Some Suggestions for Further Diffusion of Work System Method Ideas in Systems Analysis and Design

Doncho Petkov.
petkovd@easternct.edu
Department of Business Administration, Eastern
Connecticut State University, CT, USA

Ram B Misra
misrar@mail.montclair.edu
Department of Management and Information Systems,
Montclair State University, NJ, USA

Olga Petkova
petkovao@ccsu.edu
Department of MIS, Central
Connecticut State University, CT, USA

Abstract

The Work System Method by Steven Alter has a significant potential for improving requirements definition in information systems development. Previous publications on the Work System Method and also on Design Science concepts and their relevance for Systems Analysis and Design are reviewed. We suggest some directions for further work on the diffusion of work system method ideas in systems analysis and design organized along the conceptual framework for IS research by Hevner, March, Park and Ram.

Keywords: systems development, work system method, systems analysis and design.

1. INTRODUCTION

Hevner et al (2004) presented seminal directions for work in design science within the Information Systems field. These lead subsequently to an increased interest in research in Systems Analysis and Design (SA&D) (see Bajaj et al., 2005; Iivari et al., 2005 and Harris et al., 2006). The importance of Systems Analysis and Design for any program of study in information systems and, we may add, to the field of IS development is well summarized by Harris et al. (2006:242). Among the most important aspects of the relevance of SA&D, Harris et al. (2006) list development of analytical and problem solving skills and the development and implementation of information systems.

The growing interest in SA&D was evolving in parallel with a renewed attention on the applicability of systems thinking to Information Systems as a discipline (see Alter, 2004a; Alter, 2004b, Mora et al., 2007, Mora et al., 2008). The ideas of Steven Alter on his work system method (WSM) played persistently an important role throughout these developments (e.g. see Alter, 2004b; Alter and Browne, 2005; Alter, 2006c). The work system method has

emerged over the last decade as a theory for understanding the role of information systems in organizations and is gaining popularity among IS researchers (see Alter, 2006c; Korpela et al., 2004; Siau et al., 2004; Petkov and Petkova, 2008). We feel however that there is a need for more work on the diffusion of work system method ideas in Systems Analysis and Design. This is the motivation for the work presented here.

The purpose of the article is to suggest possible research directions for incorporating work system method related ideas in the practicing and teaching of Systems Analysis and Design. These are not overlapping with the proposals by Alter and Browne (2005). Our suggestions are also in line with the recent revival of research in SA&D as advocated in Bajaj et al (2005). We may note that the detailed explanation of the basic concepts of the WSM is beyond the scope of our paper as there is a significant body of knowledge on it reflected in the work of Alter, a significant portion of which is provided in the references at the end. The paper proceeds with an overview of the work system method (WSM) and related research, a review of recent publications in systems analysis and design as well as design science, which are followed by the proposed directions for future work on applying WSM in SA&D and a conclusion.

2. THE WORK SYSTEM METHOD AND RELATED RESEARCH

The work system method is one of the two existing theoretical frameworks to support teaching of information systems at present. The other approach to introduce the IS field (used predominantly for teaching of MBA students) is the IS Interaction Model which focuses on the relationships between IS, their environment and the organization (see Silver et al. (1995)). The Work System Method (Alter, 2006c), however, can be used both for IS teaching and research and that distinguishes it from the Interaction Model and makes it suitable for exploring its role in systems analysis. The work system method is an approach for understanding and analyzing systems in organizations including Information Systems (Alter, 2002a). The next section presents briefly some of its elements.

The Work System Method

The work system method provides a rigorous but non-technical approach to any manager or business professional to visualize and analyze systems related problems and opportunities (Alter, 2006c). A very detailed justification for the work system method and how to apply it to define a work system, analyze it, formulate recommendations for improvement and guide its evolution is given in Alter (2006c). This method is more broadly applicable than techniques designed to specify detailed software requirements. The WSM is designed to be more prescriptive and more powerful than domain-independent systems analysis methods such as soft system methodology (Alter, 2002a).

The work system method (Alter, 2006c) has two major components: *the work system framework*, representing a static description of the work system and *the work system life cycle*, focusing on the dynamics of a work system. Detailed definitions of the components of the work system framework are presented in Alter (2002a, 2006c). The interrelationships between the various elements of a work system and their boundaries are useful for generating an analysis of a specific business problem. Alter has developed also *Sysperanto, a model based ontology of the IS field* based on the work system method (Alter, 2005)

Both the work system framework (the static view of a work system) and the work system life cycle (the dynamic view how a current or proposed system evolves over time) have a complementary role (see Alter (2002a, 2006c)). Table 1 defines several basic terms underlying the work system method. Further elaboration on important definitions of related concepts is presented in Alter (2006c).

The work system framework consists of 9 elements, 4 internal and 5 external (Alter, 2002). The four internal elements, considered part of the work system, include processes and activities to accomplish work items, participants to execute processes, technology needed to enable completion of processes and work items, and information or knowledge base needed.

Table 1. Some Basic Terms Underlying the Work System Method (after Alter (2002a) and Petkov and Petkova, (2008))

Basic Term	Definition
Work system	A view of work as occurring through a purposeful system
Work system framework	Model for organizing an initial understanding of how a particular work system operates and what it accomplishes.
Organization	Multiple work systems coordinated to accomplish goals that these work systems cannot accomplish individually
Static view	How a work system operates, based on a particular configuration
Dynamic view	How a work system's configuration evolves over time
Work system life cycle	Process through which a specific work system is created and changes over time through planned and unplanned changes.

The five external elements, considered not part of the work system yet are important for its functioning, include strategy (both business and IS/IT), infrastructure needed to support the work system, environmental factors, product/services, and customers (internal, work system users and external, end customers).

The practical value of the WSM emerges more strongly through the introduction in its most recent version in Alter (2006c) of *three problem solving steps*:

SP—*Identify the System and Problems*: Identify the work system that has the problems that launched the analysis. The system's size and scope depend on the purpose of the analysis.

AP—*Analyze the system* and identify Possibilities: Understand current issues and find possibilities for improving the work system.

RJ—*Recommend and Justify changes*: Specify proposed changes and check the recommendation.

Within each step there are three levels of detail in which the issues are explored. The result of level one is a rough definition of the problem. At level two are explored answers to a number of specific questions for each step providing additional information and perspectives on the problem situation. At the third level of applying WSM are employed a number of diverse techniques and any other relevant data that can provide deeper understanding of the problem situation.

Recently the ideas of the WSM were extended to service organizations (Alter (2007b). Alter (2007b) proposed also a new analysis tool, *service responsibility tables* in which one column is identifying provider responsibilities, while a second column is identifying corresponding customer responsibilities. Additional aspects of the analysis may be introduced in other columns, like problems and issues, business rules, information used and others, according to Alter (2007b).

Past Discussion of the Work System Method in IS research

Information systems constitute a special case of work systems in which the business processes performed and the products and services produced are devoted to information (Alter, 2002a:95). Information systems exist to support other work systems and there could be some overlap with them. Various possible relationships between an IS and a work system are described in Alter (2002a:96). Guidelines for analyzing work systems are presented in Alter (2002a, 2006c).

The systemic nature of the work system method and its applicability to understanding business and IS problems is its most distinctive and important characteristics (Petkov and Petkova, 2008). The work system method has a relatively short history and a small but growing group of followers for now. Alter's multifaceted work, bringing together systems ideas with methods for deeper understanding of work systems and IS, has strong appeal. Petkov et al. (2008)

have proposed that the WSM could be used to *change the attitudes of clients in managerial and operational user roles in combination with* other relevant methods for the purpose of developing better understanding of organizational problems and to improve the communication between clients and software developers.

Alter's proposal for work systems to replace the IT artifact as the focus of the IS discipline is an interesting innovative idea that has been considered to a degree already by others (see Alter (2003), Jasperson et al. (2005) and Alter (2006a)). A detailed discussion on the IT artifact is outside the scope of this paper. Alter (2002b) considers the four elements of an IT artifact that include information technology, the tasks, task structure, and task context within which it is used and shows "that the term IT artifact seems to encompass almost anything IT touches or affects directly, and is too unclear to serve as a basic concept for defining the IS field. IT artifact verges on being a synonym for the clearer term *IT-reliant work system*" (Alter, 2002b:496). Since the nature of the IT artifact is a central issue in IS research, it indirectly affects possible future work on the WSM and Systems Analysis and Design.

Most of the publications related to the work system method have been related to the potential application of its concepts (e.g. see Siau et al., 2004, Casey and Brugha, 2005 and others). There have been very few attempts for a critical analysis of the WSM (see Korpela et al. (2004)) or for linking it to other methods like the "work practice approach" (see Petersson (2005)).

The WSM was explored as a teaching tool only by a few authors discussed briefly in Alter (2006c). Ramiller (2005) is one of the few currently published sources on applying WSM ideas. It describes the use of the work system concept for understanding the notion of business processes in an undergraduate IS course. A few cases are discussed in Alter (2006c). An elaborate detailed case study of WSM application can be found in Cox et al. (2002). Alter (2006c) shows evidence that work system ideas provide support for better understanding of business and systems problems when used with masters students who usually have a broader IT background

(see Alter, 2006c). A detailed discussion of pitfalls in analyzing systems in organizations based on investigating 200 masters projects is presented in Alter (2006b). The first controlled field experiment on the impact of the work system method on understanding an IS implementation problem is presented in Petkov and Petkova (2008). Their research explored the role of the work system framework for improvement of student understanding of an IT related work system problem in an introductory business course on IS. They measured student learning through assessment of a team project and concluded that the Work System Framework has a positive impact on student understanding of business situation involving a complex IS problem. To the best of our knowledge no publication addresses currently issues related to how the work system method can be applied in the practicing and teaching of systems analysis and design. Recognizing the pioneering efforts of Alter, we believe that further work is needed on expanding the application of the WSM in Systems Analysis and Design by a broader research community. That is in line with recent developments in design science and SA&D discussed in the next section.

3. RECENT IDEAS IN DESIGN SCIENCE AND SYSTEMS ANALYSIS AND DESIGN

The renewal of interest in Systems Analysis and Design is related to a considerable degree to a fundamental contribution to IS research by Hevner et al. (2004) that aimed to restore the balance between the two inseparable areas of IS research – behavioral research and design science research. Hevner et al (2004) raised a number of theoretical and practical aspects of stimulating research in design science, one of the two fundamental paradigms in IS research. They provide a conceptual model of IS research that integrates important considerations on relevance and rigor. At the same time they show the complementary role of design science and behavioral science approaches in IS research. They assert the role of design science within the dual understanding of design as a process and as an artifact. According to Hevner et al. (2004:79) behavioral science deals with the development and justification of theories that explain or predict the phenomena

related to the identified business need while design science addresses research through the building and evaluation of artifacts that meet the business need. They define further that the knowledge base in their model provides the raw materials from and through which IS research is accomplished.

The aspects of design science research discussed by Hevner et al (2004) had a direct impact on the subsequent interest in Systems Analysis and Design teaching and research (see Bajaj et al., 2005 and Iivari et al., 2005). Alter and Browne (2005) were among the first to provide their contribution to the debate on the need for more research in SA&D. They note that existing definitions of SA&D like the one by Iivari et al. (2005) focus only on the role of SA&D in the early stages of software development. Alter and Browne (2005) provide a much broader view of Systems Analysis and Design that captures better the diverse extent of the change in work practices by a particular activity requiring SA&D and the range of focus from technical to social aspects of the project. They define as a result six contexts of distinct SA&D situations and they focus on two Information Systems development performance processes (following Iivari, Hirschheim and Klein, 2004): organizational alignment and requirements construction. Thus, Alter and Browne (2005) focus on areas that are closely related to the core of Information Systems as a discipline, leaving out aspects of project management and software design as they are perceived to be closer to software engineering. As a result of the interweaving of the work system method with numerous other existing approaches to organizational alignment and requirements construction they provide a broad and systematic range of research issues in SA&D (see Alter and Browne, 2005).

Bajaj et al (2005) outline the characteristics of the gap between teaching and research in systems analysis and design. They provide possible factors that contribute to that. Then they proceed to discuss how the IS research framework proposed by Hevner et al (2004) applies to Systems Analysis and Design. According to them:

> "SA&D touches on several areas of the IS research framework….. In the knowledge base section, SA&D

contributes by providing the models used to represent requirements and systems, and the methodologies used to develop systems drawing from several theories such as cognitive theories, frameworks…and ontologies …. In the IS Research Section, the framework identifies artifacts as a product of IS research, where artifacts can range from initial system requirements, to formal representations of systems, and to actual software. SA&D feeds the knowledge base via the creation of several IS artifacts. SA&D research can employ various research strategies such as laboratory experiments, field study, case study, action research, simulation, and analytical methods. SA&D also touches the Environment section given that SA&D research can be done in an organizational environment and incorporates the effects of personal or organizational characteristics." (Bajaj et al. (2005:481).

Bajaj et al (2005) provide as an example of design science research the task of evaluation of a conceptual model using modeling grammars like class diagrams, entity relationship diagrams or use case diagrams. Among the emerging research areas in SA&D they include the identification of a balanced approach between discipline and agility in software development. They provide guidelines for research in the existing modeling approaches that is extended into the area of distributed software development environments. They proceed with an analysis of the gap between teaching and research in Systems Analysis and Design and provide at the end an illustration on how research and teaching can be integrated in several topics of the SA&D curriculum.

We agree fully with the research directions on using the Work System Method provided by Alter and Browne (2005). At the same time we feel that it is possible to formulate further complementary possibilities for investigations related to the Work System Method and SA&D along the framework for SA&D research by Bajaj et al (2005) as presented in the next section.

4. POSSIBLE RESEARCH DIRECTIONS RELATED TO THE INCORPORATION OF WORK SYSTEM METHOD IN SYSTEMS ANALYSIS AND DESIGN

Our suggestions are framed following the conceptual model for IS research and design science research according to Hevner et al (2004) and Bajaj et al. (2005).

On SA&D and the WSM as part of the knowledge base of IS research

Further work is needed *on identification of the philosophical base* of the Work System Method since currently very little is known about it apart from certain link between it and pragmatism as suggested by Alter (2007a) and Alter (2006c). Another possible direction for investigation is *whether the WSM can embrace more fully systems concepts* (see on the latter Bertalanffy, 1962). According to Alter (2007a), evaluation of WSM in relation to general systems theory is all the more difficult because WSM was not developed as an application of general systems theory but as a set of ideas and tools that business professionals can use when trying to understand and analyze systems from a business viewpoint. Alter (2007a) provides as an answer to this question a challenging reply in the form of "weak maybe". There is a scope for further work on showing that *systems concepts incorporated in the WSM provide practical benefits to IS researchers* along the research directions suggested in Alter (2004b) and distinguish the role of the WSM in the knowledge base of Information Systems as a discipline.

There are only few publications on Sysperanto (see Alter, 2005 and 2006c) as ontology in applying the work system method. It is an open issue to *investigate both the theoretical and practical value of Sysperanto compared to other ontologies suggested in the IS research literature* like that by Wand and Weber (2002) and others.

The work system concept is used also in the socio-technical systems field and in other strands of IS research. To the best of our knowledge there is *a need for an analysis of any differences between the way how the* notion of "work system" is used by Alter and those researchers working in other areas of IS or between notions like work system and "human activity system" (see Checkland, 1999) *or purposeful systems* as used in other systems thinking sources.

Another fundamental issue mentioned earlier in the paper is *whether the work system should replace the IT artifact* as the focus of IS research as argued by Alter (2003). The finer details on how that notion is used in practice require a broader discussion as demonstrated by the debate in Jasperson et al (2005) and Alter (2006a).

Alter (2008) provides an interesting perspective on service system fundamentals and his ideas on how the work system framework, the work system snapshot and the service value chain framework can be applied to service system management. That can *stimulate comparative analysis with other frameworks explaining service systems and more practical implementation case studies on the relevance of the service value chain framework.*

On the interplay of SA&D and the WSM as part of the body of IS research methods in the conceptual model for Design Science Research suggested by Hevner et al. (2004)

The main artifacts that the work system method provides to IS research are the work system framework and the work system life cycle. We have mentioned above the limited previous publications on the applicability of work system ideas in Information Systems research or teaching like the cases described by Ramiller (2005) and Alter (2006c) or the field experiment discussed in Petkov and Petkova (2008). There is a *need to provide evidence from further case studies, laboratory experiments and field experiments on the applicability of the WSM in the teaching of SA&D and in conducting research in SA&D.* Introducing WSM ideas in the teaching of SA&D requires changes in the way how SA&D is taught at undergraduate level, in postgraduate courses and in professional development courses. There is also a need to *investigate how the WSM is taught already at universities and to disseminate the*

experience with it to a wider audience of IS educators through conference and journal papers along other concerns about SA&D research and teaching as communicated in Bajaj et al. (2005)*.*

WSM is suitable as an analysis tool for business professionals, "most of whom require direct guidance from consultants or IT professionals when trying to understand formal documentation produced through IT tools such as CASE (computer-aided software engineering) and Unified Modeling Language (UML) tools". He continues with the claim that "Service responsibility tables may provide a link between the less-formal analysis that is appropriate for business professionals and the highly formal, high-precision analysis and documentation that is desirable for programming" (Alter, 2007b:84). Further *research on the combined use of WSM and tools and methodologies like UML* may be a promising way for improving the success rate in implementing information systems.

An open *issue is the utility of the main artifacts of the WSM* (described briefly in section two) *to practicing information systems developers with respect to improving their understanding of the work system and the systems analysis tasks and their potential in providing a balance between agility and discipline in IS development* (see Boehm and Turner, 2004), along the suggested research directions in Bajaj et al. (2005).

On SA&D and the WSM and their role for analyzing the IS environment

Alter (2003; 2006c) points that the practical reasons for developing the work system ideas were associated with the needs to provide clients with a better way to express their understanding of their work environment and IS requirements. Alter (2006b) has demonstrated the pitfalls associated with poor expression of those issues. Alter and Browne (2005) show how the WSM can be applied for investigating the IS environment which they justify with many published accounts of under-performing information systems.

As is indicated in Iivari et al. (2005) and Bajaj et al (2005), the investigation of

people, organizations and technologies are central to SA&D. Hence we may conclude that *more analytical and case study work on the integration of the WSM in SA&D for the analysis of the environment of information systems development may contribute to higher rate of IS success.*

5. CONCLUSION

We set out to identify possible research directions for incorporating work system method (Alter, 2002a) in systems analysis and design. These research directions are further extensions to what has been previously proposed by Alter and Browne (2005) and Alter (2006c), and are along the lines recommended by Bajaj et al (2005). Our suggestions are framed following the conceptual model for IS research and design science research following Hevner et al (2004) and Bajaj et al. (2005). We identify the following possible areas of research:

- Identification of the philosophical base of the Work System Method.
- Investigation into whether the WSM can embrace more fully systems concepts.
- Investigate both the theoretical and practical value of Sysperanto compared to other ontologies suggested in the IS research literature.
- Analysis of any differences between the way how "work system" is used by Alter and those researchers working in other areas of IS or between notions like work system and "human activity system".
- Developing a broader discussion on whether the work system should replace the IT artifact as the focus of IS research as argued by Alter (2002b, 2003 and 2006a).
- Investigation into the applicability of WSM for service systems.
- Provide evidence on the applicability of the WSM in the practicing and teaching of SA&D through case studies, laboratory experiments and field experiments.
- Establish the utility of the main artifacts of the WSM mentioned above to practicing information systems developers with respect to improving their understanding of the

work system and the systems analysis tasks and their potential in providing a balance between agility and discipline in IS development, along the suggested research directions in Bajaj et al. (2005).

We may conclude that the Work System Method (Alter, 2006c) is an important theoretical development that emerged within the IS discipline. The emerging research on it indicates its potential to contribute both to the relevance and rigor aspects of IS research. We hope that our suggestions may enrich future theoretical and practical work in incorporating WSM concepts in the practice and teaching of Systems Analysis and Design.

Acknowledgement

REFERENCES

Alter, S. (2002a). The Work System Model and Its Role for Understanding Information Systems and Information Systems Research, *Communications of the Association for Information Systems*, 9, 90-104.

Alter, S. (2002b). Sidestepping the IT artifact, scrapping the IS silo and laying claim to "systems in organizations". *Communications of the Association for Information Systems,* 12, 494-526.

Alter, S. (2003). 18 Reasons Why IT-Reliant Work Systems Should Replace 'The IT Artifact' as the Core Subject Matter of the IS Field, *Communications of the Association for Information Systems*, 12(23), 365-394.

Alter, S. (2004a). A Work System View of DSS in its Fourth Decade, Decision *Support Systems,* 38(3), December, 319-327.

Alter, S. (2004b). Desperately Seeking Systems Thinking in the Information Systems Discipline, *Proceedings of Twenty Fifth ICIS Conference. December*, 2004, 757-769.

Alter, S. (2005). Architecture of sysperanto – a model based ontology of the IS field. *Communications of the Association for Information Systems*, 15(1), 1-40.

Alter, S. (2006a). Work Systems and IT Artifacts: Does the Definition Matter? *Communications of the Association for Information Systems*, 17(14), 299-313.

Alter s. (2006b). Pitfalls in analyzing systems in organizations, *Journal of Information Systems Education,* 17(3), 295-303

Alter, S. (2006c). *The Work System Method: Connecting People, Processes, and IT for Business Results*, Larkspur, CA: Work System Press.

Alter, S. (2007a). Could the Work system Method Embrace systems concepts More Fully? *Information Resource Management Journal*, 20(2), 33-43.

Alter, S. (2007b). Service system fundamentals: Work system, value chain, and life cycle. *IBM systems journal*, 47(1).

Alter, S. and Browne, G. (2005). A Broad View of Systems Analysis and Design: Implications for Research, *Communications of the Association for Information Systems*, 16(50), 981-999.

Bajaj, A., Batra, D., Hevner, A., Parsons, J. and Siau, K. (2005). Systems Analysis and Design: Should We Be Researching What We Teach?, Communications *of the Association for Information Systems*, 15,478-493.

Bertalanffy, L. von (1962). General Systems Theory - A Critical Review. *General Systems* 7, 1-20.

Boehm, B. & Turner R. (2004). *Balancing agility and discipline - a guide for the perplexed*. Addison –Wesley, Boston.

Casey, D. & Brugha, C, (2005). From fighting fires to building bridges: the role of metaphor in systems requirements, *Proceedings International Professional Communication Conference, 2005. IPCC*

2005. available at http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?arnumber=1494256

Checkland, P. (1999). *Systems thinking, systems practice*. Wiley, Chichester.

Cox, S., Dulfer R., Han D., Ruiz U., Alter, S. (2002). TDG Engineering: do we need really another upgrade? *Communications of the Association for Information Systems* (8), 232-250

Harris A. L, Lang, M., Oates B., Siau, K. (2006). Systems Analysis & Design: An Essential Part of IS Education, *Journal of Information Systems Education;* Fall 2006; 17, 3; 241-248.

Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design Science in Information Systems Research. *MIS Quarterly*, 28(1), 75-105

Hirschheim, R. & Klein, H.K. (2003). Crisis in the IS field? A critical reflection on the state of the discipline. *Journal of the Association of Information Systems*, 4(5), 237-293.

Iivari, J., Hirschheim, R. & Klein, H. (2004). Towards a Distinctive Body of Knowledge for Information Systems Experts: Coding ISD Process Knowledge in Two IS Journals., *Information Systems Journal*, 14, 313-342.

Iivari, J., Parsons, J. and Hevner, A. R. (2005). Research in Information Systems Analysis and Design: Introduction to the Special Theme Papers, *Communications of the Association for Information Systems*, 16, 810-813.

Jasperson, J., Carter, P.E. and Zmud, R.W. (2005). A Comprehensive Conceptualization of Post-Adoptive Behaviors Associated with Information Technology Enabled Work Systems, *MIS Quarterly*, 29(3), September, 525-557.

Korpela, M, Mursu, A, Soriyan, A, Eerola, A, Häkkinen, H, Toivanen, M. (2004). Information systems research and development by activity analysis and development: dead horse or the next wave? In: Kaplan B., Truex III, D.P.,

Wastell, D., Wood-Harper, A.T., DeGross, J.I.,(eds.) *Information Systems Research. Relevant Theory and Informed Practice.* p. 453-471. Kluwer Academic Publishers, Boston.

Mora, M., Gelman, O., Forgionne, G., Petkov, D. and Cano, J. (2007). Integrating the fragmented pieces in IS research paradigms and frameworks – a systems approach, *Information Resource Management Journal*, 20(2), April –June, 1-22.

Mora, M., Gelman O., Frank M., Paradice, D., Cervantes, F., Forgionne, G.A. (2008). Towards an Interdisciplinary engineering and Management of Complex IT Intensive Organizational Systems: a Systems View, *International Journal on Information Technologies and the Systems Approach*, 1(1), 1-24.

Petersson, J (2005). Aren't the fundamental concepts of work systems about actions?*, Fifth Conference for the Promotion of Research in IT at New Universities and University Colleges in Sweden*, 11-13 May, 2005, Borlänge, available at: http://www.ida.liu.se/~gorgo/div/JohanP.pdf

Petkov, D., Edgar-Nevill, D., Madachy, R. and O'Connor, R. (2008), Information systems, software engineering and Systems thinking – challenges and opportunities, *International Journal on Information Technologies and the Systems Approach*, 1(1), 62-78.

Petkov, D. and Petkova, O. (2008). The Work System Model As A Tool For Understanding The Problem In An Introductory Is Project*, Information Systems Education Journal*, 6 (21).

Ramiller, N.C. (2005). Animating The Concept Of Business Process In The Core Course In Information Systems, *Journal of Informatics Education Research*, 3(2).

Siau, K., Sheng H. and Nah, F. (2004). The Value of Mobile Commerce to Customers, *Proceedings Pre ICIS SIGCHI Symposium,* available at: http://sigs.aisnet.org/sighci/

Silver, M, Markus, M.L, and Beath, C. (1995). The Information Technology Interaction Model: A Foundation For The MBA Core Course, *MIS Quarterly*, 19(3), 361-390.

Wand, Y. and R. Weber (2002). Research Commentary: Information Systems and Conceptual Modeling – A Research Agenda. *Information Systems Research*, 13(4), December, 363-376.