the experience of flow. In this state, the individual will appraise the introduction of IT as an achievable endeavor offering potential benefits. Thus, the ES appears to provide opportunity for growth and benefit, rather than as a threat to be avoided.

> *H2a: Enjoyment during education positively influences primary cognitive appraisal of perceived opportunity.*

> *H2b: Enjoyment during education negatively influences primary cognitive appraisal of perceived threat.*

Organizational change literature recognizes that change management of complex ES systems requires more than traditional IT planned methods, and should also incorporate new, flexible, improvisational methods (Orlikowski and Hofman 1997) including use of experiential learning and dynamic business simulations (Senge 1994). The concept of realistic technology previews is used to capture the assessment formed during direct exposure to the ES through interaction with the technology outside of the pressured workplace. Realistic technology previews capture initial impressions of ES formed during the productive problem-focused transitional environment education experience. Social cognitive theory states that behavior influences outcome expectancies (Bandura 1977; Compeau and Higgins 1995b; Bandura 2001). Having guided the user in performing productive IT behaviors during transitional education, the realistic technology preview is essentially primed to see the usefulness of the system and highlight its benefits to the individual and the organization. Following a realistic technology preview, the user has a better understanding of the IT’s functionality and the possible benefits to themselves and the company. The tone and content of transitional education should encourage the user to engage in a productive problem-focused adaptation strategies. The coping model of user adaptation (CMUA) (Beaudry and Pinsonneault 2005) model’s feedback loop indicates reappraisals occur as the user adapts. CMUA proposition 5 states “the adaptation efforts outcomes lead to a reappraisal of the IT event, which can trigger a new sequence of adaptation efforts” (Beaudry and Pinsonneault 2005, p. 503). This positions the realistic technology preview as a likely trigger for cognitive reappraisal. The supportive, low risk transitional education environment should establish positive realistic technology preview assessments through reduced user defensiveness and minimize feelings of dependency on current IT and job practices. With a more positive outlook about the system’s potential and a view of the IT skills required to use it, the fear of the unknown IT is reduced. In this frame of mind, the cognitive appraisal of perceived threat should be reduced while perceptions of challenge and opportunity are elevated.

> *H3a: Realistic technology previews positively influence primary cognitive appraisal of opportunity.*

> *H3b: Realistic technology previews negatively influence primary cognitive appraisal of threat.*

At the introduction of a new IT, users form a secondary cognitive appraisal regarding their ability to effectively use the IT or acquire the knowledge and resources necessary to interact with the IT on the job. The realistic technology preview provides users a valuable first-hand experience with the ES supported by training and resources that enable productive problem-focused use. Social cognitive theory states that behavior influences outcome expectancies (Compeau and Higgins 1995b; Bandura 2001). Through behavioral modeling including enacted mastery and observational learning, users increase their declarative knowledge & task performance. In the context of the transitional education which forms the realistic technology preview, behavioral modeling-based learning is supported by the observational learning processes of a) attentional processes (regulation of exploration and perception of modeled activities), b) production processes (organizing sub-skills into new IT practices) and b) retention processes (converting experiences to internal models for later use) (Yi and Davis 2003). These observational learning processes influenced declarative knowledge and post-training software self-efficacy. Ultimately, motivation processes will determine whether new IT knowledge will be put to use in workplace but increased knowledge of the IT provides an increased sense of control over future interactions with the technology.

A realistic technology preview captures an assessment of using the ES in a non-threatening trial run during which the job role is temporarily suspended, absent risks of negative impacts, and during which the system's benefits are highlighted. Having learned some essential skills and methods of ES usage, the user should see further ways to enhance their skills for future productivity. A preview enables the learner to better anticipate the dynamic nature of the ES through implicit learning (Berry and Broadbent 1987). With these experiences, the user will start to understand interdependency of functions across the enterprise and discover ways to be productive using the ES. Cognitive appraisals made in a safe and supportive transitional education setting after learning some ES skills are likely to be better informed, more objective and less constrained by current work practices. The declarative and tacit knowledge affirm the user's ability to further expand their ES knowledge, to have the basic abilities to interact with the system and cope productively through problem-focused coping strategies. Therefore, it is expected that realistic technology previews will have a positive influence on appraisal of perceived control.

H3c: Realistic technology previews positively influence secondary cognitive appraisal of control.

Kegan and Lahey (2001) identify a psychological dynamic known as a competing commitment which interferes with one's ability to handle change. The body of IT habit literature has demonstrated the strong role of prior, routinized behaviors (Limayem et al. 2007; Kim 2009) which provide strong prior IT dependencies which can hamper adaptation and use of new IT. Therefore, change management interventions should aim at reducing dependency on the prior IT habit which serves as a competing commitment. Dependencies, habit or competing commitments may include familiar manual work practices, habitual use of prior IT, existing task interdependencies and current social interactions within a familiar job role. In this study, the intervention utilizes simulation-based education as a transitional object to reduce prior dependency relationships (Wastell

1999; Daniel 2006) including IT habit and business routines. Transitional objects facilitate affective and cognitive growth by providing temporary support that allows and individual to diminish an existing dependency relationship. The construct of *computer simulation education* herein is defined based on the framework of virtual learning environments (Piccoli et al. 2001) and the use of computer simulations in training (Senge 1994; Ruben 1999; Winn 2002). *Computer simulation-based education* is a type of virtual learning environment where technology emulates a phenomenon so that users can learn its dynamics through direct interaction. Simulations allow learners to interact experimentally with an environment rather than merely observe it (Pufall 1988; Ruben 1999; Anderson and Lawton 2009). Simulations go beyond symbolic mental rehearsal types of behavioral modeling (Davis and Yi 2004) to actually performing IT tasks. This provides actual rehearsal of IT functions in a simulated real-world context to approximate future work experiences. Winn (2002) identifies the most important attribute of simulations as the ability for learners to take control of the educational material and learning process. This experiential, constructivist learning orientation is learner-centered and provides opportunities for the learner to construct their own knowledge. The constructivist learning model is effective in facilitating acquisition of tacit knowledge, discovering conceptual relationships and developing critical thinking skills (Leidner and Jarvenpaa 1995). Berry and Broadbent (1987) found that implicit learning of indirect cause-and-effect relationships occurred from using a dynamic business simulation. In their study, learner's subsequent performance confirmed acquisition of tacit knowledge even though learners were not consciously aware it. Through simulation education, users are exposed to some essential elements of ES system dynamics and business processes while they receive feedback, personalized coaching and collaboration. Control over the simulation and the opportunity for self-assessment based on simulation results will promote feelings of control and IT self-efficacy. In the CMUA model's feedback loop of IT adaptation, the user forms a secondary cognitive appraisal of what they can do to prevent harm or to improve the possibilities for benefits based on their current abilities and available resources (Folkman et al. 1986a; Beaudry and Pinsonneault 2005). Having acquired basic system knowledge and exercised user interface skills, the user will reduce prior dependencies on comfortable past routines and increase confidence in continuing to develop the skills to productively cope with the ES. With effective simulation education, the secondary appraisal of perceived control is expected to increase.

In summary, simulation-based education offers a user-directed learning experience whereby knowledge is constructed by the learner (Leidner and Jarvenpaa 1995) through rehearsal, implicit learning (Berry and Broadbent 1987) and behavioral modeling (Bandura 1977; Bandura 2001; Davis and Yi 2004). Computer simulation education increases the user's IT knowledge, their tacit knowledge of the implicit dynamics ES and the ability to anticipate impacts of ES adoption. Early success using the ES during the simulation increases user confidence in achieving future use and obtaining beneficial outcomes from using the ES. For these reasons, it is anticipated that effective simulation-based education will positively influence the secondary cognitive appraisal of perceived control.

H4: Computer simulation education effectiveness positively influences secondary cognitive appraisal of perceived control.

Enterprise systems are unfamiliar to most users of computer desktop applications. Behavioral modeling training has shown to be more effective than other forms of training with unfamiliar IT, resulting in increased self-efficacy and higher performance (Compeau and Higgins 1995b; Compeau and Higgins 1995a). Simulation-based transitional education utilizes behavioral modeling techniques including verbal persuasion through ES demonstrations, guided practice and direct personal experience along with vicarious enactment by observing the instructor and peers. Johnson and Marakas found that behavior modeling thorough vicarious experience and enacted mastery contribute to increases in computer self-efficacy. Computer self-efficacy reflects both one's confidence in their ability to develop needed technical skills and to perform with the new IT (Davis and Yi 2004). Social cognitive theory (SCT) identifies a cyclic reciprocal interaction between the environment and an individual’s perceptions of self-efficacy and behavior (Bandura 1977; Compeau et al. 1999). This means, while IT self-efficacy is an antecedent to technology use, it is also the found that successful interactions with technology positively influence subsequent self-efficacy (Compeau et al. 1999). Therefore, by giving the user positive, successful experiences with the ES in a real-world context, computer simulation education encourages confidence in building new IT skills which should result in increased computer self-efficacy.

H5: Computer simulation education effectiveness positively influences computer self-efficacy.

In addition to reflecting current ability and resources to perform the tasks, computer self-efficacy also reflects an expectancy of future performance ability

(Compeau and Higgins 1995b). Both of these components are considered in a secondary cognitive appraisal of perceived control (Major et al. 1998). In a *secondary cognitive appraisal*, an individual evaluates their possible responses to the positive and negative aspects of their environment (Lazarus 1993). With IT, the individual projects their ability to use the ES based on early experiences with using the system or knowledge about it. Cognitive appraisals are based on the abilities and resources currently available or anticipated. The higher an individual's computer self-efficacy, the more they anticipate having the ability and resources to overcome difficulties (threat) as well as to leverage abilities and resources to increase benefits (opportunity). In summary, computer self-efficacy is a natural consideration in the secondary cognitive appraisal process because it represents the individual's calibration of their IT abilities and resources to draw from in stressful IT events. Because higher IT abilities and resources enable the user to exert more control over the IT, it is expected that advancements in computer self-efficacy will positively influence secondary cognitive appraisal of perceived control.

> *H6: Computer self-efficacy positively influences secondary cognitive appraisal of perceived control.*

Introduction of an ES affects the work environment, triggering stress and coping reactions. Assessing demanding job or life impacts such a being required to use an ES initiates a cognitive appraisal which is a mental projection of the degree of change in job role and the future outcomes from ES use. This cognitive appraisal in turn influences an individual's expected job satisfaction. When an individual foresees benefits from ES use, then primary cognitive appraisal of opportunity is high and the expectation of positive outcomes for job satisfaction should also be high. Stress reactions perceived during primary cognitive appraisals of threat often lead to failure (Tomaka et al. 1997; Drach-Zahavy and Erez 2002). Threat appraisals of IT events lead to non-productive emotion-focused coping strategies such as self-preservation, disturbance-handling or avoidance, rather than the productive problem-oriented coping strategies of benefits-maximizing or exploration-to-innovate or exploitation (Beaudry and Pinsonneault 2005; Bala 2008). Non-productive emotion-focused coping, such as those based on a lack of important ES knowledge, can lead to avoiding use of the ES. Energy is expended addressing emotional responses rather than on learning and using the technology effectively to solve business problems. Therefore, projection of increased threat should have negative impact on job satisfaction. In summary, when an individual anticipates positive benefits are achievable (i.e. new opportunities) and a low degree of negative consequences (i.e. low threat) then the impacts on job satisfaction should be positive.

H7a: Primary cognitive appraisal of opportunity positively influences ES job satisfaction.

H7b. Primary cognitive appraisal of threat negatively influences ES job satisfaction.

Secondary cognitive appraisal is an evaluation of the resources, options or abilities an individual possesses or can obtain to prevent harm, overcome barriers or to improve the possibilities for benefits (Folkman et al. 1986a; Folkman et al. 1986b; Major et al. 1998). Perceptions of control are needed to achieve possible benefits or to overcome barriers presented, so high secondary appraisal of control is a recognition of having the mechanisms and abilities to maximize the potential of a situation. In this way, perceptions of control influence satisfaction and overall well-being by contributing to the feelings of mastery needed to achieve possible benefits (Folkman et al. 1986a). When a individual feels out of control of a situation, this leads to energy spend on emotion-focused coping (Lazarus 1993), greater passivity, helpless and can even lead to depression (Folkman et al. 1986b). So, low perceptions of control over the ES would increase emotion-focused reactions, diminish job-related problem-focused activities, lead to passivity on the job and avoidance of the ES which lowers satisfaction and overall well-being. Secondary cognitive appraisal of perceived controllability is essential to feeling competent to use the ES to complete job tasks and work towards achieving the opportunities presented in a situation, which in turn positively influences ES job satisfaction.

H7c. Secondary cognitive appraisal of perceived control positively influences ES job satisfaction.

When a computer business simulation is utilized as a safe and supportive transitional environment, it provides a dynamic business context in which to learn and realistically assess use of an ES. An effective learning environment allows the user to practice, gain skills and increase confidence in mastery over the system. The dynamic simulation facilitates growth of declarative and tacit knowledge through practice, feedback (Anderson 1982) and implicit learning (Berry and Broadbent 1987). With increased knowledge comes increased mastery and self-efficacy with the ES. Secondary cognitive appraisal has been summed up as an assessment of an individual's perceived control in the situation (Major et al. 1998). Thus, effective simulation education should increase IT self-efficacy leading to increased perceptions of control over the ES.

H8: The influence of simulation education effectiveness on control is mediated by IT self-efficacy.

Methodology

The original goal was to execute a field study with company employees being introduced to an ES with a backup contingency plan of using student participants. Due to the economic downturn of 2008-2010, corporate educational activities were greatly curtailed and field research with corporate employees was not feasible. Therefore, a cross-sectional survey was undertaken targeting graduate and undergraduate students who were educated using HEC Montreal's ERP manufacturing simulation game (Léger 2006) and utilizing the commercial SAP enterprise resource planning system (Corbitt and Mensching 2000). The survey was delivered to students at a single American university that is a member of the SAP University Alliance. One university was selected to establish uniformity in delivery of the ERP simulation and to eliminate unwanted variance in the educational setting due to institutional and pedagogical differences. An initial sample of 156 complete survey responses were gathered from participants in seven ERP classes where students had previously experienced the same ERP manufacturing simulation following the same education protocol. Data collection took place in the summer and fall of 2009 and the spring of 2010. Due to sensitivity to survey length, a minimal length instrument as devised and delivered online using the www.qualtrics.com survey delivery system.

Simulation Educational Intervention

In transitional education, the users are all introduced to the enterprise application in a guided series of incremental stages including exposure to a business process, a few key application commands and transactions followed by participation in a dynamic real-time business simulation. There simulation educational interventions all followed the same general sequence of events. Introduction to the simulation game was done using a standard training video clips and presentation slides provided by HEC Montreal faculty, the developers of the ERPsim manufacturing simulation. All participants were provided with the same HEC Montreal training manual. During this simulation activity, each user is provided with a focused job aid, instructor support and peer consultation. Immediate, self-assessed feedback is provided through simulation financial results which are the direct result of the individual's utilization of ES in the competitive market environment. A majority of educational experience is time spent in running a real-time, business market simulation with teams of individuals operating their own simulated company in a competitive cereal market. A minimum of 3 quarters of the ES simulation were run and the entire simulation game was completed prior to collecting survey data.

Measurement Scales

Survey items were all based on previously published and validated measures which were measured using a 7-point Likert scale from 1='Strongly Disagree' to 7= 'Strongly Agree'. Appendix A contains the measurement items used in the survey. Two binary variables captured the effect of having technology expertise (Tech_expertise) as well as accounting and finance expertise (Acct_Expertise). The independent variables of attention and enjoyment utilized measures for these two facets of cognitive absorption from Agarwal and Karahanna (2000). The construct of realistic technology preview (RTP) was evaluated using the twelve item ERP end user computing satisfaction (EUCS) scale as previously validated for ERP in (Somers et al. 2003) and based on the original EUCS scale (Doll and Torkzadeh 1988). In developing this measure, Doll and Torkzadeh (1988) evaluated several different item loading schemes, based on different eigenvalues and a varying number of factors, until settling on the five identified subscales based on clarity of concept and definition. In EUCS, four scales evaluate product usefulness, and the fifth scale for ease of use evaluates the user friendliness of the application (Somers et al. 2003). In this study, four items were added to the ES EUCS scale (and three retained in analysis) as an exploratory attempt to more broadly capture the business context of ES use. The RTP construct is conceptually distinct from (although related to) the EUCS construct based on both the timing and extent of IT application usage and the context of usage. RTP occurs in a simulated work context prior to actual on the job ES usage. Perceptions of an IT application gathered by the RTP factor represent initial impressions formed in a relatively short time and in a representative but not fully authentic circumstances. Some inauthentic aspects of previewing an IT include the emulation of a simplified business environment, readily available support and consultation, as well as lack of risk and negative career/job consequences. The RTP construct is operationalized using the EUCS scale because RTP is an IT evaluation based on the same attributes of IS success as used in longer term assessments based on the actual job usage.

The construct of *computer simulation education* was defined (table 2) based on the framework of virtual learning environments (Piccoli et al. 2001) and is operationalized based on the construct and measures of computer-based learning effectiveness (Workman 2004). The items from Workman (2004) were previously validated for determining the perceived effectiveness of computer-based and computer-aided forms of education. Computer self-efficacy was evaluated using a well-accepted subset of four items from the larger original scale from Compeau and Higgins (1995b). The three forms of cognitive appraisal (opportunity, appraisal and control) were assessed using measurement scales from Bala (2008) based on Major et al. (1998) with opportunity measures also based on Drach-Zhavy and Erez (2002). ES job satisfaction used accepted scales for job satisfaction about the work itself from Spector (1985) augmented by a items from Tsui et al. (1992).

Results

A sample size of N=142 usable surveys were retained, after eliminating extreme outliers based on SPSS outlier diagnostics and the chi square distribution of the Mahalanobis D-Square metric (Kline 2005). Of the usable responses, the mean participant age was 23.34 years old (standard deviation of 4.348) with ages ranging from 19 to 60 years of age. Participants consisted of 37% female and 63% males (standard deviation of). The sample has a mean reported GPA of 3.2 (standard deviation of 0.447), a mean full time work experience of 1.5 years (standard deviation of 4.223) and mean part time work experience of 3.7 years (standard deviation of 2.408). 16% of participants have accounting or financial expertise and 50% of participants have information systems or engineering technical expertise. Descriptive statistics are presented in table 3. The standard assumptions required for linear regression were checked and the assumptions for linearity, normally distributed error terms and homoscedasticity were verified using data plots and normal distribution graphs. To address the concern that some variables may display multicolinearity, variance inflation factors (VIF) were checked. Typically, VIF's below 10 were considered evidence of acceptable minimal multicolinearity, but Cohen et al. (2003) advises use of stricter criteria. In this study, all VIFs were below 2.5 and are well within acceptable limits.

Construct validity and reliability were assessed using guidelines by Fornell and Larcker (1981) and Nunnally (1978). Factor analysis using principal component analysis (PCA) identified eleven factors by using the Varimax rotation method with Kaiser Normalization using an eigenvalue of 0.80 (table 4). For retained items, the factor loadings were greater than .70 for are preferred and all loadings greater than .60 were retained for this exploratory factor analysis when all cross-loadings are below 0.40. Note that the enjoyment variable was dropped from further analysis due to factor loadings below the 0.60 requirement for exploratory analysis and a resulting unacceptably low AVE, well below the enjoyment variable's correlation with other variables (row 3 in table 5). The simulation effectiveness variable was then retained with an AVE of 0.709 which then exceeded all variables retained for analysis. Based on factor analysis, three of the new ES EUCS items were retained and two items from the original EUCS scale were dropped (table 4). Three of the EUCS product usefulness subscales of information, accuracy and formats loaded together and all were combined into RTP reports. The other two subscales remained separate as RTP: timeliness and RTP: ease of use (EOU). Seven items were retained for simulation education effectiveness, three items were retained for computer self-efficacy and 5 of six items were retained for job satisfaction. All items were retained for each of the other variables, namely attention, CA Opportunity, CA threat and CA control. Almost all summative variables had Cronbach Alpha's above 0.900, except for attention with an alpha of 0.886 and self-efficacy with an alpha of 0.715 (ICR column in correlation matrix, table 5). The self-efficacy factor and scale are very well-established in literature and this parsimonious 3 item measurement was determined acceptable. The variance shared between the constructs and their measures is determined by the square roots of the average variance extracted (AVE) (diagonal elements in table 5). After dropping the enjoyment variable due to low AVE, all other AVE's proved higher than the variable's correlations with other constructs. These findings support convergent and discriminant validity of the measures (Fornell and Larcker 1981).

Linear Regression Results

Linear regression analysis results are presented in tables 6a and 6b. Four antecedent variables of attention, enjoyment, realistic technology previews and simulation education effectiveness were each hypothesized to influence cognitive appraisals. Attention's influence on opportunity was not supported, failing to support H1a, but attention's influence on threat was significant, supporting the negative influence predicted in H1b. This indicates that increased attention results in lower perceptions of threat. The enjoyment variable is excluded from analysis because the measures lacked psychometric validity so H2a and H2b remain untested. H3 predicted that RTP would positively influence opportunity (H3a), would negatively influence threat (H3b) and would positively influence control (H3c). The subscales of RTP were not individually hypothesized, but, following the factors identified in factor analysis, separate regressions were run for the three RTP aspects of reports, EOU and timely. Results showed that the two RTP subscales that captured perceived usefulness (reports and timely) each significantly influenced opportunity, partially supporting H3a. The RTP EOU subscale capturing perceived user-friendliness displays a significant positive influence on threat, indicating that objective usage of system increases perceived threat for its use, partially supporting H3c. However, per post hoc testing H3b', simulation education effectiveness has a larger and negative effect on threat, which may counter the negative RTP EOU influence. Tests for H3c provides full support for all aspects of RTP influencing control, with increasingly significant beta coefficients for reports (0.0224), for EOU (0.230) and timely (0.282), respectively. H4 is supported as simulation effectiveness has a highly significant influence on control with a beta coefficient of 0.495. Simulation effectiveness also has a highly significant influence on self-efficacy (beta coefficient of 0.344) supporting H5. Per testing of H5', this influence occurs both alone and in the presence of other independent variables (attention and RTP). H6 predicts that self-efficacy will have a positive influence on control which is supported given a highly significant beta coefficient of 0.402. Self-efficacy's influence (beta coefficient of 0.249) continues in the presence of other independent variables, even with a highly significant influence of RTP (beta coefficients of 0.213 (reports), 0.267 (EOU) and 0.233 (timely) based on post hoc test H6' (table 6b). The last regression tests assess whether each of the three forms of cognitive appraisal influence ES job satisfaction in hypotheses H7a (opportunity), H7b (threat) and H7c (control). There is strong support for all H7a and H7c hypotheses, finding highly significant beta coefficients of 0.278 for opportunity and 0.482 for control. Threat was non-significant with a beta coefficient of -0.072.

Mediation Analysis Results

H8 hypothesized that the influence of simulation effectiveness on control was mediated by self-efficacy. Results supported partial mediation based on both Baron and Kenny (1986) mediation tests showing that the direct effects of simulation effectiveness on control were diminished from a beta coefficient of 0.495 to one of 0.405 in the presence of self-efficacy as a mediator (table 7a). Sobel tests also support self-efficacy as a mediator with a highly significant indirect effect of 0.131 (table 8). Two post hoc analyses for mediation were carried out to determine whether RTP reports also acted as a mediator between simulation effectiveness and control, and to determine if self-efficacy and RTP reports together provided full mediation. There is support for partial mediation through RTP reports based on both Baron and Kenny tests (table 7b) and Sobel tests which found a highly significant indirect effect of 0.381 (table 8). The second post hoc analysis supports full mediation through RTP reports and self-efficacy based on Baron and Kenny mediation analysis (table 7c) which shows the direct effect of simulation effectiveness on control is rendered non-significant in the joint presence of RTP reports and self-efficacy. The Sobel tests found highly significant indirect effects through RTP reports with an indirect effect size of 0.297and through self-efficacy with an indirect effect size of 0.086 (table 8). All hypotheses and findings are summarized in table 9.

Discussion

In the factor analysis, the primary factor loadings for enjoyment measurement items all fell below 0.600 (from 0.575 to 0.515) and also cross-loaded on several other factors including simulation effectiveness (highest item cross-loading of 0.399), attention (highest item cross-loading of 0.429) and job satisfaction (highest cross-loading of 0.427). The enjoyment variable appears to be too closely correlated with (and possibly confounded by) the simulation effectiveness construct based on high correlation of 0.709. This correlation was equal to the AVE of simulation effectiveness, highlighting the conflict between these two factors in the model. For these reasons, enjoyment was dropped from analysis due to these unacceptable psychometric qualities. Conceptually, the two personality state variables from cognitive absorption, enjoyment and attention, were possibly extraneous in this model which focuses on evaluative measures of education effectiveness, initial experiential technology assessment (RTP), and cognitive appraisal in predicting satisfaction. Enjoyment and attention are personality state constructs (Bandura 1977; Agarwal and Karahanna 2000), and, therefore the research model mixes personality state variables with a individual’s evaluations of the intervention and the ES itself.

Overall, findings strongly support the value of simulation education to inform cognitive appraisals of control and that these effects operate primarily through RTP reports along with self-efficacy. While support for H5 and H6 reveal that self-efficacy partially mediates between simulation education and control (table 7a), the indirect effect on control is only 0.131 (Sobel test, table 8). Post hoc analysis reveals that RTP report is a more effective mediator between simulation education and control, having a larger indirect effect on control of 0.381 (Sobel test, table 8). Performing the Baron and Kenny (1986) mediation tests shows mediation by RTP report alone renders the direct effect of simulation education to become marginally significant, demonstrating that RTP reports nearly accomplishes full mediation (table 7b). Therefore, RTP reports provides an important mechanism by which the simulation experience influences cognitive appraisals of ES use on the job. Additional post hoc testing for mediation jointly through RTP reports and self-efficacy supports full mediation (Baron and Kenny tests in Table 7c) with significant indirect effects on control of 0.297 via RTP reports and of 0.086 via self-efficacy (Sobel tests, table 8). This lends support to the theory that ES simulation-based education provides a safe and supportive transitional environment, apparently reducing dependency needs, evoking less emotional response and maintaining open-mindedness to more objectively consider using the new ES. RTP captures the ES evaluation based on brief immersive early experience with the ES. Thus, RTP evaluations may well serve as useful predictors of ES cognitive appraisals and ES job satisfaction. Emotions experienced early in IT use are found to have important long term effects on IT adoption (Beaudry and Pinsonneault 2005; Beaudry and Pinsonneault 2010), so it is vital that early exposures to ES create positive experiences and promote feelings of efficacy in ES use. Bandura espoused that efficacy expectations have stronger predictive power then past performance (Bandura 1977). Simulation education appears to promote both positive experiences and increase efficacy with ES, with RTP reports acting as a mechanism conveying those effects to subsequent CA and job satisfaction. In sum, the RTP construct provides a mechanism to capture early experiences with IT that inform user stress-related coping and satisfaction evaluations. The effects captured by RTP carry through to influence perceptions of ES control leading to greater ES job satisfaction.

Supporting the general RTP hypotheses (3a, 3b and 3c), RTP of the ES is found to directly and significantly affect all three forms of CA, but in finer granularity of investigation, different aspects of RTP reveal differential effects on cognitive appraisals. Breaking down the aspects of RTP shows that RTP usefulness assessments (reflected through the report and the timeliness variables) influence opportunity but not threat; while RTP user friendliness assessments (as reflected in the RTP EOU variable) negatively influence threat but not opportunity. It is very interesting to note that all aspects of RTP influence control. Control reflects the user's fundamental beliefs about acquiring the abilities and resources need to operate the ES application, the type of knowledge that forms the foundational level of the ES knowledge hierarchy (Sein et al. 1999; Kang and Santhanam 2003). This suggests a potentially powerful role for RTP in influencing base level beliefs in a user's ability to handle the ES and in predicting broader appraisals of future benefits and obstacles as represented by opportunity and threat. RTP reports and timeliness both capture the perceived usefulness of an IT which has a direct bearing on what future opportunities are made available through use of the ES. EOU captures the user-friendliness of the system and the comfort level of the user in being able to operate the system to achieve goals. This reflects the degree of control anticipated in future use of the system. Future tests should delve into how the various aspects of RTP operate differentially on forms of CA.

There will be cases where realistic technology previews confirm a user's fear of being overly challenged by the ES. In realistic job preview literature, some studies indicate that realistic job previews can decrease initial job expectations (Krausz and Fox 1981; Premack and Wanous 1985). With IT, individuals reacting with strong threat perceptions or exhibiting the inability to adapt can be identified early, providing pre-emptive opportunities to provide early intervention and additional support. Such RTP findings can also be an early warning of a significant job mismatch when the ES is introduced. In these cases, the benefit of a realistic technology previews is early diagnosis of user adjustment problems, allowing for targeted interventions or job changes to prevent maladaptive coping strategies from undermining productive IT use.

As in the prior two essays, primary and secondary cognitive appraisals are found to strongly influence enterprise system job satisfaction, with the strong effects of opportunity appearing to attenuate the negative effects of threat. Note that the inter-variable correlations of CA with job satisfaction were all significant and higher than the beta coefficients in the regression, with correlations of 0.551 (opportunity), -0.232 (threat) and 0.621 (control) respectively. As in the prior two essays, this again demonstrates that larger positive effects of opportunity and control on job satisfaction attenuate the lesser influence of threat, rendering threat insignificant as an influence on job satisfaction outcomes. The CMUA model found that forms of cognitive appraisal are influence IT adaptive use (Beaudry and Pinsonneault 2005). The CMUA model's feedback loop indicates that adaptation behaviors and subsequent outcomes can lead to reappraisal of the IT event which in turn influences new adaptation efforts. Therefore, interventions that improve cognitive appraisals can initiate a re-assessment of IT and renew efforts toward increased IT use and adaptation.

The temporal nature of the constructs suggests what post hoc mediation testing supports, that the simulation education effectiveness provides a safe and supportive transitional environment wherein the individual forms an well-informed, experiential initial assessment (RTP) of the ES. This RTP assessment then informs the individual's cognitive appraisal of their ability and resources that can be brought to bear on controlling the ES in future job situations. Similarly, an effective simulation education provides experience which increases computer self-efficacy which then serves to increase confidence in one's ability to operate and control the ES to accomplish future job tasks. In specific, there is strong support for the effects of a simulation education intervention on cognitive appraisal of control to be fully mediated through computer self-efficacy and the RTP assessment of ES's ability to provide reports that have useful information that is well–formatted and accurate. Based on these findings, a revised model (figure 6) is proposed for future study wherein all aspects of RTP are positioned as mediators between simulation education effectiveness and the three forms of cognitive appraisal. This revision proposes including the direct influence of attention on simulation education effectiveness as well as including the influence of the simulation on the two forms of primary cognitive appraisal, namely opportunity and threat. Attention is proposed to be an antecedent to simulation education effectiveness which may mediate attention's affects on CA variables. IT self-efficacy retains its position mediating effects on control but is joint by joint mediator RTP. Additionally, possible direct effects of simulation education effectiveness on CA opportunity and CA threat are added.

In conclusion, analysis provides support for simulation education effectiveness positively influencing cognitive appraisal of control and this relationship is fully mediated by realistic technology preview of ES reports and IT self-efficacy. A realistic technology preview contains assessments of the systems usefulness and user-friendliness. The usefulness aspects of reports and timeliness directly influenced appraisals of opportunity, while the ease of use aspect, along with attention, influenced appraisal of threat. All three aspects of RTP influence control. In conjunction with IT self-efficacy, the RTP report factor fully mediated the influence of simulation education effectiveness on cognitive appraisal of control. Only opportunity and control are found to influence job satisfaction as the effects of threat on the job satisfaction outcome are fully attenuated fully by the stronger positive cognitive appraisals of opportunity and control.

Limitations and Future Research

As performing this study with industry professionals was not feasible during the economic downturn, the sample of college graduate and undergraduate students somewhat limits the generalizability of this study. However, these student participants do have prior work experience with a mean of 1.52 years of fulltime work experience and a mean of 3.727 years of part time work experience. These participants are reasonably representative of industry new hires facing use of an ES for the first time, although the study will not generalize to experienced industry professionals or veteran ES users. A future study could investigate the revised model in an experiment using the ES simulation intervention with industry professionals undergoing an imminent change-over to a new ES system. Particularly beneficial would be doing a longitudinal study with pre, post and lagging measurement related to the simulation intervention. Such a study would be great opportunity to expand the nomological network of the study to incorporate other factors such as depth and extent of IT use (Burton-Jones and D. W. Straub 2006), job embeddedness (Mitchell et al. 2001), or IT habit (Limayem et al. 2007; Kim 2009).

A refined model and longitudinal study could better differentiate short term from longer term impacts resulting from simulation-based education experience whose evaluation is captured by RTP. In other words, a longitudinal study could separate immediate impacts on the user's state during the intervention from the longer term impacts to CA and ES job satisfaction. In a revised field experiment, more variables should be used to capture characteristics of the simulation education intervention and aspects of the RTP. Some study design characteristics to consider are to vary the extent of ES simulation education intervention, particularly attributes likely to provide the safety and supportiveness of the transitional environment (types and extent of support and assistance, lack of negative consequences, reward structures, simulation length, extent and depth of ES use, i.e. which and how many different types of ES transactions).

Contributions

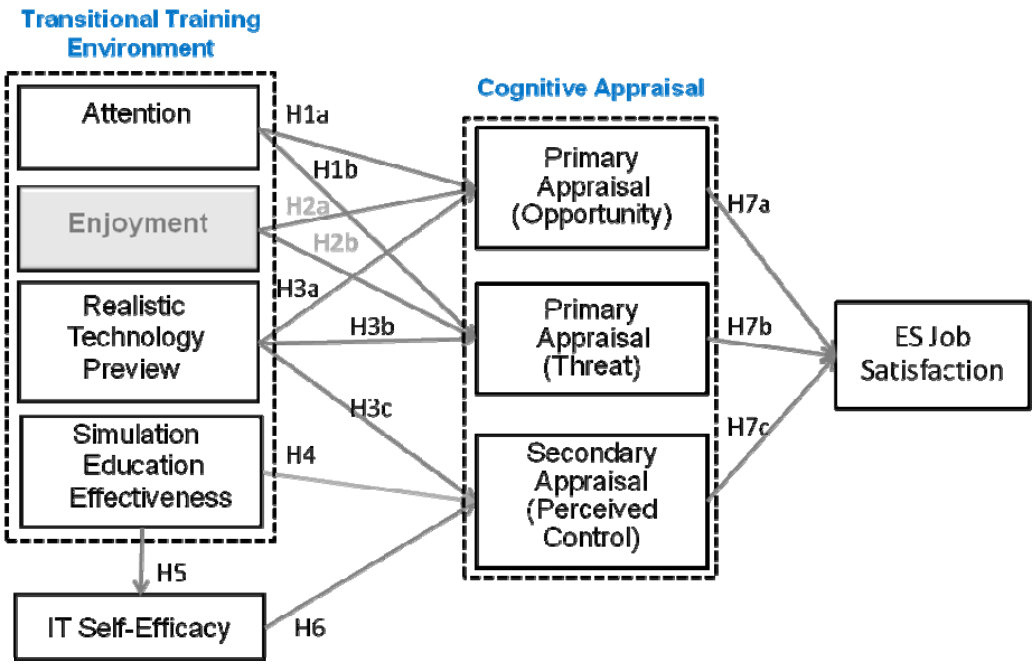
This essay extends application of the theory of safe and supportive transitional space in IT beyond Wastell's (1999) use in software development environments**,** applying it more broadly to IT users. Wastell argued that "many IS projects miscarry due to the inherently high levels of stress and anxiety that imbue information systems development and that elicit defense-avoidance behavior patterns in project teams.“ (Wastell 1999, p. 586). Similar issues exist on a wide scale with new ES users due to their negative stress reactions at being required to use an unfamiliar and complex ES. Findings here demonstrate that ES simulation education effectively serves as a safe and supportive transitional space that eases adoption of an ES, by reducing the negative stress reactions and thereby improving cognitive appraisals that increase ES job satisfaction. Such interventions promoting ES adaptation and acceptance are greatly needed, as evidenced by the large body of literature on ERP failures e.g. (Scott 1999; Liang et al. 2007) and the well documented reports of rejection and resistance to IT (Beaudry and Pinsonneault 2005; Kim and Kankanhalli 2009; Beaudry and Pinsonneault 2010). Wastell (1999) found that stress reactions trigger defense mechanisms that paralyze learning processes critical to effective IS development. In this essay, findings support the value of a simulation-based educational intervention which creates a safe and supportive learning environment that overcomes dependency needs and avoids defensive reactions to ES change. Creating a supportive ES transitional environment allows formation of a less emotionally biased initial technology assessment that is based on a reduced-scope, facilitated, and non-confrontive experience of the ES. The resulting cognitive appraisals and job satisfaction outcomes are improved by the user’s transitional experience which informed the realistic technology preview.

The construct of realistic technology previews is introduced into the IT change management nomological network, offering particular value in the complex environment of enterprise systems adaptation studied here. Transitional environments offer IT adaptation theory a new mechanism for introducing users to ES based on use of authentic and dynamic business simulations in a non-threatening context for initial use and assessment of the ES. Strong evidence herein supports use of realistic technology preview as means to improve primary and secondary cognitive appraisals that inform user's job satisfaction using the ES. These findings answer the need for improved ES educational interventions and improvements in ES change management. For researchers, this research expands the typical goal of IT education beyond knowledge acquisition to more broadly address the emotional dependency needs and stress-induced coping reactions that face individuals during adaptation to a complex enterprise system. This work contributes to a growing recent stream of IT research focusing on emotional responses to IT (Beaudry and Pinsonneault 2005; Kim and Kankanhalli 2009; Beaudry and Pinsonneault 2010). Two theoretical concepts are introduced to IS usage, namely that of a transitional educational environment and of realistic technology previews. These conceptualizations contribute to IT adaptation theory and to change management literature, especially as they pertain to the demanding nature of enterprise systems adaptation. Transitional education expands the use of 'transitional space' in IT research beyond Wastell's focus on IT development environments and broadly addresses the user adaptation to new IT. As such, it investigates ES simulation-based education as an important antecedent to the coping model of user adaptation (Beaudry and Pinsonneault 2005) and lends further empirical support to the findings of Bala (2008) . To date, virtual learning environments (Piccoli et al. 2001) and other computer-based education environments (Winn 2002; Workman 2004) have mainly addressed alternate computer-based delivery methods for traditional learning models. This study expands the scope of virtual learning environment research to include delivery of more realistic, constructivist learning models as embodied in the ES computer-based simulation education studied.

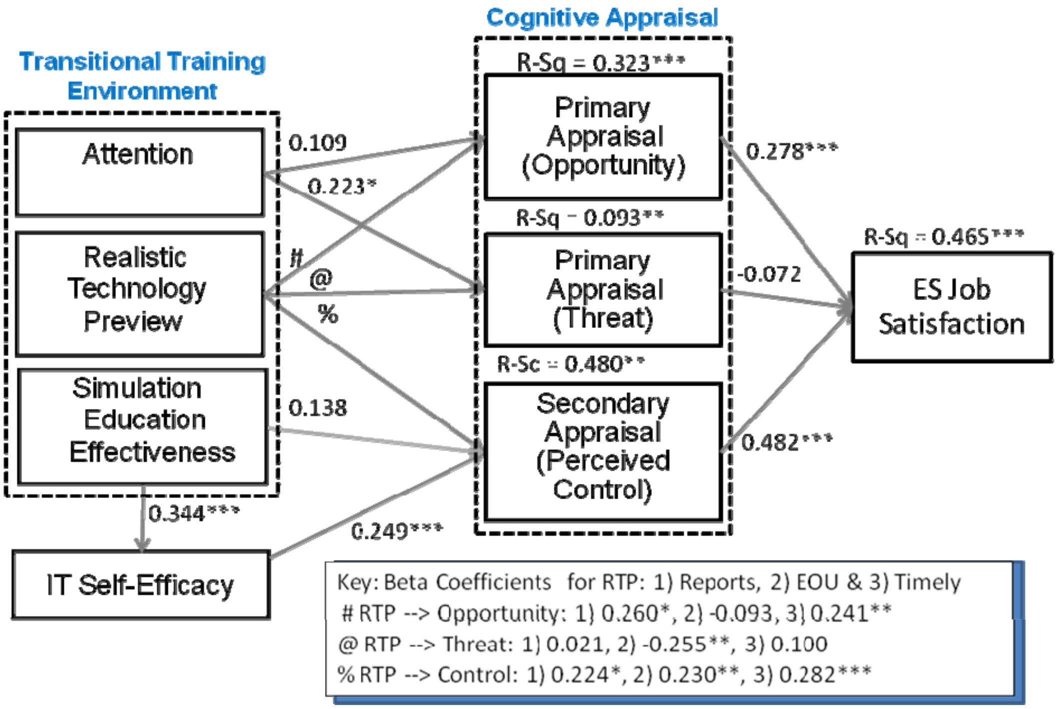
For practitioners, the value of simulation-based education and of capturing ES assessments using the new RTP construct has been demonstrated in this preliminary empirical study. It is recommended that practitioners provide similar transitional opportunities to new ES users for initially assessing a technology based on short term, realistic simulations in a controlled and constructed environment. Effective transitional environments should provide immediate and supportive assistance along with the psychological safety by being free of negative consequences and stress-inducing factors. As shown here, the improvement in assessment of RTP reports and of computer self-efficacy act as valuable mediators in explaining how simulation education effectiveness operates on the individual's cognitive appraisal of control. Perceptions of control are a critical and fundamental skill on which other parts of the ES knowledge hierarchy rely. Consistent with the prior two essays in this dissertation, both primary cognitive appraisal (opportunity) and secondary appraisal of control are positively influence ES job satisfaction. Cognitive appraisal of threat is effectively mitigated by stronger perceptions of opportunity and control resulting from the supportive transitional environment provided by simulation education.

Research Model, Figures and Tables

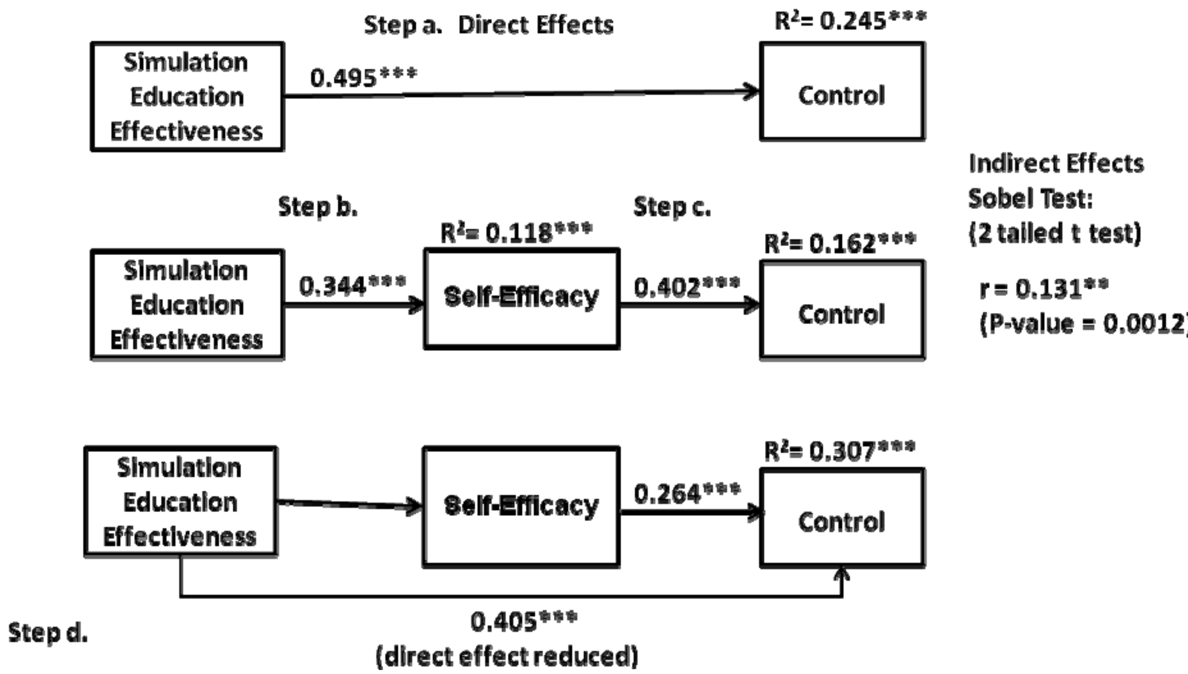
Essay 3 - Figure 1. Research Model (Enjoyment not testable)



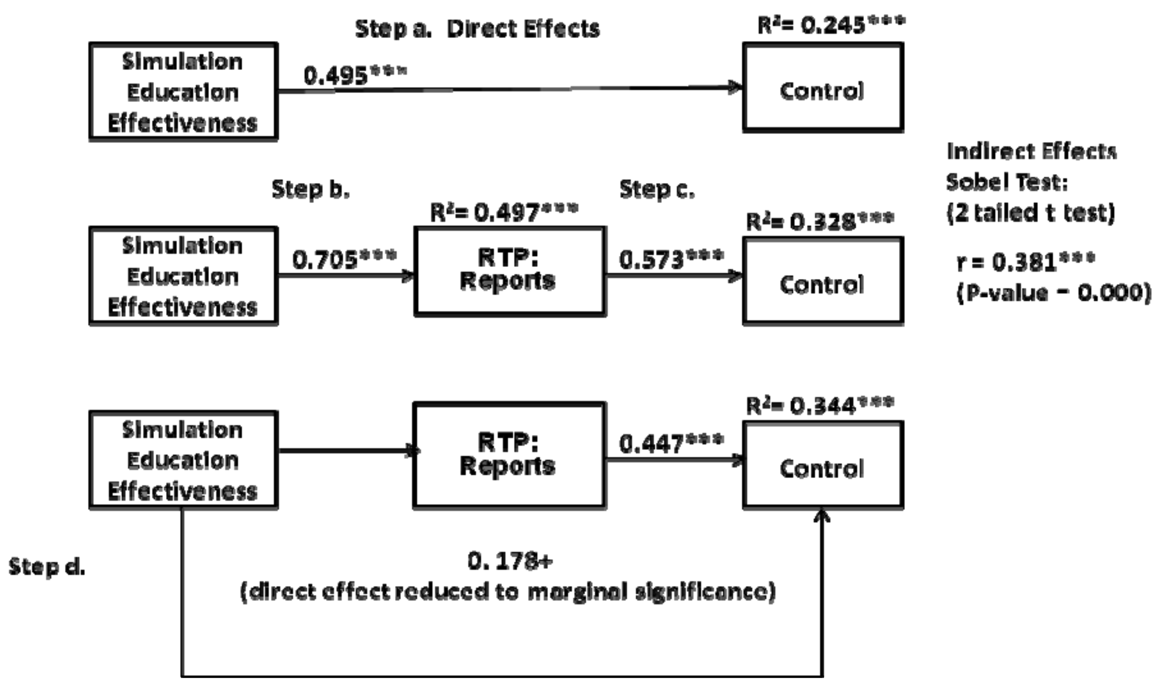
Essay 3 - Figure 2. Model Regression Results



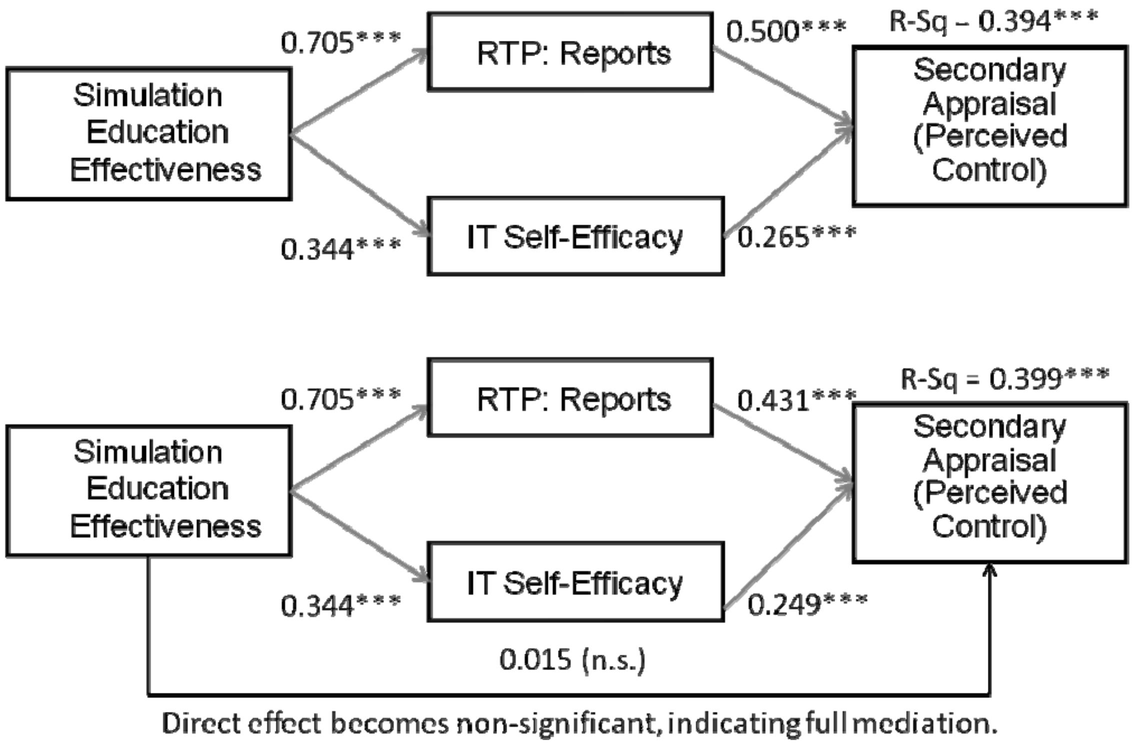
Essay 3 - Figure 3. Mediation by Self-Efficacy



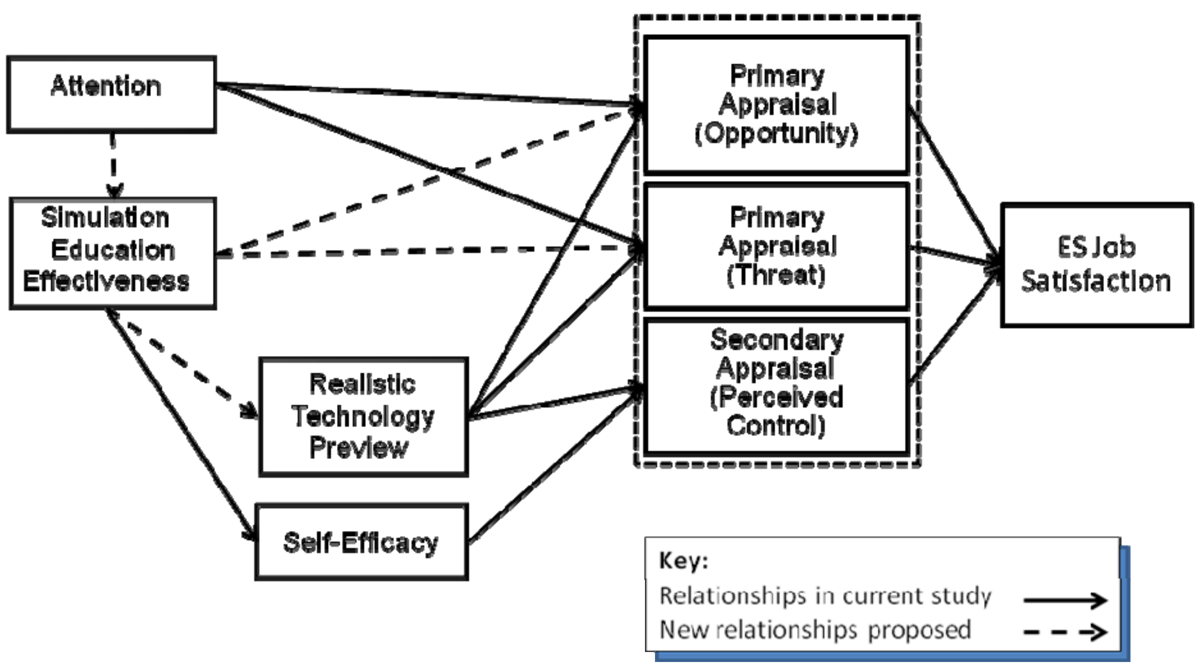
Essay 3 - Figure 4. Results for Mediation by Self-Efficacy



Essay 3 - Figure 5. Combined Mediation by RTP and Self-Efficacy



Essay 3 - Figure 6: Revised Research Model Proposed



Essay 3 - Table 1. Pilot Study: Simulation Attributes with Greatest Learning Value (N=38)

% of Responses	Simulation Attributes with Greatest Learning Value
73%	Use of an actual live SAP R/3 system.
36%	The experience of running a real business
36%	Knowledgeable SAP facilitator.
30%	Quick reference sheet (learning aid)
30%	Opportunity to experiment and make mistakes
18%	Teamwork
18%	Time compression.
12%	Competition
12%	Enjoyment
9%	Non-real-time business quarters.
9%	Clear business goal (revenue, ROI).
6%	Challenge of the "museli game"

Essay 3 - Table 2. Classification of Dimensions of ES Simulation Education

Based on dimensions of Virtual Learning Environments (Piccoli et al. 2001)

Dimension	Definition (Piccoli, et al. 2001)	Attributes of ES Simulation Education Environment
Time	Time of instruction	Training is held at a scheduled time, allowing breaks for consultation between real-time runs of the dynamic simulation. Time compression occurs in simulation where the cause-effect cycle of the simulated phenomena is accelerated (an example is completing a 3 month business cycle in 1 hour of simulation time.)
Place	Physical location of instruction	Typically learners are co-located during training, but the simulation technology supports separate locations and can support virtual teams.
Space	Collection of materials and resources available to the learner.	The learner has access to a fully functional enterprise system, a simulation training manual and introductory videos. The focus is on experiential and collaborative learning, so minimal external materials are typically used, but resources could be made available online.
Technology	The collection of tools used to deliver learning material and to facilitate communication	Learners directly utilize the target system during training, i.e. learning-in-use occurs as the users apply new system interface skills immediately under dynamic conditions. The simulation 'engine' is hidden in the background to drive transactions to the ES.
Interaction	Degree of contact and educational exchange among learners; between learners and instructors.	Simulation-based learning is a non-traditional, constructivist, learner-driven process that encourages learner interaction. The instructor serves as guide, coach and technical consultant and peer interaction is an important part of the learning experience.
Control	The extent to which the learner can control the instructional presentation.	The simulation provides a temporal flow that is automated and instructor managed, as it is a shared environment with many learners interacting simultaneously with the simulation learning environment. The learner has control over their strategies and system interactions in response to the simulated environment. The learner impacts simulation events by their business decisions and how they enact those decisions via the ES. Future actions are based on measurable results & on results monitored via the ES.

Table 3. Descriptives						
N=142	**Min.**	**Max.**	**Mean**	**SE**	**Std.Dev.**	**Variance**
Demographics						
Age	19	60	23.340	0.365	4.348	18.906
Gender	0	1	1.371	0.038	0.486	0.236
GPA	2	4	3.201	0.038	0.447	0.200
Full Time	0	38	1.520	0.354	4.223	17.833
Part Time	0	10	3.727	0.203	2.408	5.798
Accounting Expertise	0	1	0.160	0.031	0.364	0.133
Technical Expertise	0	1	0.500	0.042	0.502	0.252
Latent Variables						
Attention	1.5	7	5.141	0.090	1.070	1.146
Enjoyment	1	7	4.937	0.113	1.352	1.828
Simulation Effectiveness	1	7	5.318	0.095	1.136	1.290
RTP: Reports	2	7	5.080	0.083	0.983	0.967
RTP: EOU	1	7	4.387	0.126	1.499	2.246
RTP: Timeliness	2.5	7	5.528	0.078	0.932	0.868
IT Self-Efficacy	3	7	5.336	0.081	0.966	0.934
CA: Opportunity	2.5	7	5.762	0.074	0.878	0.771
CA: Threat	1	7	2.923	0.134	1.584	2.509
CA: Control	1.25	7	5.070	0.091	1.078	1.162
ES Job Satisfaction	2	7	5.210	0.087	1.037	1.076

Key to Demographics Measures
GPA (4.0=A scale)
Full Time: Years of full time work experience
Part Time: Years of part-time work experience
RTP: Realistic Technology Preview
CA: Cognitive Appraisal

Table 4. Factor Analysis: Factor Loadings and Cross-Loadings

	1	2	3	4	5	6	7	8	9	10	11	12
Workman-sm_1	0.284	**0.698**	0.231	0.123	0.311	-0.162	0.053	0.092	-0.012	0.069	0.152	-0.156
Workman-sm_2	0.288	**0.705**	0.277	0.189	0.286	-0.063	0.113	0.098	-0.025	0.03	0.248	-0.114
Workman-sm_3	0.366	**0.722**	0.128	0.295	0.249	-0.115	0.085	0.164	0.043	0.059	0.094	0.011
Workman-sm_4	0.504	0.592	0.178	0.126	0.068	-0.038	0.116	0.041	0.053	0.061	0.321	0.107
Workman-sm_5	0.370	**0.612**	0.157	0.127	0.119	-0.056	-0.012	0.066	0.080	0.103	0.380	0.058
Workman-sm_6	0.163	**0.786**	0.121	-0.085	0.074	-0.043	0.125	0.073	0.071	0.142	-0.092	-0.012
Workman-sm_7	0.389	**0.598**	0.121	0.262	0.227	-0.093	0.027	0.136	0.193	0.029	0.034	0.096
Workman-sm_8	0.202	**0.788**	0.088	0.134	0.172	-0.179	0.155	0.156	0.121	0.087	0.076	0.000
Workman-sm_9	0.42	**0.635**	0.120	0.213	0.294	-0.104	0.078	-0.08	0.154	0.086	-0.072	0.134
Attention_1	0.358	0.245	0.135	0.093	**0.728**	-0.034	0.134	0.013	0.011	-0.012	-0.043	0.070
Attention _2	0.182	0.199	0.109	0.059	**0.768**	-0.037	0.144	0.086	0.150	0.176	0.197	-0.058
Attention _3	0.204	0.340	0.22	0.097	**0.701**	-0.105	0.096	0.050	0.115	0.223	0.098	0.015
Attention _4	0.286	0.207	0.159	0.053	**0.732**	-0.096	0.095	0.052	-0.007	0.023	0.07	0.003
Enjoy_5	0.271	0.399	0.36	0.104	0.407	-0.077	0.154	0.012	0.179	0.029	**0.515**	-0.011
Enjoy_6	0.230	0.365	0.391	0.094	0.429	-0.06	0.097	0.031	0.161	0.024	**0.575**	0.033
Enjoy_7	0.225	0.376	0.427	0.129	0.362	-0.078	0.064	0.060	0.123	0.050	**0.570**	0.055
RTP-1_1	**0.773**	0.252	0.008	0.223	0.188	0.000	0.276	-0.098	-0.004	0.040	0.123	0.053
RTP-1_2	**0.809**	0.257	0.037	0.203	0.163	-0.027	0.196	-0.057	0.029	0.046	0.125	0.026
RTP-1_3	**0.798**	0.194	0.177	0.091	0.266	0.039	0.118	0.102	0.073	0.127	0.038	0.033
RTP-1_4	**0.775**	0.274	0.087	0.198	0.123	-0.075	0.213	0.042	0.03	0.044	0.053	0.016
RTP-1_6	0.533	0.203	0.069	0.127	0.325	-0.008	0.281	0.189	0.038	0.256	-0.057	-0.394
RTP-1_7	**0.614**	0.249	0.076	0.149	0.243	-0.060	0.306	0.105	-0.017	0.167	-0.045	-0.467
RTP-1_8	**0.636**	0.258	0.128	0.069	0.230	-0.025	0.144	0.136	0.163	0.179	0.096	-0.09
RTP-1_9	**0.694**	0.186	0.348	0.153	0.141	0.000	-0.024	0.121	0.259	0.168	0.198	0.055
RTP-1_10	**0.743**	0.263	0.288	0.182	0.149	0.031	0.037	0.121	0.227	0.064	0.035	0.094

RTP-1_11	**0.651**	0.300	0.322	0.167	0.088	0.113	0.035	0.030	0.225	0.141	-0.025	0.177
RTP-1_12	0.326	0.134	0.314	0.191	0.097	0.198	0.012	-0.11	**0.733**	0.067	0.096	0.079
RTP-1_13	0.241	0.216	0.305	0.212	0.134	0.149	0.060	-0.071	**0.760**	0.001	0.110	-0.015
RTP-1_14	0.518	0.193	0.300	0.039	0.178	-0.025	0.218	0.057	0.374	0.410	0.005	-0.201
RTP-1_15	0.293	0.179	0.091	0.283	0.151	-0.078	0.196	0.142	0.052	**0.737**	0.056	-0.008
RTP-1_16	0.342	0.222	0.063	0.232	0.207	-0.021	0.173	0.060	0.016	**0.742**	0.033	0.083
S-Efficacy_1	0.174	0.12	0.185	0.492	0.226	0.067	-0.023	0.387	0.258	-0.310	0.047	0.094
S-Efficacy_2	0.031	0.18	0.048	0.13	0.133	-0.027	0.237	**0.774**	-0.084	0.077	-0.106	0.075
S-Efficacy_3	0.075	0.102	0.106	0.379	0.057	-0.044	0.126	**0.709**	-0.183	-0.002	-0.121	-0.011
S-Efficacy_4	0.079	0.089	0.054	−0.01	-0.048	0.008	0.107	**0.724**	0.116	0.116	0.362	-0.065
Appraisal1_1	0.224	0.185	0.154	0.251	0.094	-0.276	**0.741**	0.097	-0.013	0.205	0.019	-0.023
Appraisal1_2	0.206	0.172	0.116	0.187	0.138	-0.283	**0.767**	0.125	-0.025	0.219	-0.019	0.039
Appraisal1_3	0.22	0.091	0.167	0.147	0.178	-0.256	**0.795**	0.152	0.019	0.067	0.035	-0.049
Appraisal1_4	0.203	0.028	0.255	0.056	0.075	-0.073	**0.806**	0.177	0.105	-0.024	0.111	0.059
Appraisal1_5	0.000	-0.099	-0.043	0.001	-0.073	**0.917**	-0.152	0.011	0.088	0.021	0.056	-0.019
Appraisal1_6	-0.021	-0.085	-0.045	0.029	-0.054	**0.938**	-0.164	0.003	0.131	0.005	-0.008	0.021
Appraisal1_7	0.027	-0.11	-0.011	0.102	-0.015	**0.914**	-0.181	-0.075	0.107	-0.042	0.051	0.013
Appraisal1_8	-0.001	-0.098	-0.143	-0.16	-0.065	**0.814**	-0.053	0.019	-0.148	-0.075	-0.210	-0.066
Appraisal1_9	0.220	0.097	0.230	**0.728**	0.077	0.076	0.089	0.176	-0.080	0.175	-0.049	-0.007
Appraisal1_10	0.251	0.210	0.20	**0.763**	0.039	-0.046	0.249	0.127	0.064	0.126	-0.005	0.043
Appraisal1_11	0.222	0.153	0.236	**0.788**	0.008	-0.028	0.194	0.036	0.180	0.212	0.154	-0.015
Appraisal1_12	0.207	0.150	0.210	**0.737**	0.140	-0.031	0.113	0.101	0.307	0.064	0.151	0.032
JobS4_13	0.332	0.077	**0.623**	0.363	0.137	-0.174	0.206	0.033	-0.006	0.099	-0.158	0.168
JobS4_14	0.181	0.227	**0.775**	0.218	0.142	-0.137	0.080	0.140	0.175	0.105	0.178	-0.015
JobS4_15	0.112	0.158	**0.767**	0.192	0.173	-0.015	0.334	0.021	0.136	0.093	-0.006	-0.033
JobS4_16	0.193	0.286	**0.710**	0.234	0.129	-0.028	0.067	0.115	0.245	-0.024	0.288	0.038
JobS4_17	0.215	0.202	**0.728**	0.223	0.204	-0.118	0.259	0.050	0.138	-0.032	0.154	0.074
JobS4_18	0.361	0.143	0.288	0.220	0.154	-0.123	0.198	0.125	0.072	0.157	0.030	0.604

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Table 5. Correlation Matrix with ICR and AVE

	# Items	ICR	1	2	3	4	5	6	7	8	9	10	11
1. Simulation Effective.	7	0.938	0.709										
2. Attention	4	0.886	.651**	0.733									
3. Enjoyment (note 3)	*3*	*0.960*	*.709***	*.682***	*0.554*								
4. RTP: Reports	9	0.949	.705**	.621**	.598**	0.725							
5. RTP: EOU	2	0.931	.421**	.359**	.524**	.535**	0.747						
6. RTP: Timely	2	0.909	.501**	.470**	.400**	.585**	.289**	0.860					
7. IT Self Efficacy	3	0.715	.344**	.244**	.238**	.274**	0.05	.314**	0.735				
8. CA: Opportunity	4	0.931	.450**	.425**	.402**	.499**	.203*	.474**	.408**	0.778			
9. CA: Threat	4	0.937	-.254**	-.187*	-.196*	-0.079	0.14	-0.141	-0.105	-.409**	0.897		
10. CA: Control	4	0.915	.495**	.385**	.444**	.573**	.467**	.522**	.402**	.478**	-0.081	0.754	
11. ES Job Satisf.	5	0.926	.583**	.513**	.692**	.581**	.571**	.414**	.317**	.551**	-.232**	.621**	0.723
Demographic Correlations													
12. Accounting Expert	1	NA	-0.126	-0.045	-0.098	-0.045	-0.089	0.041	0.042	0.101	-0.034	0.041	-0.066
13. Technical Expert	1	NA	0.08	0.046	0.061	0.073	0.061	0.099	0.119	0.022	0.058	.268**	.225**
14. Age	1	NA	.168*	.181*	0.111	0.15	-0.04	.186*	0.101	0.015	-0.078	0.149	0.11
15. GPA	1	NA	0.033	0.124	0.077	-0.02	0.029	0.123	-0.031	0.151	-.207*	0.072	0.15
16. FT	1	NA	0.133	0.13	0.103	0.079	-0.063	0.121	0.121	-0.067	-0.112	0.13	0.069
17. PT	1	NA	-0.025	-0.02	-0.05	-0.103	-0.155	-0.099	0.143	-0.111	-0.082	-.224**	-.192*

Notes:

1. ICR: Internal consistency reliability (Cronbach's Alpha)
2. Diagonal elements are the square root of the shared variance (AVE: Average Variance Extracted) between the constructs and their measures.
3. The enjoyment variable was dropped from further analysis as the measures did not display adequate psychometric qualities.
4. Off-diagonal elements are correlations between constructs.
5. Definitions of abbreviations used in table: RTP = Realistic Technology Preview; CA = Cognitive Appraisal which has three factors of opportunity, threat and perceived control; GPA=Grade point average; FT=Full time work experience; PT=Part time work experience.
6. +p<0.10, *p < 0.05, **p < 0.01, ***p < 0.001.

Table 6a. Linear Regression Results

Hypotheses	H1a, H3a	H1b, H3b	H1b’ H3b’	H3c	H4	H5	H5’
Dep. Variable	Opportunity	Threat	Threat	Control	Control	Self-Efficacy	Self-Efficacy
Simulation	0.115 (0.291)		-0.369**	0.138 (0.174)	0.495***	0.344***	0.281*
Attention	0.109 (0.270)	-0.219*(0.041)	-0.099 (0.372)	-0.061 (0.506)			-0.005
RTP: Reports	0.260*(0.030	-0.025(0.843)	0.132 (0.325)	0.224* (0.043)			0.045
RTP: EOU	-0.093	0.261**	0.282**	0.230**			-0.146
RTP: Timely	0.241**(0.00	-0.098 (0.339)	-0.068 (0.501)	0.282***			0.191+
Model Statistics							
R-Sq	0.323***	0.093**	0.151***	0.428***	0.245***	0.118***	0.160***
Adjusted R-Sq	0.298***	0.067**	0.119***	0.407***	0.239***	0.112***	0.129***
Model significance	0.000	0.009	0.000	0.000	0.000	0.000	0.000

Notes:

1. H2a and H2b are not tested due to the enjoyment measurements’ lack of psychometric validity.
2. Hypothesis number and dependent variable is specified at top of each column. Columns give regression results for each hypothesis and some post hoc testing (indicated by ‘accent’ mark after the hypothesis modified). Independent variables listed in leftmost column. Upper table presents beta coefficients immediately followed by the significance level in parentheses, lower table contains model statistics.
3. + p<0.10; *p < 0.05; **p < 0.01; ***p < 0.001

Table 6b. Linear Regression Results

Hypotheses	**H6**	**H6’**	**H7a**	**H7b**	**H7c**	**H7’ (All)**
Dep. Variable	**Control**	**Control**	**Job Satisf.**	**Job Satisf.**	**Job Satisf.**	**Job Satisf.**
Stage 1:						
Simulation Effectiveness		0.072 (0.469)				
Attention		-0.062 (0.476)				
RTP: Reports		0.213* (0.045)				
RTP: EOU		0.267*** (0.001)				
RTP: Timely		0.233** (0.004)				
Stage 2						
Self Efficacy	0.402***(0.000)	0.249*** (0.000)				0.003 (0.963)
Stage 3:						
CA: Opportunity			0.551*** (0.000)			0.278*** (0.001)
CA: Threat				-0.232** (0.006)		-0.072 (0.307)
CA: Control					0.621***(0.000	0.482*** (0.000)
Model Statistics						
R-Sq	0.162***	0.480***	0.303***	0.054***	0.386***	0.465***
Adjusted R-Sq	0.156***	0.457***	0.298***	0.047***	0.381***	0.453***
Model significance	0.000	0.000	0.000	0.006	0.000	0.000

Notes:

1. Hypothesis number and dependent variable is specified at top of each column. Columns give regression results for each hypothesis and some post hoc testing (indicated by ‘accent’ mark after the hypothesis modified). Independent variables listed in leftmost column. Upper table presents beta coefficients immediately followed by the significance level in parentheses, lower table contains model statistics.
2. + $p<0.10$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table 7a. H8: Mediation Effects of Simulation Education Effectiveness on Control via Self-Efficacy

	Depend. Var.	R^2	Model P-value	Indep. Var.	Beta Coeff.	SE(B)	t	Signif.
Step a:	Control	0.245***	0.000	(Constant)		0.383	6.706	0.000
				Simulation Effectiveness	0.495***	0.070	6.69	0.000
Step b:	Self Efficacy	0.118***	0.000	(Constant)		0.000	10.298	0.000
				Simulation Effectiveness	0.344***	0.068	4.33	0.000
Step c:	Control	0.162***	0.000	(Constant)		0.470	5.715	0.000
				Self Efficacy	0.402***	0.087	5.163	0.000
Step d:	Control	0.307***	0.000	(Constant)		0.383	2.99	0.003
				Simulation Effectiveness	0.405***	0.072	5.348	0.000
				Self Efficacy	0.264***	0.084	3.493	0.001

Table 7b. Post Hoc Mediation Test of Simulation Education Effectiveness on Control via RTP Reports

	Depend. Var.	R^2	Model P-value	Indep. Var.	Beta Coeff.	SE(B)	t	Signif.
Step a:	Control	0.245***	0.000	(Constant)		0.383	6.706	0.000
				Simulation Effectiveness	0.495***	0.070	6.690	0.000
Step b:	RTP Reports	0.497***	0.000	(Constant)		0.282	6.495	0.000
				Simulation Effectiveness	0.705***	0.052	11.771	0.000
Step c:	Control	0.328***	0.000	(Constant)		0.393	4.836	0.000
				RTP Reports	0.573***	0.076	8.215	0.000
Step d:	Control	0.344***	0.000	(Constant)		0.405	4.185	0.000
				Simulation Effectiveness	0.178+	0.093	1.819	0.071
				RTP Reports	0.447***	0.107	4.557	0.000

+ $p<0.10$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table 7c. Post Hoc Test of Mediation Effects of Simulation Effectiveness on Control via Self-Efficacy & RTP Reports								
	Depend. Var.	**R^2**	**Model P-value**	**Indep. Var.**	**Beta Coeff.**	**SE(B)**	**t**	**Signif.**
First step:	Control	0.394***	0.000	(Constant)		0.483	1.508	0.134
				Self Efficacy	0.265***	0.077	3.835	0.000
				RTP Reports	0.500***	0.075	7.234	0.000
Last Step:	Control	0.399***	0.000	(Constant)		0.485	1.408	0.161
				Simul. Effectiveness	0.105	0.092	1.087	0.279
				Self Efficacy	0.249***	0.079	3.511	0.001
				RTP Reports	0.431***	0.103	4.566	0.000

+ $p<0.10$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Note: Prior mediation testing established the initial significant relationships that serve as prerequisites for testing mediation according to Baron and Kenny (1986) as shown in tables 5a and 5b.

Table 8. Sobel Test for Mediation						
Hypothesis	**Hypothesis Statement**	**Finding**	**Indirect Effect**	**Sobel SE**	**PValue 1-tailed**	**PValue 2-tailed**
H8	The influence of simulation education effectiveness on secondary cognitive appraisal of perceived control is mediated by self-efficacy.	Supported	0.131**	0.0396	0.0006	0.0012
Post Hoc	The influence of simulation education effectiveness on secondary cognitive appraisal of perceived control is mediated by realistic technology previews of information reports.	Supported	0.381***	0.05665	0.0000	0.0000
Post Hoc	The influence of simulation education effectiveness on secondary cognitive appraisal of perceived control is fully mediated by the combined variables of IT self-efficacy and realistic technology previews of information reports.	Supported: Self-Efficacy Supported: RTP Reports	0.086** 0.297***	0.03013 0.07009	0.0024 0.0000	0.0049 0.0000

Table 9. Hypotheses and Findings

H1a	H1a: Attention during education positively influences primary cognitive appraisal of perceived opportunity.	Not Supported
H1b	H1b: Attention during education negatively influences primary cognitive appraisal of perceived threat.	Supported
H2a	H2a: Enjoyment during education positively influences primary cognitive appraisal of perceived opportunity.	Not Testable
H2b	H2b: Enjoyment during education negatively influences primary cognitive appraisal of perceived threat.	Not Testable
H3a	H3a: Realistic technology previews positively influence primary cognitive appraisal of opportunity.	Supported (Information, timely) Not Supported (EOU)
H3b	H3b: Realistic technology previews negatively influence primary cognitive appraisal of Threat.	Supported (for EOU only) ## Not Supported (Infor., timely)
H3c	H3c: Realistic technology previews positively influence secondary cognitive appraisal of control.	Supported
H4	H4: Computer simulation education effectiveness positively influences secondary cognitive appraisal of perceived control.	Supported
H5	H5: Computer simulation education effectiveness positively influences computer self-efficacy.	Supported
H6	H6: Computer self-efficacy positively influences secondary cognitive appraisal of perceived control.	Supported
H7a	Primary cognitive appraisal of opportunity positively influences ES job satisfaction.	Supported
H7b	Primary cognitive appraisal of threat negatively influences ES job satisfaction.	Supported
H7c	Secondary cognitive appraisal of perceived control positively influences ES job satisfaction.	Supported
H8	The influence of simulation education effectiveness on control is mediated by self-efficacy.	Supports Partial Mediation
Post Hoc	The influence of simulation education effectiveness on control is mediated by realistic technology preview: reports.	Supports Partial Mediation
Post Hoc	The influence of simulation education effectiveness on control is mediated by self-efficacy and realistic technology preview: reports.	Supports Full Mediation

alternate H3b' test of RTP's influence on threat in the presence of simulation effectiveness reveal possible suppression effects, as the influence of RTP EOU changes from negative to positive in the presence of simulation effectiveness which is a negative influence. See Table 6a.

Appendix F – Survey Measurement Items

Essay 3 – Dependent Variable Measurement Items

Italicized items were not use in statistical analysis based on factor analysis results.

Enterprise Systems Satisfaction: adapted Job Satisfaction facets

Job Satisfaction: Work Itself. Items from (Spector 1985) - Applied to ERP.

1. I feel my ERP work is meaningful.
2. I like doing the work I do with ERP.
3. I feel a sense of pride in doing my ERP work.
4. My work with ERP is enjoyable.

Job Satisfaction: From: (Tsui et al. 1992)- Applied to ERP.

1. I am satisfied with the nature of the ERP work I perform.
2. *I am satisfied with my relations with others in the organization with whom I work (i. e. my peers).*

Essay 3 - Independent Variable Measurement Items

Attention (used focused immersion items from Agawal & Karahanna 2000)
1. While using the system I am able to block out most other distractions.
2. While using the system, I am absorbed in what I am doing.
3. While on the system, I am immersed in the task I am performing.
4. While on the system, my attention does not get diverted very easily.

Enjoyment (used Heightened Enjoyment items from Agawal & Karahanna 2000)
Note: these items are included in descriptive, factor analysis and correlation matrix but were not used in regression analysis due to lack of discriminant validity (low AVE in table 5).
1. I have fun interacting with the system.
2. Using the system provides me with a lot of enjoyment.
3. I enjoy using the system.
4. Using the system bores me. (R)

Realistic Technology Preview (RTP)
End user computing satisfaction (EUCS) scale as validated for ERP from: Somers, Nelson, and Karimi (2003, p. 595-621).
+Items added in addition to the scale in Somers, Nelson, and Karimi (2003, p. 595-621).

<u>Content</u>
1. The system provides the precise information that I need.
2. The system's information content meets my needs.
3. The system provides reports that seem to be just about exactly what I need.
4. The system provides sufficient information from all different functional business areas.
5. The system does not have all the reports I need to operate the business.+
<u>Accuracy</u>
6. The system is accurate.
7. I am satisfied with the accuracy of the system.
8. The system information reflects the reality of the business.+
<u>Format</u>
9. I think the system’s output is presented in a useful format.
10. The information reported by the system is clear.
11. System reports are easy to understand.+
<u>Ease of Use/User Friendly</u>
12. I find the system to be user friendly.
13. The system is easy to use.
<u>Timeliness</u>
14. I get the information I need from the system in a timely manner.
15. The system provides up-to-date information.
16. The system provides me with timely information about other functional areas. +

Simulation Education Effectiveness Scale: Items from Workman (2004) for perceived effectiveness of computer-based and computer-aided education scale.

1. The computer-based simulation was effective at keeping my attention.
2. My interest was aroused by this computer-based simulation.
3. The computer-based simulation was appropriately interactive.
4. *The feedback was sufficient for the learning material.*
5. Sufficient practice was generated by this computer-based simulation.
6. The computer-based simulation made me realize things I thought I knew but didn’t.
7. *The ERP simulation information was presented in a coherent way.*
8. My knowledge was improved by this computer-based simulation.
9. The simulation education material was organized so that I could understand it.

Computer Self-efficacy: (adapted from Compeau and Higgins, 1995b)

I could complete a task using the system…
… *If there was no one around to tell me what to do as I go.*
… If I could call someone for help if I got stuck.
… If I had just built-in help facility for assistance.
… If I had a lot of time to complete the job for which the software was provided.

Primary cognitive appraisal: measures for perceived opportunity and perceived threat.

Perceived opportunity - from Bala (2008) as adapted from Drach-Zahavy and Erez (2002) and Major et al. (1998).

1. I am confident that the system will have positive consequences for me.
2. I feel that the system will open new avenues for success in my job.
3. The system will provide opportunities to improve my job performance.
4. The system will provide opportunities to gain recognition and praise.

Perceived threat - from Bala 2008 as adapted of Major et al. (1998)

1. I am scared that the system will have harmful (or bad) consequences for me.
2. I am worried that the new system may worsen my job performance.
3. I feel that the new system might actually degrade my status in the organization.
4. I feel stressed about having to use the new system to accomplish my job.

Secondary cognitive appraisal:
Perceived controllability - from Bala (2008) as adapted from Major et al. (1998).

1. I personally have what it takes to deal with these situations caused by the system.
2. I have the resources I need to successfully use the system.
3. I have the knowledge necessary to use the new system.
4. I so confident that I will be able to use the system without any problems.

CHAPTER 5

Conclusions and Contributions

In summary, the first two essays in this dissertation investigated how different ES educational models influence higher levels of ES knowledge, namely business process knowledge and business motivational knowledge, as well as the resulting influence on affective user reactions. The third essay assessed various ES simulation factors to determine which attributes are most effective at influencing affective user reactions to the ES. The results of this work contribute to IT change management literature (Senge 1994; Balogun and Jenkins 2003); to sociotechnical understanding of ES implementation (Dery et al. 2006; Grant et al. 2006); and to the resistance to IT literature (Kim and Kankanhalli 2009; Liang and Xue 2009) including the coping model of user adaptation (Beaudry and Pinsonneault 2005). This work provides a richer conceptualization of ES knowledge acquisition utilizing a hierarchical model of ES knowledge and empirically testing the influence of two types of business context knowledge, namely business process knowledge and motivational knowledge. Identification of an effective, simulation-based ES change management educational intervention provides guidance to research and practice in addressing the decline in job satisfaction experienced by firms during early ES adaptation and use.

Essay 3 focuses on the utilization of simulation-based education as an effective transitional environment for ES change management and education. The new construct of realistic technology preview was defined and empirically tested. Findings demonstrate that the RTP construct has value as a predictor of stress coping reactions to ES by using measures of cognitive appraisal. Analysis supports that simulation education effectiveness positively influences cognitive appraisal of control and this relationship is fully mediated by realistic technology preview of ES reports and IT self-efficacy. A realistic technology preview contains assessments of the systems usefulness and user-friendliness. The usefulness aspects of reports and timeliness directly influenced appraisals of opportunity, while the ease of use aspect, along with attention, influenced appraisal of threat. All three aspects of RTP influence control. In conjunction with IT self-efficacy, the RTP report factor fully mediated the influence of simulation education effectiveness on cognitive appraisal of control. Only opportunity and control are found to influence job satisfaction as the effects of threat on the job satisfaction outcome are fully attenuated fully by the stronger positive cognitive appraisals of opportunity and control.

In sum, a realistic technology preview provides a dynamic experiential learning experience which can improve affective reactions to a technology. This resulting improvement in stress coping reactions of opportunity and control along with the attenuation of threat, are found to positively influence job satisfaction of the new technology. Assessing ES knowledge acquisition using knowledge structure methods and Pathfinder network analysis shows some promise. Further work is needed to refine the initial measurement items presented in these essays and to better understand the role of conceptual ES knowledge in the process of user adaptation to ES. Hopefully, insights gathered from this research should inform future ES change management interventions.

REFERENCES

Agarwal, R., and Karahanna, E. "Time Flies When You're Having Fun: Cognitive Absorption and Beliefs About Information Technology Usage," *Management Information Systems Quarterly* (24:4), Dec 2000, pp. 665-694.

Anderson, J.R. "Acquisition of Cognitive Skill," *Psychological Review* (89:4) 1982, pp. 369-406.

Anderson, P., and Lawton, L. "Business Simulations and Cognitive Learning: Developments, Desires, and Future Directions," *Simulation & Gaming* (40:2) 2009, p. 193.

Bala, H. "Nothing Endures But Change: Understanding Employees' Responses To Enterprise Systems Implementation and Business Process Change " in: *Information Systems*, University of Arkansas, Fayetteville, Arkansas, 2008, p. 214.

Balogun, J., and Jenkins, M. "Re-Conceiving Change Management: A Knowledge-Based Perspective," *European Management Journal* (21:2) 2003, p. 247.

Bandura, A. "Self-Efficacy - Toward a Unifying Theory of Behavioral Change," *Psychological Review* (84:2) 1977, pp. 191-215.

Bandura, A. "Social Cognitive Theory: An Agentic Perspective," *Annual Review of Psychology* (52) 2001, pp. 1-26.

Barki, H., Titah, R., and Boffo, C. "Information System Use-Related Activity: An Expanded Behavioral Conceptualization of Individual-Level Information System Use," *Information Systems Research* (18:2) 2007, p. 173.

Beaudry, A., and Pinsonneault, A. "Understanding User Responses to Information Technology: A Coping Model of User Adaptation," *Management Information Systems Quarterly* (29:3) 2005, pp. 493-524.

Beaudry, A., and Pinsonneault, A. "The Other Side of Acceptance: Studying the Direct and Indirect Effects of Emotions on Information Technology Use," *MIS Quarterly* (34:4) 2010, pp. 689-710.

Berry, D.C., and Broadbent, D.E. "The Combination of Explicit and Implicit Learning-Processes in Task Control," *Psychological Research-Psychologische Forschung* (49:1) 1987, pp. 7-15.

Boudreau, M.-C., and Seligman, L. "Quality of Use of a Complex Technology: A Learning-Based Model," *Journal of Organizational and End User Computing* (17:4) 2005, p. 1.

Boudreau, M., and Robey, D. "Enacting Integrated Information Technology: A Human Agency Perspective," *Organization Science* (16:1) 2005, pp. 3-18.

Breaugh, J.A., and Starke, M. "Research On Employee Recruitment: So Many Studies, So Many Remaining Questions," *Journal of Management* (26:3) 2000, p. 405.

Browne, C.J., and Shlosberg, E. "Attachment Theory, Ageing And Dementia: A Review of the Literature," *Aging & Mental Health* (10:2) 2006, pp. 134-142.

Burton-Jones, A., and D. W. Straub, J. "Reconceptualizing System Usage: An Approach and Empirical Test," *Information Systems Research* (17:3) 2006, p. 228.

Cohen, D.S. "Why Change Is an Affair of the Heart; In the Drama of Change, Emotions, Not Logic, Impel People to Cast Off the Old and Embrace the New," *CIO* (19:5) 2005, p. 1.

Cohen, J., Cohen, P., West, S.G., and Aiken, L.S. *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*, (3rd ed.) Lawrence Erlbaum Associates, Mahwah, New Jersey, 2003, p. 703.

Compeau, D., Higgins, C.A., and Huff, S. "Social Cognitive Theory and Individual Reactions To Computing Technology: A Longitudinal Study," *Management Information Systems Quarterly* (23:2), Jun 1999, pp. 145-158.

Compeau, D.R., and Higgins, C.A. "Application of Social Cognitive Theory to Training for Computer Skills," *Information Systems Research* (6:2), Jun 1995a, pp. 118-143.

Compeau, D.R., and Higgins, C.A. "Computer Self-Efficacy - Development of a Measure and Initial Test," *MIS Quarterly* (19:2), Jun 1995b, pp. 189-211.

Corbitt, G., and Mensching, J. "Integrating SAP R/3 into a College of Business curriculum: Lessons learned," *Information Technology & Management* (1:4) 2000, pp. 247-258.

Csikszentmihalyi, M., and LeFevre, J. "Optimal Experience in Work and Leisure," *Journal of Personality and Social Psychology* (56:5) 1989, pp. 815-822.

Daniel, S.I.F. "Adult Attachment Patterns and Individual Psychotherapy: A Review," *Clinical Psychology Review* (26:8), Dec 2006, pp. 968-984.

Davis, F.D., and Yi, M.Y. "Improving Computer Skill Training: Behavior Modeling, Symbolic Mental Rehearsal, and the Role of Knowledge Structures," *Journal of Applied Psychology* (89:3) 2004, p. 509.

Dehning, B., Richardson, V.J., and Zmud, R.W. "The Value Relevance of Announcements of Transformational Information Technology Investments," *Management Information Systems Quarterly* (27:4) 2003, p. 637.

Dery, K., Grant, D., Harley, B., and Wright, C. "Work, Organisation and Enterprise Resource Planning Systems: An Alternative Research Agenda," *New Technology Work and Employment* (21:3), Nov 2006, pp. 199-214.

Doll, W.J., and Torkzadeh, G. "The Measurement of End-User Computing Satisfaction " *Management Information Systems Quarterly* (12:2) 1988, pp. 259-274.

Drach-Zahavy, A., and Erez, M. "Challenge Versus Threat Effects On The Goal-Performance Relationship," *Organizational Behavior and Human Decision Processes* (88:2) 2002, p. 667.

Folkman, S., Lazarus, R.S., Dunkelschetter, C., Delongis, A., and Gruen, R.J. "Dynamics of a Stressful Encounter - Cognitive Appraisal, Coping, and Encounter Outcomes," *Journal of Personality and Social Psychology* (50:5), May 1986a, pp. 992-1003.

Folkman, S., Lazarus, R.S., Gruen, R.J., and Delongis, A. "Appraisal, Coping, Health-Status, and Psychological Symptoms," *Journal of Personality and Social Psychology* (50:3), Mar 1986b, pp. 571-579.

Fornell, C., and Larcker, D.F. "Evaluating Structural Equation Models With Unobservable Variables and Measurement Error," *Journal of Marketing Research* (18) 1981, pp. 39-50.

Garris, R., Ahlers, R., and Driskell, J., E. "Games, Motivation, and Learning: A Research and Practice Model," *Simulation & Gaming* (33:4) 2002, p. 441.

Gowan, M.A., Riordan, C.M., and Gatewood, R.D. "Test of a Model of Coping With Involuntary Job Loss Following a Company Closing," *Journal of Applied Psychology* (84) 1999, pp. 75-86.

Grant, D., Hall, R., Wailes, N., and Wright, C. "The False Promise of Technological Determinism: The Case of Enterprise Resource Planning Systems," *New Technology, Work, and Employment* (21:1) 2006, pp. 2-15.

Hoffman, D.L., and Novak, T.P. "Marketing in Hypermedia Computer-Mediated Environments: Conceptual Foundations," *Journal of Marketing* (60:3) 1996, p. 50.

Hom, P.W., Griffeth, R.W., Palich, L.E., and Bracker, J.S. "An Exploratory Investigation Into Theoretical Mechanisms Underlying Realistic Job Previews," *Personnel Psychology* (51:2), Sum 1998, pp. 421-451.

Hultman, K. *Making Change Irresistible: Overcoming Resistance to Change in Your Organization*, Davies-Black Publishing, Palo Alto California, 1998.

Igbaria, M., Parasuraman, S., and Baroudi, J.J. "A Motivational Model of Microcomputer Usage," *Journal of Management Information Systems* (13:1) 1996, p. 127.

Jasperson, J., Carter, P.E., and Zmud, R.W. "A Comprehensive Conceptualization of Post-Adoptive Behaviors Associated With Information Technology Enabled Work Systems," *Management Information Systems Quarterly* (29:3) 2005, p. 525.

Kang, D., and Santhanam, R. "A Longitudinal Field Study of Training Practices in a Collaborative Application Environment," *Journal of Management Information Systems* (20:3), Win 2003, pp. 257-281.

Kappas, A. "Appraisals Are Direct, Immediate, Intuitive, and Unwitting… and Some Are Reflective…," *Cognition & Emotion* (20:7) 2006, pp. 952-975.

Kegan, R., and Lahey, L.L. "The Real Reason People Won't Change," *Harvard Business Review* (79:10), Nov 2001, pp. 84-+.

Kim, H.-W., and Kankanhalli, A. "Investigating User Resistance to Information Systems Implementation: A Status Quo Bias Perspective," *Management Information Systems Quarterly* (33:3) 2009, pp. 567-582.

Kim, S.S. "The Integrative Framework of Technology Use: An Extension and Test," *Management Information Systems Quarterly* (33:3) 2009, pp. 513-537.

Kline, R.B. *Principles and Practice of Structural Equation Modeling* Guilford Press, New York, 2005, p. 366.

Krausz, M., and Fox, S. "Short Research Notes - Two Dimensions of a Realistic Preview and Their Impact Upon Initial Expectations, Expectation Fulfilmant, Satisfaction and Intentions to Quit," *Journal of Occupational Behavior (pre-1986)* (2:3) 1981, p. 211.

Lazarus, R.S. "From Psychological Stress to the Emotions: A History of Changing Outlooks," *Annual Review of Psychology* (44) 1993, p. 1.

Leana, C.R., Feldman, D.C., and Tan, G.Y. "Predictors of Coping Behavior After A Layoff," *Journal of Organizational Behavior* (19:1), Jan 1998, pp. 85-97.

Léger, P.M. "Using a Simulation Game Approach to Teach Enterprise Resource Planning Concepts," *Journal of Information Systems Education* (17:4) 2006, p. 441.

Leidner, D.E., and Jarvenpaa, S.L. "The Use of Information Technology to Enhance Management School Education: A Theoretical View," *Management Information Systems Quarterly* (19:3) 1995, pp. 265-291.

Liang, H., Saraf, N., Hu, Q., and Xue, Y. "Assimilation of Enterprise Systems: The Effect of Institutional Pressures and the Mediating Role of Top Management," *Management Information Systems Quarterly* (31:1) 2007, pp. 59-87.

Liang, H., and Xue, Y. "Avoidance of Information Technology Threats: A Theoretical Perspective," *Management Information Systems Quarterly* (33:1) 2009, pp. 71-90.

Limayem, M., Hirt, S.G., and Cheung, C.M.K. "How Habit Limits the Predictive Power of Intention: The Case of Information Systems Continuance," *MIS Quarterly* (31:4) 2007, pp. 705-737.

Lyytinen, K., and Rose, G.M. "Disruptive Information System Innovation: The Case of Internet Computing," *Information Systems Journal* (13:4), Oct 2003, pp. 301-330.

Major, B., Richards, C., Cooper, M.L., Cozzarelli, C., and Zubek, J. "Personal Resilience, Cognitive Appraisals, And Coping: An Integrative Model Of Adjustment To Abortion," *Journal of Personality and Social Psychology* (74:3) 1998, p. 735.

Malone, T.W. "Toward a Theory of Intrinsically Motivating Instruction," *Cognitive Science: A Multidisciplinary Journal* (5:4) 1981, pp. 333-369.

Marakas, G.M., Johnson, R.D., and Palmer, J.W. "A Theoretical Model of Differential Social Attributions Toward Computing Technology: When the Metaphor Becomes the Model," *International Journal of Human-Computer Studies* (52:4), Apr 2000, pp. 719-750.

Miller, E. *From Dependency To Autonomy: Studies In Organization And Change* Free Association Books, Oxford, England:, 1993, p. 342 pp. .

Mitchell, T.R., Holtom, B.C., Lee, T.W., Sablynski, C.J., and Erez, M. "Why People Stay: Using Job Embeddedness To Predict Voluntary Turnover," *Academy of Management Journal* (44:6) 2001, p. 1102.

Mitchell, T.R., and Lee, T.W. "The Unfolding Model Of Voluntary Turnover and Job Embeddedness: Foundations For A Comprehensive Theory Of Attachment," in: *Research In Organizational Behavior*, 2001, pp. 189-246.

Nunnaly, J.C. *Psychometric Theory*, (second ed.) McGraw-Hill, New York, 1978.

Orlikowski, W.J., and Hofman, J.D. "An Improvisational Model for Change Management: The Case of Groupware Technologies," *Sloan Management Review* (38:2), Win 1997, pp. 11-21.

Papert, S. *Mindstorms: Children, Computers, and Powerful Ideas*, (2nd Edition ed.) BasicBooks, A Division of HarperCollins Publishers, New York, NY, 1980, p. 225.

Peluso, P.R., Peluso, J.P., Kern, R.M., Kern, R.M., and White, J.A.F. "A Comparison Of Attachment Theory And Individual Psychology: A Review Of The Literature," *Journal of Counseling & Development* (82:2) 2004, pp. 139-145.

Peterson, W.J., Gelman, L., and Cooke, D.P. "ERP Trends, Report Number: R-1292-01-RR ", The Conference Board, /www.conference-board.org, pp. 1-31.

Piccoli, G., Ahmad, R., and Ives, B. "Web-Based Virtual Learning Environments: A Research Framework and a Preliminary Assessment of Effectiveness in Basic IT Skills Training," *Management Information Systems Quarterly* (25:4) 2001, pp. 401-426.

Popovich, P., and Wanous, J.P. "The Realistic Job Preview As a Persuasive Communication," *Academy of Management. The Academy of Management Review (pre-1986)* (7:000004) 1982, p. 570.

Premack, S.L., and Wanous, J.P. "A Meta-Analysis of Realistic Job Preview Experiments," *Journal of Applied Psychology* (70:4) 1985, p. 706.

Pufall, P.B. "Function in Piaget's System: Some Notes for Constructors of Microworlds," in: *Constructivism in the Computer Age*, G. Forman and P.B. Pufall (eds.), Lawrence Erlbaum Associates, Publishers, Hillsdale, New Jersey, 1988.

Randel, J.M., Morris, B.A., and et al. "The Effectiveness of Games for Educational Purposes: A Review of Recent Research," *Simulation & Gaming* (23:3) 1992, p. 261.

Robey, D., Ross, J.W., and Boudreau, M.C. "Learning To Implement Enterprise Systems: An Exploratory Study of the Dialectics of Change," *Journal of Management Information Systems* (19:1), Sum 2002, pp. 17-46.

Ruben, B.D. "Simulations, Games, and Experience-Based Learning: The Quest For a New Paradigm For Teaching and Learning," *Simulation & Gaming* (30:4) 1999, p. 498.

Scott, J. "The FoxMeyer Drugs' Bankruptcy: Was it a Failure of ERP?," *Proceedings of the Americas Conference on Information Systems (AMCIS)* (Paper 80) 1999, pp. 223-225.

Sein, M.K., Bostrom, R.P., and Olfman, L. "Rethinking End-User Training Strategy: Applying a Hierarchical Knowledge-Level Model," *Journal of End User Computing* (11:1) 1999, pp. 32-39.

Senge, P. "The Leader's New Work," *Executive Excellence* (11:11) 1994, p. 8.

Somers, T.M., Nelson, K., and Karimi, J. "Confirmatory Factor Analysis of the End User Computing Satisfaction Instrument: Replication within an ERP Domain," *Decision Sciences* (34:3) 2003, pp. 595-621.

Somers, T.M., and Nelson, K.G. "The Impact of Strategy and Integration Mechanisms on Enterprise System Value: Empirical Evidence From Manufacturing firms," *European Journal of Operational Research* (146:2), Apr 2003, pp. 315-338.

Spector, P.E. "Measurement of Human-Service Staff Satisfaction - Development of the Job-Satisfaction Survey," *American Journal of Community Psychology* (13:6), Dec 1985, pp. 693-713.

Tomaka, J., Kibler, J., Blascovich, J., and Ernst, J.M. "Cognitive and Physiological Antecedents of Threat and Challenge Appraisal," *Journal of Personality & Social Psychology* (73:1) 1997, pp. 63-72.

Tsui, A., Egan, T., and O'Reilly, C., III "Being Different: Relational Demography and Organizational Attachment," *Administrative Science Quarterly* (37:4) 1992, p. 549.

Venkatesh, V. "Creation of Favorable User Perceptions: Exploring the Role of Intrinsic Motivation," *Management Information Systems Quarterly* (23:2) 1999, pp. 239-260.

Venkatesh, V., Speier, C., and Morris, M.G. "User Acceptance Enablers In Individual Decision Making About Technology: Toward An Integrated Model," *Decision Sciences* (33:2) 2002, pp. 297-316.

Wastell, D.G. "Learning Dysfunctions In Information Systems Development: Overcoming The Social Defenses With Transitional Objects," *Management Information Systems Quarterly* (23:4) 1999, pp. 581-600.

Webster, J., and Ahuja, J.S. "Enhancing the Design of Web Navigation Systems: The Influence of User Disorientation on Engagement and Performance," *Management Information Systems Quarterly* (30:3) 2006, p. 661.

Winn, W. "Current Trends in Educational Technology Research: The Study of Learning Environments," *Educational Psychology Review* (14:3) 2002, pp. 331-351.

Workman, M. "Performance and Perceived Effectiveness in Computer-Based and Computer-Aided Education: Do Cognitive Styles Make a Difference?," *Computers in Human Behavior* (20:4) 2004, pp. 517-534.

Yi, M.Y., and Davis, F.D. "Developing and Validating An Observational Learning Model Of Computer Software Training And Skill Acquisition," *Information Systems Research* (14:2) 2003, pp. 146-169.