Chapter 1

Introduction

1.1 Motivation

Much of what have gone into the research and writing of "*REALSpace AKE: An Appreciative Knowledge Environment Architected through Soft Systems Methodology and Scenario-Based Design*" represents stories of personal growth in the related disciplines of software engineering, software engineering education, and scholarship of teaching and learning. Indeed this growth comes from an assembly of creative thoughts and approaches developed by practitioners and academics. Yet, I have modestly placed others' and my ideas on a framework original enough to serve as the foundation of my contributions in the related areas of interest, namely, software engineering requirements analysis and system design through rationale management. In this thesis, I have chosen to tell the story of my academic efforts, spent to understand the role of soft systems methodology (SSM) (Checkland & Scholes, 1999) in contributing to the scenario-based requirements modeling and analysis of the *REALSpace* (Vat, 2009) denoting the electronic Space for a Rich Environment for Active Learning. Particularly, I am interested in how innovative pedagogic and engineering designs could leverage today's Web technologies in facilitating active learning and knowledge sharing in the *REALSpace*, characterized as a learning-centered educational environment. I shall discuss the important context of a school that learns, known as the

professional learning community (PLC) (Dufour & Eaker, 1998), which is an instance of the learning organization (LO) (Senge, 1990), and introduce the architectural development of a knowledge environment characterized as 'appreciative' based on the established paradigm of appreciative inquiry (AI) (Cooperrider, 1986). This appreciative knowledge environment (AKE) designed as a constituent of *REALSpace* comprising different information systems (IS) services, collectively known as the learning organization information systems (LOIS), is intended to support the various activities of college teaching and learning. The particular LOIS subsystem supporting knowledge work is constituted by organizational processes involving the respective knowledge work. To help realize the LO model for the AKE, the thesis explicates on an organizational modeling and analysis method tailored from soft systems methodology (SSM), to produce the peculiar organizational models for *REALSpace* and the AKE, as the basis for the subsequent electronic transformation to Web-enable various organizational activities, based on the essential concerns of the stakeholders for different organizational scenarios. The discussion deliberates on the software engineer's tasks in modeling different user and systems requirements and in prototyping suitable IS services for various knowledge work related to undergraduate education. In the subsequent discussion of my thesis, rich pictures will be used to illustrate any point of interest, especially as a mechanism for visualizing, specifying, and documenting software systems and the organizational systems being served.

1.2 The Situation of Concerns

The term *software engineering* was coined in 1968 as a response to the desolate state of the art of developing quality software on time and within budget (Naur & Randell, 1969; Bruegge & Dutoit, 2004). Software developers were then not able to set concrete objectives, predict the resources necessary to attain those objectives, and manage the customers' expectations. Today, after more than forty years of accrued experience in the field, software engineering is largely recognized as the process of solving customers' problems by the systematic development and evolution of large, high-quality software systems within cost, time and other constraints (Lethbridge & Laganiere, 2005, p.6). Yet, the challenge of building and delivering useful software systems on time within budget has been characterized by two words: complexity and change. To remain useful, software systems need to evolve with the users' need and the target environment. Oftentimes, software engineers are faced with ill-defined problems and partial solutions, and have to rely on empirical methods to evaluate solutions (Moran & Carroll, 1996; Brooks, 1995; Neumann, 1995; Popper, 1992). Indeed, software systems are complex creations: they perform many functions; they are built to achieve many different, and often conflicting, objectives. They comprise many components; many of their components are custom made and complex themselves. Their requirements are complex: they need to be updated when errors are discovered and when the developers have a better understanding of the application.

1.2.1 Themes of Software Engineering

More importantly, through the hard work of Tomayko and Hazzan (2004, pp.113-124) and Bruegge and Dutoit (2004, pp.5-10), software engineering, is also recognized as a multi-faceted discipline still in its youth and evolution. In the context of this thesis research, software engineering as a multi-faceted discipline, is perceived as a modeling activity, as a problem-solving activity, as a knowledge acquisition activity, and as a rationale-driven activity:

- *Software engineering is a modeling activity*: Software engineers deal with complexity through modeling, by focusing at any one time on only the relevant details. In the course of development, software engineers build many different models of the system and of the application domain.
- *Software engineering is a problem-solving activity*: Models are used to search for an acceptable solution. This search is driven by experimentation. Software engineers do not have infinite resources and are constrained by budget and deadlines. Given the lack of a fundamental theory as in natural sciences, they often have to rely on empirical methods to evaluate the benefits of different alternatives.
- *Software engineering is a knowledge acquisition activity*: In modeling the application and solution domain, software engineers collect data, organize it into information, and formalize it into knowledge. This process of knowledge acquisition is not sequential

as a single piece of additional data can invalidate earlier modeling efforts.

- *Software engineering is a rationale-driven activity*: When acquiring knowledge and making decisions about the system or its application domain, software engineers also need to capture the context in which decisions were made and the rationale behind the decisions. Rationale information, represented as a set of issue models enables software engineers to understand the implication of a proposed change when revising a decision.

In the context of my thesis research and writing, I have tried to make explicit the above multi-faceted implicit activities of software engineering when they are applied to investigate the domain of learning-centered higher education, exploring the requirements behind the *REALSpace AKE* environment, whose aspiration is described as follows, from a teacher-researcher's perspective in the area of software engineering education:

1.2.2 Background of Thesis Research

In universities and colleges sailing into the 21st century of the knowledge economy, the essence of teaching quality can occasionally feel overwhelming. To achieve excellence in teaching as an institute, or to become a good teacher as an individual, it is convinced that we first need to understand our students' experiences of learning. To improve our teaching, we need to apply evidence from research into student learning.

It is technically difficult to arrive at any right answer to the question of how to teach students better. My experience as a teacher in the past 18 years shows there are solutions that may work better or worse for each individual teacher, each department, each university and each group of students. The motivation behind my conceiving the *REALSpace* is to help teachers and students find their own way through reason combined with intuition, in the context of designing suitable technology-enhanced learning experiences as user-participants of a virtual learning and knowledge environment. The basic premise of my exploration is that we can improve our teaching by studying our students' learning. And by the word 'learning', I mean to render the opportunities and possibilities to change the ways in which students understand, or experience, or conceptualize the world around them, including the concepts and methods that are characteristic of the field of learning in which they are studying. Accordingly, the vital competences in academic disciplines and the application of knowledge lie in understanding. By understanding, I mean the way in which students apprehend and discern phenomena related to the subject in a way that is helpful for solving real problems. Learning that involves a change in understanding implies and includes a facility with a subject's techniques and an ability to remember its details. These skills become embedded in our knowledge during the slow process of changing our understanding of a topic, as anyone who will reflect on their own learning will recognize. In university education, the idea of learning lies in a qualitative change in a person's view of reality: facts and skills are by no means the opposite of understanding, but they are of little use

without it. Thereby, the aim of teaching is to make student learning possible. Our teaching should involve attempts to change students' understanding so that they begin to conceptualize phenomena and ideas in the way we as academics want them to understand. The design philosophy of *REALSpace* is to help improve university teaching through encouraging academic staff to reason about what they do and why they do it. The key rests on the proposition that higher education will benefit if those who teach inquire into the effects of their activities on their students' learning. To teach is to make an assumption about what and how the student learns; therefore, to teach well implies learning about students' learning. Good teaching involves striving continually to learn about students' understanding and the effects of teaching on it. Thereby, changes in how we think about and experience teaching are crucial to improvements in higher education. Yet, improving the quality of teaching requires intervention at several different levels of the enterprise of higher education. The level of the individual academic is an important point of influence, but it is not the only one. To achieve change in the quality of teaching and learning, we ought to look carefully at the environment in and with which a teacher works and the system of ideas which that environment represents. This means an emphasis on teams, curricula, courses and departments, as well as on individual academics. The highest point of intervention is the institution itself. What understanding of teaching is evident in its public statements and its internal procedures? To what extent does it vigorously promote teaching that will lead to learning of high quality? A distinctive characteristic of professionals is

that they retain theoretical and empirical knowledge on which to base their activities. Teaching includes the aims of a course, the methods of presenting the knowledge those aims embody, assessing students' achievement and evaluating the effectiveness of the whole process. Indeed, changing students' approaches to the subject matter they learn is the key to improving their learning: in turn, the key to improving teaching is changing the way in which the process is understood by its practitioners. Professional teachers in higher education should never lose sight of the primacy of their goals for student learning; they listen to and learn from their students; they constantly evaluate their own performance. They understand that teaching is about making it possible for students to learn; they succeed in integrating educational theory and shrewd classroom knowledge. In the context of my thesis research in software engineering, this brief discussion on the situation of concerns provides an essential problem space to direct my rationale-driven design of suitable IS services in *REALSpace* to enhance the scholarship of teaching and learning in higher education.

1.3 Research Context

If software engineering could be conceived as a multi-faceted discipline covering such activities as modeling, problem-solving, knowledge acquisition, and rationale management (Bruegge & Dutoit, 2004), then the research context behind the investigation of *REALSpace* and its AKE environment, could also be conceived in terms of such activities. Indeed, the implicit contributions of Soft Systems Methodology (SSM)

(Checkland & Poulter, 2010, 2006), to be made explicit in the body of this thesis, are quite consistent with the theme of these software engineering activities (see Chapter 6 of this thesis): namely, it is a modeling activity, capable of being a generic problem solving technique, intended to acquire knowledge of the problem situation, with the aim to improve the same through rendering some systemically feasible and culturally desirable means, based on rationale-driven discussion of the issues involved.

1.3.1 Modeling

Modeling is widely considered as one of the basic methods of scientific inquiry. A model is an abstract representation of a system that enables us to answer questions about the system (say, a real-world phenomenon). In fact, models are useful when dealing with systems that are too large (solar system), too small (a system of atoms), or too complicated (a society of human beings). Models allow us to visualize and understand systems that either too expensive to experience firsthand, or that are only claimed to exist. Traditionally, a distinction is made between natural sciences and social sciences to distinguish between two major types of systems: the former is to understand nature and its sub-systems, while the latter is to understand human beings. Herbert Simon (1970) coined the term *sciences of the artificial* to describe the sciences that deal with artificial systems (man-made systems): Whereas natural and social sciences have been around for centuries, the sciences of the artificial are recent: for example, the science of understanding computer systems

(computer science) is an example of the sciences of the artificial. In practice, systems modeling deals with two types of entities: the real-world system, observed in terms of a set of phenomena, and the application domain model, represented as a set of interdependent concepts, describing those aspects of the real-world system that are relevant to the problem under consideration. In the context of software engineering, software engineers need to understand the environment (the domain) in which the software system has to operate. For example, a train traffic control system requires of the software engineers to know train signaling procedures, whereas a stock trading system, the trading rules. In either case, the software engineers do not need to become an expert in the specific domain of interest, but they need to learn the application domain concepts that are relevant to the system. In other terms, they need to learn enough to build a model of the application domain. So, modeling could actually be conceived as a process of inquiry to gather enough knowledge so as to construct the necessary systems model(s) under consideration.

1.3.2 Problem Solving

Problem-solving is an engineering activity. On identifying a problem, engineers search for an appropriate solution, often by trial and error, evaluating alternatives empirically, with limited resources and incomplete knowledge. In its simplest form, the engineering method of problem solving includes five steps (Hitchins, 2007; Wilson, 1990):

1. Formulate the problem
2. Analyze the problem
3. Search for solutions
4. Decide on the appropriate solution
5. Specify the solution

In this light, software engineering is an engineering activity: it is not always algorithmic, requiring experimentation, the plausible reuse of pattern solutions, and often the incremental evolution of the system toward a solution that is acceptable to the client(s). In the context of object-oriented software development (Bruegge & Dutoit, 2004; Lethbridge & Laganiere, 2005; Sigfried, 1996; Jacobson, Christerson, Jonsson, & Overgaard, 1992), the software engineering development activities typically include: requirements elicitation, analysis, system design, object design, and implementation. During requirements elicitation and analysis, software engineers formulate the problem with the client and build the application domain model. Requirements elicitation and analysis correspond to steps 1 and 2 of the engineering method above. During system design, software engineers analyze the problem, break it down into smaller pieces, and select general strategies for designing the system. During object design, software engineers select detail solutions for each piece and decide on the most appropriate solution. System design and object design result in the solution domain model. System design and object design correspond to steps 3 and 4 of the engineering method. During implementation, software engineers

realize the system by translating the solution domain model into an executable representation. Implementation corresponds to step 5 of the engineering method. Yet, what makes software engineering different from problem solving in other sciences or engineering disciplines (mechanical or civil) is that often change occurs in the application and the solution domain while the problem is being solved. Indeed, it is the intention of this thesis to make explicit that software development should include activities whose purpose is to evaluate the appropriateness of the respective models created to understand the problems at hand. This is done through making explicit the implicit contributions of SSM during analysis and design reviews, to compare the application domain model and the solution domain model with the client's reality, which in turn might change as a result of modeling based on crafting specific organizational scenarios of purposeful human activities.

1.3.3 Knowledge Acquisition

Knowledge acquisition is an inquiry-based activity installed to acquire knowledge needed to accomplish a specific goal in system development, such as to develop a system model (Milton, 2007). It is largely not a linear process, in a sense that in any inquiry efforts (e.g., requirements analysis), the addition of a new piece of information may invalidate all the knowledge we have acquired for the understanding of a system. It is understood in requirements management that even if we had already secured such an understanding in documents and code, we must be mentally prepared to start from scratch. This has important implications

on the set of activities and their interactions we define to develop the software systems. For example, issue-based development attempts to remove the linearity effect by identifying any yet-to-be-resolved issues in any development activity (analysis, design, and implementation) which can influence any other activity, since they are often executed in parallel. Yet, the difficulty with such a non-sequential development model remains: namely, it is quite difficult to manage.

1.3.4 Rationale Management

Rationale management is an important activity in software engineering (Burge, Carroll, McCall, & Mistrik, 2008; Dutoit, McCall, Mistrik, & Paech, 2006). A rationale is the justification of decisions. Given a decision, its rationale includes the problem that it addresses, the alternatives that developers considered, the criteria that developers used to evaluate the alternatives, the debate developers went through to achieve consensus, and the decision. Rationale is the most important information developers need when changing the system. If a criterion changes, developers can re-evaluate all decisions that depend on this criterion. If a new alternative becomes available, it can be compared with all the other alternatives that were already evaluated. If a decision is questioned, they can recover its rationale to justify it. However, rationale is also the most complex information developers deal with during development, and thus, the most difficult to update and maintain. To deal with this challenge, the contributions from Soft Systems Methodology (SSM) capture rationale in the form of root definitions and conceptual

models, as well as some form of rational discussion leading to systemically feasible and cultural desirable change for system development. It is argued that without SSM, when asked to explain a decision, developers may have to spend a substantial amount of time recovering its rationale. In order to deal with changing systems, it is convinced that software engineers must address the challenges of capturing and accessing rationale. With SSM, the organizational modeling and analysis efforts could help meet this challenge by producing rationales in the form of organizational models as the basis to justify any computing-oriented decisions.

1.4 Research Problem

The problem statement to formulate my thesis is developed from the research theme as follows: *REALSpace AKE: An Appreciative Knowledge Environment Architected through Soft Systems Methodology and Scenario-Based Design*. Namely, I am going to discuss a scenario-based approach to conceive (analyze, design and prototype) an appreciative knowledge environment (AKE) named under *REALSpace* for some target participants (users) referred to as professional learning communities (PLC). And I am to present my work from the perspective of soft systems methodology (SSM). To use the terms of Software Engineering, the requirements analysis and system design of *REALSpace* is based on a series of scenario-based modeling activities to put into perspective the user requirements and feedback of user experience. The models derived are intended as ways of thinking about reality. In particular, modeling is

considered as an intellectual construct based on the concept that all individuals (students, teachers, and educational executives) within organized groups (in an institute of higher education) are acting to try to achieve some purpose (though not necessarily the same purpose, such as teaching, learning, researching, collaborating, and managing). Thereby, useful models can be derived that characterize purposeful human activities based on which the analysis and design of *REALSpace* could be performed. More precisely, different models should represent a description of what has to be done (as a set of interlinked services) to achieve some prescribed purpose. Accordingly, it is important to define the purpose to be achieved by the activities within the model. In the context of SSM, this is to define the root definition (RD) of *REALSpace*, as a way of trying to capture the essence (root) of the purpose to be served. The conceptual models (CMs) developed from RDs will contain not only the activities expressed through verbs in the imperative, but also the logical dependencies between activities. They have the characteristics of systems (Wilson, 1990), and are termed *Human Activity Systems* (HAS) in the thesis. This label is useful because it describes what the model is. It is a system of activities that could be undertaken by human operators. The important step in developing a concept of a HAS therefore is to select some purposes that are believed to be relevant to the real-world situation under investigation. Yet, constructing a definition of purpose, which is what the RD is seeking to, requires a particular structure. At its core, according to (Checkland & Scholes, 1999), a RD describes a transformation process, T, which is always explicit and is given by the

main verb of the RD. Another essential element in a RD is a variable often considered as a component of perception and denoted by the letter W with its origin from the German word Weltanschauung, which literally translates as ‘world view’. There has been much discussion of an academic nature concerning W and the various ways it has been, or might be, interpreted (Davis, 1989; Checkland & Davies, 1986) but perhaps the most practical way it can be introduced with a RD is as a belief that is associated with the words within the RD definition. It is a value judgment about the acceptability of the purpose as a real-world activity. To ensure a proper formulation of the concepts used within a RD, a mnemonic device developed by (Smyth & Checkland, 1976) has become handy and useful. It is called CATWOE, representing the following elements of interest in a root definition:

- T – Transformation process described either as an input-output conversion or the process itself
- W – Weltanschauung, practically interpreted as the statement of belief within the RD
- C – Customer, the recipient of the output of the transformation process
- A – Actors, individuals who would do the activities in the resultant conceptual model if they were to map onto reality
- O – Owner, a wider-system stakeholder with the authority over the system defined, with a concern for the performance of the system
- E – Environmental constraints external to the system defined, which are taken to be significant

The chosen intellectual construct for all SSM-driven analysis is to derive a properly formulated RD that is essential in the development of some purposeful activity models of HAS. One of the major functions of the CATWOE mnemonic is that, if used properly, it provides a mechanism for testing the RD and ensuring that the words chosen are as precise as possible and that they represent the best choice of meaning for representing user requirements and systems design. It is the RD that leads to the CM and against which it can be defended. The relationship between the RD and the CM is a being-doing pair: the former tells what the system is, whereas the latter tells what the system must do to be the one defined. Typically, the RD formulation process is driven by the situation of concerns and the total intellectual structure into which the RD/CM pair fit. In the context of *REALSpace*, the root definition, which constitutes the essence of the problem statement in the thesis research, is formulated as follows:

1.4.1 Root Definitions for *REALSpace*

One RD per system	*Definition*
HAS-01 with RD01 *REALSpace*	A university-owned system, operated by skilled professionals, which, under the initiative of learning-centered education (LCE), develops and maintains a virtual space of learning, called *REALSpace* (*R*ich *E*nvironment for *A*ctive *L*earning *Space*) for teachers and students, by applying Soft Systems Methodology (SSM) and using the virtual organizing strategy, in order to contribute to students' meaningful learning in relation to curriculum development, and the learning-teaching-assessing (LTA) processes of college education.
HAS-02 with RD02 *REALSpace AKE*	An appreciative knowledge environment (AKE), owned by the university, and operated by teachers, students, and administrators, which, under the LCE initiative, improves the quality of teaching by applying in the curriculum different effective educational practices such as learning communities, group-based project work and outcomes-based LTA, supported by various learning organization information systems (LOIS) services rendered available through *REALSpace*, in order to produce students' meaningful learning.
HAS-03 with RD03	A system, owned by the university, and operated by teachers, students,

REALSpace AKE(PLC)	and administrators, which, under the LCE initiative, nurtures, develops and facilitates learning communities, by using different AKE-based LOIS support rendered available through *REALSpace AKE* in order to induce student engagement in meaningful learning.
HAS-04 with RD04 *REALSpace AKE(GPW)*	A system, owned by the university, and operated by teachers, students, and administrators, which, under the LCE initiative, nurtures, develops, and facilitates group-based project work among students, by using different AKE-based LOIS support rendered available through *REALSpace AKE*, in order to enable students' achievement of intended learning outcomes
HAS-05 with RD05 *REALSpace AKE(LTA)*	A system, owned by the university, and operated by teachers, students, and administrators, which, under the LCE initiative, nurtures, develops and facilitates outcomes-based learning, teaching, and assessment (LTA) processes, by using different AKE-based LOIS support rendered available through *REALSpace AKE*, in order to produce evidences of students' meaningful learning through shaping and delivering a learning-centered college curriculum.

The specific CATWOE elements associated with the preceding RDs can be deliberated as follows:

Elements	*HAS-01*	*HAS-02*	*HAS-03*	*HAS-04*	*HAS-05*
C	Students and teachers	Students and teachers	Students and teachers	Students and teachers	Students and teachers
A	Teachers, students, and skilled professionals	Teachers, students, and administrators	Teachers, students, and administrators	Teachers, students, and administrators	Teachers, students, and administrators
T	Apply SSM and virtual organizing strategy	Apply different effective educational practices, such as learning communities, group-based project work, and outcomes-based assessment with LOIS support from *REALSpace*	Apply AKE-based LOIS support from *REALSpace*	Apply AKE-based LOIS support from *REALSpace*	Apply AKE-based LOIS support from *REALSpace*
W	*REALSpace*, developed through SSM and virtual organizing, can contribute to students' meaningful learning	Improved quality of teaching, in the form of different educational practices supported through the *REALSpace AKE*, can produce students' meaningful learning	Learning communities, supported through the *REALSpace AKE*, can induce student engagement in meaningful learning	Group-based project work, supported through the *REALSpace AKE*, can enable students' achievement of intended learning outcomes	Outcomes-based LTA processes, supported through the *REALSpace AKE*, can contribute to evidence-based learning for students
O	University	University	University	University	University

E	University culture and norms in curriculum development, and the LTA procedures	University culture and norms in curriculum development, and the LTA procedures	University culture and norms in curriculum development, and the LTA procedures	University culture and norms in curriculum development, and the LTA procedures	University culture and norms in curriculum development, and the LTA procedures

C for customers; A for actors; T for transformation; W for worldview;

O for owners; E for environmental constraints

1.4.2 Line of Defensible Logic

To produce a model as a representative description of an organizational unit (of whatever scale), it is necessary to describe its basic purpose; namely, what it is trying to achieve and also what it must be doing (in terms of its business processes) to be successful in realizing that purpose. Oftentimes, depending upon what is taken to be a statement of basic purpose, a particular set of business processes will be determined. A different set will be obtained for a different choice of purpose. Given the range of multiple concepts in the heads of people, there will be multiple views about the basic purpose and hence about necessary business processes. Indeed, it is often the case that when concerned with describing the real world of human activity, unique, valid and non-contentious descriptions of reality are not readily available. To make progress in analysis of this kind, it is necessary to make and to maintain a distinction between 'the real world', which is complex, messy and contains people, and the intellectual process of 'thinking about the real world', which can be simple, precise and defensible. Thereby, models (of any kind) are hereby rendered as not descriptions of the real world but as descriptions of ways of thinking about the real world. The research in this thesis can be defined as the issues that exist in the practice of HAS

modeling that become the concerns behind the domain-specific scenario-based analysis, systems design and prototyping for the *REALSpace*. In particular, the research investigation begins with the following root definition and CATWOE analysis generic enough to tackle the situation of concerns to be elaborated in the body of the thesis:

RD: A system owned by O and operated by A, to do P by Q in order to contribute to achieving R (i.e., requirements of C) within the constraints E.

CATWOE Elements:

T – to do P

W – doing Q will lead to the completion of P in order to achieve R

C – customers with requirements as the beneficiary of the transformation process

A – actors with the capability of doing the required activities

E – constraints under which the system is to operate

O – owner of the wider system

Namely, the modeling starts by installing the activities to do Q, and then by refining activities and allocating the same to A to ensure that these lead to the completion of P in meeting the requirements of C (i.e., the achievement of R), within the constraints of E, under the monitoring action of O.

1.5 Research Concerns

According to my discussion so far, I am yet to provide the background of

the terms used in the root definition for exploring *REALSpace*: professional learning community (PLC), appreciative knowledge environment (AKE), outcomes-based assessment (OBA), learning-centered education (LCE) and virtual organizing, to describe what connotations they are to contribute to my thesis research. Indeed, each of these terms represents an important concern to be elaborated in the research of *REALSpace*, and it is hereby debriefed as follows.

1.5.1 Professional Learning Community (PLC)

The idea behind the context of a professional learning community (PLC) is this: How can a school become a place where all members of the staff are learning, growing, and working to increase student achievement? In my investigation, the answer lies in two important practices: systems thinking and continuous improvement. Systems thinking involve understanding phenomena (mostly human endeavors) bound by invisible fabrics of interrelated actions that often take time to fully play out their effects on one another. Nonetheless, a system is often interpreted as a perceived whole whose elements hang together because they continually affect one another over time and operate toward a common purpose. Indeed, systems thinking considered as a conceptual framework, oriented to looking at the interrelatedness of forces, and seeing them as part of a common process, makes understandable the subtlest aspect of the school that learns – the shift of mind from seeing ourselves as separate from the world to connected to the world where people are continually discovering how they create their reality, and how they change it. Continuous

improvement, a mantra in the domain of education, simply means an unwavering commitment to progress. What are much more complex, however, is what the particular innovations should be, why they are necessary, and how they can be achieved. When continuous improvement becomes embedded in a system's culture, it functions as "the guiding force that keeps the schools on target in an uncompromising quest for quality at every corner of the campus" (Abbott, 1998, p.25). The experience of the shifts in thinking that are necessary to transform a school into a PLC could be modeled as a cycle of steps in continuous improvement, examples of which include: 1) Identify core beliefs; 2) Create a shared vision; 3) Use data to determine gaps between the current reality and the shared vision; 4) Identify the innovations that will most likely close the gaps; 5) Develop and implement an action plan; and 6) Endorse collective accountability. These issues represent relevant concerns in the analysis and design of *REALSpace*, in the process of requirements modeling and systems prototyping.

1.5.2 Appreciative Knowledge Environment (AKE)

In the context of this thesis research, the idea of AKE is based on the foundation of appreciative inquiry (AI) (Cooperrider, 1986), a well established paradigm of positive change in the field of organization development. This word "appreciative" is derived from its noun form of "appreciation" carrying with it the recognition of the quality, significance, or magnitude of people and things, and a judgment or opinion, especially a favorable one, as well as an expression of gratitude according to The

American Heritage Dictionary of the English Language, Fourth Edition. Therefore, appreciation is feeling validated for our opinion, our efforts, and the unique qualities we bring to bear on a situation. In appreciative inquiry, there is a deliberate action of selectivity and judgment. The inquirer is choosing to look at some stimuli intently and in the process see them more fully. Interestingly, when changing the way we perceive a new situation, we have the power to keep clear of the deficit thinking that is inherent in an organization, though the way we are trained mostly makes it easy to focus on the negative and what is not working in a situation. Yet, it may seem simple and obvious that people who appreciate one another in the workplace will have a better working relationship than those who have an adversarial relationship. To this end, the discussion presented in the thesis is organized around story-telling a community-centered approach of collaborative learning (Hemlin, Allwood, & Martin, 2004) in which developing a culture of appreciative knowledge sharing and creation from the perspective of appreciative inquiry, has the generative potential conducive to the enhancment of student learning.

1.5.3 Outcomes-Based Assessment (OBA)

The idea behind the context of outcomes-based assessment is the fundamental question, “What did the student learn?” It is closely related to the growing concerns about the quality of higher education. It is about building shared responsibility for student learning through some collaborative analysis of student works. It requires that faculty come together to determine what curricular and course outcomes should be. It

is important that teachers and students are part of an educational system in which each part affects the behaviors and properties of the whole. In coming together to contemplate their collective impact – something that most had previously been taken for granted, carried out privately, and seen little reason to improve, increasingly more faculty members have realized that much college teaching could have been improved by decades of research on human learning. In particular, we are aware today that students learn more if we set high expectations for them; engage them actively in their learning; provide opportunities for them to interact in connection with their work with faculty and with other students; and assess their progress often, providing timely feedback.

1.5.4 Learning-Centered Education (LCE)

The idea behind the context of learning-centered education is the fundamental question, "What do we know about learning that implicates teaching?" It focuses attention squarely on learning: namely, what the student is learning, how the student is learning, the conditions under which the student is learning, and how current learning positions the student for future learning. Despite the widespread interest in student learning today, few resources identify the things a teacher should do if instruction is to promote learning. We need resources that set out to teachers who want to promote learning what to do about attendance, assignments, tests, papers, lecturing, group work, classroom management, content, and grades. By learning-centered education, I mean to seek an answer to this question: What should teachers do in order to maximize

learning outcomes for their students? To make teaching more learning-centered, my efforts with *REALSpace* need to be investigated in the context of what is known and what others have experienced. When instruction is learning-centered, the spotlight moves from teacher to student; namely, the action focuses on what students (not teachers) are doing. This learning-centered orientation accepts, cultivates, and builds on the ultimate responsibility students have for learning. Teachers cannot do it for students. Teachers may set the stage, and help out during rehearsals, but then it is up to students to perform, and when they do learn, it is the student, not the teacher, who should receive accolades.

1.5.5 Virtual Organizing for Learning and Research University

The idea of virtual organizing, attributed to Venkatraman and Henderson (1998), can be considered as a method of operationalizing a professional learning community (PLC), dynamically assembling and disassembling nodes on a network of people or groups of people, to meet the demands of a particular learning context. This term emerged in response to the concept of virtual organization, which appeared in the literature around the late twentieth century (Byrne, Brandt, & Port 1993; Cheng 1996; Davidow, & Malone 1992; Goldman, Nagel, & Preiss 1995; Hedberg, Dahlgren, Hansson, & Olve 1997). There are two main assertions associated with virtual organizing. First, virtual organization should not be considered as a distinct structure such as a network organization in an extreme and far-reaching form (Jagers, Jansen, & Steenbakkers 1998), but virtuality is a strategic characteristic applicable to every organization.

Second, information technology (IT) is a powerful enabler of the critical requirements for effective virtual organizing. In practice, virtual organizing helps emphasize the ongoing process nature of the organization, and it presents a framework of achieving virtuality in terms of three distinct yet interdependent vectors: virtual encounter for organization-wide interactions, virtual sourcing for intellectual asset configuration, and virtual expertise for knowledge leverage. The challenge of virtual organizing is to integrate the three hitherto separate vectors into an interoperable IT platform that supports and shapes the new organizational initiative, paying attention to the internal consistency across the three vectors.

1.5.6 Significance in Software Engineering

The background of the problem statement indicates why I care to conduct this study in the context of software engineering. Nonetheless, it is important for the reader to know what is unique and different from previous research. Namely, the problem research in the selected domain must fulfill an indicated need for further advancement of previous research. In the context of *REALSpace* servicing, through the provision of an appreciative knowledge environment, the university as a professional learning community, which practices learning-centered education, with an emphasis on outcomes-based assessment, in order to produce student learning, requirements analysis of the organizational system(s) to be served, becomes foremost important before any system design and prototyping of the system to serve, could ever be conceived and realized.

Yet, the degree of variety in real-world problems is enormous, and it is helpful to see them as lying within a spectrum which extends from ‘hard’ to ‘soft’. There are a number of ways in which ‘hard’ and ‘soft’ can be defined but the definition adopted could be in terms of the degree of agreement about what the problem is among the particular population of individuals to whom the problem is of concern. Thereby, the design of a piece of software to meet a given specification is considered as a hard problem (as long as the specification is ‘a given’) whereas the specification of information and interaction requirements to meet organizational needs is considered as a soft problem particularly if the needs as specified by potential users are at odds with those required to support the organization. At the hard end of the problem spectrum, the specific methodology applicable to solve the problem, and attributed to conventional software systems engineering (SSE) (Checkland, 1999; Thayer, 2002), could include the following stages, with stages (2) and (3) involving possible iteration: 1) Define the problem; 2) Assemble the appropriate techniques; 3) Use techniques to derive possible solutions; 4) Select most suitable solution; 5) Implement the solution. At the soft end of the problem spectrum, the first of the above stages ‘Define the problem’ is itself problematic because it usually depends upon who defines it. Given that there will usually be a number of people concerned with or involved in the problem, there will be a number of legitimate definitions. Thus, soft systems methodology (SSM) (Checkland & Scholes, 1999) usually starts by defining, not a problem, but a situation that is problematic. And the methodology applicable to solve the soft

problem could include the following stages with stages (3), (4), and (5) involving possible iteration: 1) Define the situation that has provoked concerns; 2) Express the situation of concerns; 3) Select concepts that may be relevant; 4) Assemble concepts into an intellectual structure; 5) Use this structure to explore the situation; 6) Define changes to the situation (i.e., problems to be tackled or challenges to be explored); 7) Implement change processes. In SSE, the techniques comprise both the concepts and the structure, and they are typically well defined. In SSM, the concepts and the structure are independent and need to be specified separately. This may involve greater iteration around the stages indicated as progress is made in learning about the situation through such activities as modeling, problem solving, knowledge acquisition, and rationale management. Accordingly, it is the aim of this thesis to make explicit the implicit contributions of SSM to provide a flexible and customized approach to requirements analysis through organizational modeling, unique in its contextual inquiry, and adaptable into mainstream software engineering development activities, in the architecting of *REALSpace* and the AKE environment.

1.6 Research Methods

The research approach followed in this thesis comes close to action research (Koshy, 2005; Costello, 2003; Cunningham, 1993). The linking of the terms *action* and *research* highlights the essential feature of the method: trying out ideas in practice as a means of improvement and as a means of increasing knowledge (Kemmis & McTaggart, 1982). It is an

iterative research process involving my respective roles as teacher researcher and software practitioners acting together in a particular cycle of activities, including problem diagnoses, action intervention, and reflective learning. Many of today's software systems are perceived to be difficult to learn and awkward to use; they often change our activities in ways that we do not need or want. The problem lies in the software development method. Oftentimes, software designers have to face convoluted networks of trade-off and inter-dependence, the need to coordinate and integrate the contributions of many kinds of experts, and the potential of unintended impacts on people and their social institutions. It has been observed that traditional approaches to software development seek to control the complexity and fluidity of design through techniques that filters the information considered, and weakly decompose the problems to be solved. The main purpose of action research is to bring about an improvement in practice. It is a useful approach to associate research with practice and vice versa, because it is about taking action (participating in projects), and it is about reflection (analyzing and learning from action, as well as enhancing the next line of action using lessons learned).

1.6.1 Adopting Scenario-Based Design

In the context of interaction design, scenario-based design approach (Carroll, 1995; 2000) seeks to exploit the complexity and fluidity of design by trying to learn more about the concrete elements of the problem situation. A scenario is developed as a story about people carrying out an

activity, and a problem scenario is a story about the problem domain, as it exists prior to technology introduction. John Carroll characterizes scenarios as concrete stories about use through which software architects could envision and facilitate new ways of doing things and new things to do. Specifically, scenarios provide a vocabulary for coordinating the central tasks of systems development – understanding people's needs, envisioning new activities and technologies, designing effective systems and software, and drawing general lessons from systems as they are developed and used. Namely, scenarios help software designers analyze the various possibilities by focusing first on the human activities that need to be supported and allowing descriptions of those activities to drive the quest for relevant problem requirements. It is expected that through maintaining a continuous focus on situations of and consequences for human work and activities, software designers could become more informed of the problem domains, seeing usage situations from different perspectives, and managing trade-offs to reach usable and effective design outcomes (Carroll, 1994; 1995). Consequently, through the appropriate use of design scenarios, the problems of designing IS support for *REALSpace*, should never be thought of as something to be defined once and for all, and then implemented. Instead, scenarios evoke task-oriented reflection in design work. They make human activity the starting point and the standard for design work. They help designers identify and develop correct problem requirements, seeing their work as artifacts-in-use, and bearing in mind the external constraints in the design process.

1.6.2 Using Scenarios of Human Activity Systems

More importantly, software design for *REALSpace* must be based on the observation that all real-world organizational problem situations contain people interested in trying to take purposeful action. Pragmatically, the idea of a set of activities linked together so that the whole, as an entity called the human activity system (HAS) from the viewpoint of Soft Systems Methodology (SSM) (Checkland & Holwell, 1998; Checkland & Scholes, 1999) could pursue a purpose, could indeed be considered as a representative organizational scenario for architecting different IS support, which is never fixed once and for all. In practice, given a handful of the HAS models, namely, models of concepts of purposeful activity built from a declared point of view, we could create a coherent structure to debate about the problem situation and what might improve it (Checkland, Forbes, & Martin, 1990). Subsequently, from the software architect's point of view, while conceiving the necessary electronic support to serve the specific organizational knowledge requirements, the fundamental ideas could be integrated as follows: Always start from a careful account of the purposeful activity to be served by the system. From that, work out what informational support is required (by people) to carry out the activity. Treat the creation of that support as a collaborative effort between technical experts and those who truly understand the purposeful action served. Meanwhile, ensure that both system creation and system development and use are treated as opportunities for continuous learning. In this way, models of purposeful human activities

can be used as scenarios to initiate and structure sensible discussion about information or knowledge support for the people undertaking the real-world problem situations.

1.6.3 Sense-Making the Learning Cycle of HAS Modeling

Undeniably, setting up an organizational software system is a social act in itself, requiring some kind of concerted action by many different people; and the operation of *REALSpace* entails such human phenomena as attributing meaning to manipulated data and making judgments about what constitutes a relevant category. In this regard, the use of scenarios in the creation of IS support can be seen as a process which learns its way to the meanings which characterize an organizational context. This idea of learning the meanings, by which people sharing a human situation seek to make sense of it, is a significant feature of SSM (Checkland & Scholes, 1999). The important point is that we must not lose sight of the fact that the HAS models are not would-be descriptions of parts of the real world. Instead, they are abstract logical machines for pursuing a purpose, defined in terms of declared worldviews, which can generate insightful debate when set against actual would-be purposeful action in the real world. The implicit belief behind constructing the HAS models is that social reality – what counts as facts about the social world inside an organization – is the ever changing outcome of a social process in which human beings continually negotiate and re-negotiate, and so construct with others their perceptions and interpretations of the world outside themselves, and the dynamic rules for coping with it. Researching social

reality in the context of *REALSpace* development then becomes an organized discovery of how human agents make sense of their perceived worlds, and how those perceptions change over time and differ from one person or group to another. In the process, we do not expect to discover unchanging social laws to set alongside the laws of natural sciences. Rather, an organization is perceived as entailing readiness on the part of its members to conceptualize it and its internal and external relationships in a particular way, though it is also understood that such readiness changes through time, sometimes incrementally, sometimes in a revolutionary way, as perceptions and membership change.

1.6.4 Rationalizing the Scenario-Based Learning Approach

Thereby, the basic shape of the scenario-based learning approach could simply be described as follows: Find out about the problem situation that has provoked concern; Select relevant concepts that may be integrated into different human activity systems; Create HAS models from the relevant accounts of purposeful activity; Use the models to question the real-world situation in a comparison phase. The debate initiated by the comparison normally entails the findings of accommodations between conflicting interests, that is to say, situations that may not satisfy everyone, but could still be lived with, enabling action to be taken. Oftentimes, the purpose of the debate is to collectively learn a way to possible changes (improvements) to the problem situations, by activating in the people involved, a learning cycle, which counts on their ability to articulate problems, to engage in collaboration, to appreciate multiple

perspectives, to evaluate and to actively use their knowledge. It is worthwhile to notice that taking the purposeful action would itself change the situation, so that the whole cycle could begin again, and is in principle never ending. Likewise, through scenarios, software architects could provide help in articulating the requirements of specific *REALSpace* support through operating the learning cycle from meanings to intentions to purposeful action among the specific group of organizational members.

1.7 Research Goals and Challenges

There are a number of goals and challenges this thesis is expected to meet and to manage in the related areas of software engineering: namely, rationale-driven requirements modeling in scenario-based analysis and design of user-centered application development. To put my research efforts in perspective, it is not difficult to perceive that architecting software support for knowledge work in *REALSpace* is not an easy or routine kind of problem solving. My major lessons learned include the following: Firstly, there is often an incomplete description of the problem to be addressed, but it is always necessary to identify the relevant description of the current situation that is to be altered by the design work. Secondly, the problem space of allowable and possible moves is often not determined beforehand. In fact, there is often no guidance on possible design moves in reasoning from a description of the current situation toward an improved version of the situation. Thirdly, design problems themselves characteristically involve many trade-offs; any

move creates side effects, such as impacts on human activities. Fourthly, design requires many kinds of knowledge and skill; it typically requires collaboration, problem decomposition, and a lot of management. Accordingly, the challenges and goals to share in the analysis and design for *REALSpace* (Carroll, 1995; 2000) include: clarifying the problem, identifying design moves, envisioning the solution, recognizing trade-offs and dependencies, integrating diverse knowledge and skill, and anticipating impacts on human activity.

1.7.1 Clarifying the Problem

This is the first step in design problem solving: What is wrong with the current state of affairs? What is needed? What could be improved? The standard approach in software development is to carry out some sort of requirements analysis. This analysis may initially be couched as a fairly high-level statement provided by the client – the person or organization that commissioned the design work. Such a statement may also be developed by, in collaboration with, or from observation of prospective users of the system to be developed; or it may be based on the hunches of the designers. Nonetheless, this initial requirements statement must be successively elaborated and refined to obtain a precise description of the situation that highlights the specific needs that the design work will address.

1.7.2 Identifying Design Moves

To the extent that a design problem can be clarified, we need to move

toward a solution. Typically, we do not know what specific moves are possible or useful a priori; part of the creativity of design is discovering the relevance and effectiveness of a move that has not been tried before. But this is obviously difficult. Much work on design methods has focused on describing what are sometimes called weak decomposition. The basic strategy is to organize an overall design problem into a set of component sub-problems, each simpler than the original problem. This process is re-iterated until the sub-problems are easily solvable, namely, as examples of known problems with known solutions. Nevertheless, starting design work with weak decomposition tends to simplify problems in ways that implicitly discourage creative solutions, bearing in mind that requirements typically change through the course of design work. Through the experience of *REALSpace*, an actively synthetic design method of planning by doing that is complementary to the analytic techniques of problem structuring and decomposition is experimented. Designers, nonetheless, might want to make provisional design moves within a concrete design space, explore and develop requirements, and test the consequences of such moves before committing to them.

1.7.3 Envisioning the Solution

The objective in design is to specify a solution that satisfies the needs identified in the current situation. The design solution is typically described by such artifacts as: the technical drawings, diagrams and written specifications, which provide detailed guidance for those who will implement the design and for those who subsequently may debug,

enhance, or otherwise maintain the designed solution. However, such specifications can be obstacles to the full participation in the design process of clients and prospective users, who speak the language of the use situation, but not the language of software specification often characterized by rendering the vivid and open-ended designs as stilted enumerations of features and functions. After all, the essence of an interactive software support is that it is dynamic and responsive. How can this be merely captured in a static list of features and functions? As Henry Dreyfuss, in his 1955 book *Designing for People* (Dreyfuss, 1955), energetically confronts these points, the design of *REALSpace* has been crafted as something tangible, sharable with clients and prospective users. The experience is closely indicative of a design paradigm of active, mutual engagement in which designers and their clients and users work in close coordination, noticing the world as it is and responding with mock-ups of the world as it might be.

1.7.4 Recognizing Tradeoffs and Dependencies

Creating a design solution for *REALSpace* involves subtle trade-offs and dependencies regarding functionality and usability. The sheer number of important details and their many interactions is an intriguing challenge of design. Often, it is necessary to rely on structured design methods that seek to manage interactions by grouping requirements and constraints to specify sub-solutions to sub-problems, and thereby to build up a comprehensive design solution. Yet, the problem decomposition imposed through such methods might conceal important trade-offs and

dependencies. Stated another way, it is experienced that specifications that are developed strictly sub-problem by sub-problem cannot ensure an overall coherence in the design. In this regard, I identify with Dreyfuss (1955) who stressed the importance of empirical methods for instantiating and evaluating trade-offs and dependencies. These methods rely on the development of design mock-ups and observations of them in use. The understanding gained through these empirical means is found helpful to refine the design solution.

1.7.5 Integrating Diverse Knowledge and Skills

In the context of interactive systems design, every element of a design, every move that a designer makes, has a variety of potential consequences. I agree with Schon (1983) who sees design as a conversation with a situation comprising many inter-dependent elements. The designer makes different moves and then listens to the design situation to understand their consequences. When a move produces unexpected consequences, and particularly when it produces undesirable ones, it is important that the designer should articulate the theory implicit in the move, criticize it, restructure it, and test the new theory by inventing a move consistent with it. When the fluidity of interactive systems design incorporates new technologies or addresses new arenas of human activity, requirements evolve more rapidly. New design moves and new design goals then become possible and necessary to address these requirements. To manage an ambiguous and dynamic situation, designers need to integrate diverse knowledge and skill to keep track of the

conversation with the design situation, recognizing and addressing the numerous trade-offs and dependencies among elements of the design problem.

1.7.6 Anticipating Impacts on Human Activity

Designed artifacts have a myriad of impacts for people – some intended, some unintended, although the act of design is often aimed to facilitate human activities and enrich human experience. Artifacts in use are complex agents of change; some empower our lives, but others frustrate people. Oftentimes, they alter our tasks and our social structures; they have both positive and negative effects, often at the same time and in virtue of one another. Experientially, these complications work themselves out through trial and error. Doing better than this often requires sophisticated analysis of use situations coupled with flexible strategies to guide an iterative process of refinement and redesign. Typically, if we think of each design project as an isolated activity, we will not be able to see enough of the long-term consequences for people. However, some things about human activity and experience appear to be relevant across many types of situations. There is often the possibility of what might be called cumulative design (Carroll, 2000), in which we observe the human impacts of past designs through time and attempt to direct that knowledge toward guiding the development of subsequent designs. This lesson of design know-how is quite resonant in the *REALSpace* experience.

1.8 Research Contributions and Synopsis of the Thesis

There are a number of original contributions this thesis is to offer to the academic arena of software engineering, to make respectable and explicit the implicit multi-faceted activities of the software engineering discipline still in its youth and evolution:

- The thesis has demonstrated that soft systems methodology (SSM), as an organizational analysis method, can be flexibly integrated into the mainstream of software engineering development activities, especially, during requirements elicitation, analysis, and system design stages, as applicable in the process of information system (IS) development. Refer to Chapter 6 of the thesis.
- The thesis has illustrated that soft systems methodology (SSM) as an organizational modeling approach, can be combined with scenario-based design (SBD), in the requirements analysis and specification of software engineering development activities, to produce use case models for subsequent systems development, as required in use-case driven software development. Refer to Chapter 7 of the thesis.
- The thesis has elucidated that use case models produced through SSM-based scenarios could serve as the basis for user experience (UX) design to produce prototypes (UX walkthroughs) for different organizational episodes of purposeful human activities. Refer to Chapter 8 of the thesis.
- The thesis has deliberated on a case study of systems architecting,

through soft systems methodology (SSM) and scenario-based design (SBD), for an electronic environment called *REALSpace* (an electronic space to support a rich environment for active learning) and its sub-system called the *AKE*, denoting an appreciative knowledge environment, installed under *REALSpace*, and hence called *REALSpace AKE*. These environments are the original creations of the thesis, based on the organizational context at the University of Macau. The deliberation represents the original contributions of the author, through the application of SSM and SBD in the architecting process. Refer to Chapters (1, 6, 7, 8, and 10) of the thesis.

This dissertation is presented in four different sections, comprising a total of ten chapters. The first section is an introduction (Chapter 1), providing an overview of the research behind the dissertation. The second section (Part I) entitled *Setting the Stage* and comprising four chapters, delineates the important findings and issues from the several important areas of interest: story of student learning, professional learning communities (PLCs), personalized instructions, appreciative knowledge environment (AKE), outcomes-based assessment (OBA), and learning-centered education (LCE). The third section (Part II) entitled *Putting the Pieces Together*, and comprising four chapters, describes in details the author's research findings and contributions including the detailed discussion of the contexts of systems architecting of IS support for *REALSpace*, of scenario-based development of *REALSpace AKE*, of

software prototyping of different user experience (UX) for the AKE environment, and of virtual organizing various PLCs in the context of blended student learning in the university setting, and an actionable framework of appreciative inquiry (AI) applicable in an organizational scenario of collaborative action research. The fourth section (Part III) entitled *REALSpace* Epilogue, presents the author's lessons learned in doing the research behind the dissertation, and some closing thought about works to be continued. Briefly discussed below is the content of each chapter, written in a self-contained manner, for readers' convenience.

- *Chapter 1*, entitled *Introduction*, delineates the software engineering background behind the dissertation research, including the author's motivation, the research situation of concern, the problems, the methods of investigation, the perceived contributions, and the list of publications accomplished for this thesis.
- *Chapter 2*, entitled *REALSpace: The Story of Student Learning*, introduces the *REALSpace* story of student learning through supporting the context of a professional learning community (PLC). In particular, it describes the ingredients of a learning environment conducive to a new culture of learning in communities, facilitated by the design and development of an electronic space to support a rich environment for active learning (REALSpace), that addresses how educators should work to improve teaching and subsequently student learning through a process of continuous improvement.

- *Chapter 3*, entitled *REALSpace AKE: The Art of Personalized Instruction*, investigates the issues of personalized instruction in higher education, and how such an approach could be facilitated by a suitable design and development of a conceptual component in *REALSpace*, called the AKE (appreciative knowledge environment) that addresses the work required to improve teaching and student learning through integrating the perspective of appreciative inquiry (Cooperrider, 1986), into the context of a professional learning community (PLC).
- *Chapter 4*, entitled *REALSpace OBA: The Craft of Learner Assessment*, elaborates on the context of outcomes-based assessment (OBA), as another important conceptual component of *REALSpace*. The chapter deliberates OBA as an educational model in which curriculum and pedagogy and assessment are all focused on student learning outcomes. This is achieved through an educational process that fosters continuous attention to student learning and promotes institutional accountability based on student learning. It emphasizes that the key to the OBA model of education is outcomes which inform curriculum, teaching and assessment through an evidence-based mechanism such as the student learning portfolios.
- *Chapter 5*, entitled *REALSpace LCE: The Key to Student Achievement*, is devoted to the context of learning-centered education (LCE), and to describing an LCE-based approach to designing and delivering courses and curricula in higher education. The essence of this chapter is to articulate another conceptual component of the *REALSpace*

environment, called *REALSpace LCE*, which is the instantiation of a new paradigm of undergraduate education, characterized by a transition to the belief that a college or university is an institution that exists to produce student learning, rather than merely to provide quality instruction.

- *Chapter 6*, entitled *Systems Architecting of IS Support for REALSpace*, is organized to deliberate on the context of systems architecting, and to make explicit the implicit role of soft systems methodology (SSM) in contributing to a rationale-based organizational modeling of the different aspects of *REALSpace* as the foundation to investigate the necessary information system (IS) support for purposeful human activities in college teaching and learning. Of particular interest is the AKE environment as an example in organizational modeling for college education to illustrate the SSM-based investigation of selected human activity systems (HAS's) as exposited in *REALSpace* development.
- *Chapter 7*, entitled *Scenario-Based Development of REALSpace AKE*, is organized to elaborate on the scenario-based design (SBD) of the AKE environment under *REALSpace*. This elaboration is based on the results developed through SSM in Chapter 6, namely, the human activity system (HAS) for *REALSpace AKE*, including the root definition (RD), and the attendant conceptual model (CM) derived through CATWOE analysis. In particular, it is illustrated that the SBD approach could help visualize the working of the AKE in action through different real-life scenarios in college teaching and learning,

by connecting SSM with such contemporary method of software development as use-case modeling in object-oriented analysis and design.

- *Chapter 8*, entitled *Software Prototyping for REALSpace AKE*, is organized to deliberate on the scenarios created in Chapter 7 – one for each of the thirteen HAS-based CM activities in *REALSpace AKE*. Each such scenario of interest has been earlier elaborated as a set of feasible and desirable use case models for the situation of concerns in the AKE environment. The chapter focuses on demonstrating a software prototyping process for these scenarios, in relation to the modern practice of user-centered design (UCD), especially, deliberating on how the context of user experience (UX) design could be incorporated to develop the interaction aspects of the related AKE services.
- *Chapter 9*, entitled *Virtual Organizing for REALSpace AKE*, is organized to illustrate the theme of virtual organizing for the AKE environment, facilitating pedagogical redesign of higher educational course offering. In particular, the context of blended learning and how it could be supported by virtual organizing is deliberated as the transforming force to enhance a worthwhile experience in teaching and learning, especially for various communities of inquiry (CoI's). It is argued that the scarcity of fundamental change in higher education classroom stems not from a lack of resources but from a lack of understanding of what is possible by thoughtfully blending traditional face-to-face approaches with online learning. And blended learning in

support of CoI's through virtual organizing different AKE services is the argued solution presented in the chapter. Also elaborated is a wider interpretation of the AKE philosophy in terms of a guiding initiative from appreciative inquiry, to influence the pedagogical reform in higher education especially through a continuous improvement effort.

- *Chapter 10*, entitled *REALSpace Epilogue: A Journey to Create the Future*, is organized to put forth many of the lessons learned in the process of executing the research behind my doctoral study. This chapter characterizes my learning experience as a journey to create the future of my mission in higher education, especially in those areas of interest directly related to software engineering, software engineering education, organization transformation in higher education, as well as reflections in university teaching for quality learning. This chapter also puts into perspective my efforts in exploring the coherent contributions from SSM, SBD, and modern-day UX design in the context of software engineering efforts for *REALSpace* and its AKE environment, and concludes with some thoughts on systems thinking and its attendant methodology which has so enabled my deliberation of this thesis work.

1.9 My Statement of Originality as a Teacher-Researcher

As a teacher-researcher entering his eighteenth year of walking his talk in software engineering education, I find it important to maintain a generative view of the learning accrued in this field. This generative view

basically comes down to two intellectual aspects. Firstly, it is the creative attitude through which ideas and alternatives are dreamed up, invented and identified. Second is an analytic attitude through which any proposed ideas and alternatives are critically evaluated. In fact, doing action research in software engineering education over the years has increasingly crystallized my personal characterization of the generative view of knowledge contributions. In one, knowledge is often analytically interpreted as something physical that can be possessed, stored, processed, and readily distributed to people who are designated as users of knowledge. This approach of treating knowledge as a possession is to control and direct knowledge to serve some meaningful goals. The other perspective focuses on creative knowing, a process involving the interaction or engagement of different people over particular issues. The underlying premise is that knowledge is what happens in the process of peoples' interaction and that the way to facilitate the creation and use of knowledge is by encouraging people to interact, to participate, and to generate and share ideas. The focus is people with diverse capabilities, different experiences, and varied perspectives, in the form of networks, teams, or communities of practice. Actually, the discussion of *REALSpace*, as presented in this thesis, is quite consistent with this generative view of knowledge contribution. Yet, it is also my responsibility to externalize my ideas in the wider world such as international conferences, and other academic publications such as research book chapters, encyclopedia contributions, and international refereed journals, and see whether others accept the same. This kind of

validation is essential in action research. To be reasonably sure that something of worth is produced, I have to check with significant others to see if they accept it for its intrinsic worth. Listed below are my publications produced from 2000 to 2011, in support of my ongoing research in the fields of software engineering and higher education, along the analytic and creative perspectives described above.

1.9.1 International Refereed Journal Articles

During the period from 2001 to 2009, I have produced a total of ten international refereed journal publications as follows:

- Vat, K.H. (2009). Developing REALSpace - Discourse on a student-centered creative knowledge environment for virtual communities of learning. *International Journal of Virtual Communities and Social Networking* (ISSN: 1942-9010), *1* (1): 43-74, (January - March) (http://www.igi-global.com/journals/details.asp?id=7954).

- Vat, K.H. (2006). Teaching a collaborative model of IS development through problem-based learning. *Information Systems Education Journal (ISSN: 1545-679x)*, 4 (102), October (http://isedj.org/4/102/).

- Vat, K.H. (2006). Conceiving scenario-based IS support for knowledge synthesis: The organization architect's design challenge in systems thinking. *Journal of Systemics, Cybernetics and Informatics (ISSN: 1690-4524)*, *3* (3) (http://www.iiisci.org/Journal/SCI/Contents.asp?var=&Previous=ISS7574).

  An official publication of the International Institute of Informatics and Systemics (IIIS).

- Vat, K.H. (2006). Integrating industrial practices in software development through scenario-based design of PBL activities: A pedagogical re-organization perspective. *Journal of Issues in Informing Science and Information Technology (ISSN: 1547-5859 CD Version)*, 3: 687-708, June (Choose Volume 3 from http://iisit.org/ or click direct from http://informingscience.org/proceedings/InSITE2006/IISITVat229.pdf).

- Vat, K.H. (2006). Developing a learning organization model for problem-based learning: The emergent lesson of education from the IT trenches. *Journal of Cases on Information Technology (ISSN 1548-7717), 8* (2): 82-109, April-June. An official publication of the Information Resources Management Association (IRMA) since 1999.

- Vat, K.H. (2005). Systems architecting of IS support for learning organizations: The scenario-based design challenge in human activity systems. *Information Systems Education Journal (ISSN: 1545-679x), 3* (2), July (http://isedj.org/3/2/).

- Vat, K.H. (2005). Modeling human activity systems for collaborative project work: An IS development perspective. *Journal of Issues in Informing Science and Information Technology (ISSN: 1547-5859 CD Version), 2*: 49-65, June, (http://iisit.org/IssuesVol2v2.htm or click direct from http://proceedings.informingscience.org/InSITE2005/I05f65Vat.pdf).

- Vat, K.H. (2004). On the idea of organization transformation: The IS/IT design challenge in systems thinking. *Journal of Issues in Informing Science and Information Technology (ISSN: 1547-5859 CD Version), 1*: 941-950, June,

(http://iisit.org/vol1.htm or click direct from http://proceedings.informingscience.org/InSITE2004/120vat.pdf).

- Vat, K.H (2003). Architecting of learning organizations: The IS practitioners' challenge in systems thinking. *Information Systems Education Journal (ISSN: 1545-679x), 1* (26), December (http://isedj.org/1/26/).

- Vat, K.H.(2001). Web-based asynchronous support for collaborative learning. *Journal of Computing in Small Colleges (official publication of Consortium for Computing in Small Colleges, CCSC), 17* (2): 310-328, December, (Available from http://portal.acm.org/dl.cfm: Search "JCSC, Vol. 17, No. 2").

1.9.2 Case Studies and Handbooks of Research Works

In the years of 2009 and 2010, I have produced a total of two refereed Handbook-of-Research publications and two major case studies as follows:

- Vat, K.H. (2010). Conceiving community knowledge records as e-governance concerns in wired healthcare provision. In H. Rahman (Ed.), *Cases on adoption, diffusion and evaluation of global e-governance systems: Impact at the grass roots* (ISBN 978-1-61692-814-8) (pp. 207-225). Hershey, PA, USA: Information Science Reference (IGI Global, Inc.) (http://www.igi-global.com/requests/details.asp?ID=598).

- Vat, K.H. (2009). Virtual organizing professional learning communities through a servant-leader model of appreciative coaching. In Y. Inoue (Ed.), *Cases on online and blended learning technologies in higher education: Concepts and practices* (ISBN 978-1-60566-880-2) (pp.183-206). Hershey,

PA, USA: Information Science Reference (IGI Global, Inc.) (http://www.igi-global.com/reference/details.asp?ID=34829).

- Vat, K.H. (2009). The generative potential of appreciative inquiry as an essential social dimension of the semantic Web. In M. Cunha, E. Oliveira, A. Tavares, & L. Ferreira (Eds.), *Handbook of research on social dimensions of semantic technologies and Web services* (ISBN978-1-60566-650-1) (pp.411-434). Hershey, PA, USA: Information Science Reference (IGI Global Inc) (http://www.igi-global.com/reference/details.asp?id=34405).

- Vat, K.H. (2009). The e-governance concerns in IS design for effective e-government performance improvement. In H. Rahman (Ed.), *Handbook of research on e-government readiness for information and service exchange: Utilizing progressive information communication technologies* (ISBN 978-1-60566-671-6) (pp.48-69). Hershey, PA, USA: Information Science Reference (IGI Global, Inc.) (http://www.igi-global.com/reference/details.asp?id=34559).

1.9.3 Encyclopedia Contributions

During the period from 2005 to 2011, I have produced twelve articles accepted for publications in ten different encyclopedia published by the IGI Global Inc. (formerly called Idea Group Inc.), in Hershey, USA. The contexts of the twelve articles are closely related to my research areas in software engineering and information science.

- Vat, K.H. (2011). Appreciative sharing for organizational knowledge work. In D. Schwartz and D. Teéni (Eds.), *Encyclopedia of knowledge management, 2nd edition* (ISBN 978-1-59904-931-1) (pp.27-38). Hershey, PA, USA: Information Science Reference (IGI Global Inc.).

- Vat, K.H. (2011). Knowledge synthesis framework. In D. Schwartz and D. Te éni (Eds.), *Encyclopedia of knowledge management, 2nd edition* (ISBN 978-1-59904-931-1) (pp.955-966). Hershey, PA, USA: Information Science Reference (IGI Global Inc.).

- Vat, K.H. (2009). An E-portfolio scheme of flexible online learning. In Patricia L. Rogers, G.A. Berg, J. Boettcher, C. Howard, L. Justice, and K. Schenk (Eds.), *Encyclopedia of distance learning, 2nd edition* (ISBN 978-1-60566-198-8) (pp.941-949). Hershey, PA, USA: Information Science Reference (IGI Global Inc.).

- Vat, K.H. (2009). Conceiving a learning organization model for online education. In Patricia L. Rogers, G.A. Berg, J. Boettcher, C. Howard, L. Justice, and K. Schenk (Eds.), *Encyclopedia of distance learning, 2nd edition* (ISBN 978-1-60566-198-8) (pp.391-397). Hershey, PA USA: Information Science Reference (IGI Global Inc.).

- Vat, K.H. (2009). OMIS-based collaboration with service-oriented design. In M. Khosrow-Pour (Ed.), *Encyclopedia of information science and technology, 2nd edition* (ISBN 978-1-60566-026-4) (pp.2875-2881). Hershey, PA, USA: Information Science Reference (IGI Global Inc.).

- Vat, K.H. (2008). E-portfolio and pedagogical change for virtual universities. In Goran D. Putnik and M. Manuela C. Cunha (Eds.), *Encyclopedia of networked and virtual organizations* (ISBN 978-1-59904-885-7) (pp.508-515). Hershey, PA, USA: Information Science Reference (IGI Global Inc.).

- Vat, K.H. (2006). Virtual organizing online communities in support of knowledge synthesis. In S. Dasgupta (Ed.), *Encyclopedia of virtual communities and technologies* (ISBN 1-59140-563-7) (pp.547-555). Hershey, PA, USA: Idea Group Reference (Idea Group Inc.).

- Vat, K.H. (2006). IS design for community of practice's knowledge challenge. In E. Coakes and S.A. Clarke (Eds.), *Encyclopedia of communities of practice in information and knowledge management* (ISBN 1-59140-556-4) (pp.246-256). Hershey, PA, USA: Idea Group Reference (Idea Group Inc.).

- Vat, K.H. (2006). Knowledge synthesis framework. In D. Schwartz (Ed.), *Encyclopedia of knowledge management* (ISBN 1-59140-573-4) (pp.530-537). Hershey, PA, USA: Idea Group Reference (Idea Group Inc.).

- Vat, K.H. (2005). Designing OMIS-based collaboration for learning organizations. In M. Khosrow-Pour (Ed.), *Encyclopedia of information science and technology* (ISBN 1-59140-553-X) (pp.827-830). Hershey, PA, USA: Idea Group Reference (Idea Group Inc.).

- Vat, K.H. (2005). Conceiving a learning organization model for online education. In Patricia L. Rogers (Ed.), *Vol. 1 of 4, Distance learning technologies and applications, Encyclopedia of distance learning* (ISBN

1-59140-555-6) (pp.367-373). Hershey, PA, USA: Idea Group Reference (Idea Group Inc.).

- Vat, K.H. (2005). SSM-based IS support for online learning. In C. Howard, J. Boettcher, L. Justice, K. Schenk, and G.A. Berg (Eds.), *Vol. 4 of 4, Online learning and technologies, Encyclopedia of distance learning* (ISBN 1-59140-555-6) (pp.1650-1659). Hershey, PA, USA: Idea Group Reference (Idea Group Inc.).

1.9.4 Research Book Chapters

During the period from 2001 to 2010, I have produced fourteen different research book chapters whose contents are of particular interest to people involved in the education of information technology, information systems, software engineering and knowledge management.

- Vat, K.H. (2010). Developing student e-portfolios for outcomes-based assessment in personalized instruction. In Y. Kats (Ed.), *Learning management systems technologies and software solutions for online teaching: Tools and applications* (ISBN 978-1-61520-853-1) (pp.259-290). Hershey, PA, USA: Information Science Reference (IGI Global, Inc.) (http://www.igi-global.com/Bookstore/TitleDetails.aspx?TitleId=37343).

- Vat, K.H. (2010). The generative potential of appreciative inquiry as an essential social dimension of the semantic Web. In S. Dasgupta (Ed.), *Social computing: Concepts, methodologies, tools, and application, 4 volumes* (ISBN 978-1-60566-984-7) (pp.1882-1905). Hershey, PA, USA: Information

Science Reference (IGI Global Inc) (http://www.igi-global.com/Bookstore/TitleDetails.aspx?TitleId=909).

- Vat, K.H. (2009). Developing REALSpace: Discourse on a student-centered creative knowledge environment for virtual communities of learning. In N. Kock (Ed.), *E-Collaboration: Concepts, methodologies, tools and applications* (ISBN: 978-1-60566-652-5) (pp.307-340). Hershey, PA, USA: Information Science Reference (IGI Global Inc) (http://www.igi-global.com/reference/details.asp?id=34578).

- Vat, K.H. (2009). The generative potential of appreciative inquiry for CoP: The virtual enterprise's emergent knowledge model. In D. Akoumianakis (Ed.), *Virtual community practices and social interactive media: Technology lifecycle and workflow analysis* (ISBN: 978-1-60566-340-1) (pp.60-85). Hershey, PA, USA: Information Science Reference (IGI Global Inc) (http://www.igi-global.com/reference/details.asp?ID=33347).

- Vat, K.H. (2009). Building virtual communities through a de-marginalized view of knowledge networking. In Miltiadis D. Lytras & P. Ordonez de Pablos (Eds.), *Social Web evolution: Integrating semantic applications and Web 2.0 technologies* (ISBN 978-1-60566-272-5) (pp.233-248). Hershey, PA, USA: Information Science Reference (IGI Global, Inc.).

- Vat, K.H. (2009). Designing open-source OMIS Environment for virtual teams to support inter-enterprise collaboration. In Maria M. Cruz-Cunha (Ed.), *Social, Managerial and organizational dimensions of enterprise information systems* (ISBN 978-1-60566-856-7) (pp.272-288). Hershey, PA, USA:

Business Science Reference (IGI Global, Inc.) (http://www.igi-global.com/reference/details.asp?ID=34829).

- Vat, K.H. (2008). Building virtual communities through a de-marginalized view of knowledge networking. In Jerzy Kisielnicki (Ed.), *Virtual technologies: Concepts, methodologies, tools, and applications (3 Volumnes)* (ISBN 978-1-59904-955-7) (pp.488-502). Hershey, PA, USA: Information Science Reference (IGI Global Inc.).

- Vat, K.H. (2008). Knowledge synthesis framework. In Murray E. Jennex (Ed.), *Knowledge management: Concepts, methodologies, tools, and applications (6 Volumes)* (ISBN 978-1-59904-933-5) (pp.297-307). Hershey, PA, USA: Information Science Reference (IGI Global Inc.).

- Vat, K.H. (2008). IS design for community of practice's knowledge Challenge. In Murray E. Jennex (Ed.), *Knowledge management: Concepts, methodologies, tools, and applications (6 Volumes)* (ISBN 978-1-59904-933-5) (pp.850-861). Hershey, PA, USA: Information Science Reference (IGI Global Inc.).

- Vat, K.H. (2007). Conceiving a learning organization model for online education. In Lawrence A. Tomei (Ed.), *Online and distance learning: Concepts, methodologies, tools, and applications (6 Volumes)* (ISBN 978-1-59904-935-9) (pp.1128-1136). Hershey, PA, USA: Information Science Reference (IGI Global Inc.).

- Vat, K.H. (2006). Building virtual communities through a de-marginalized view of knowledge networking. In H. Rahman (Ed.), *Empowering marginal*

communities with information networking (ISBN: 1-59140-700-1) (pp.278-299). Hershey, PA, USA: Idea Group Publishing.

- Vat, K.H. (2003). Conceiving architectural aspects for quality software education through the constructivist perspective. In Tanya McGill (Ed.), *Current issues in IT education* (ISBN 1-931777-53-5) (pp.98-116). Hershey, PA, USA: IRM Press (Idea Group Inc.).

- Vat, K.H. (2002). Designing organizational memory for knowledge management support in collaborative learning. In D. White (Ed.), *Knowledge mapping and management* (ISBN 1-931777-17-9) (pp.233-243). Hershey, PA, USA: IRM Press (Idea Group Inc.).

- Vat, K.H. (2001). E-commerce in action: An educational response to re-engineer today's university model for the Internet age. In O.K. Gupta and R. Seethamraju (Eds.), *Information technology and operations management: Relationships and synergies* (ISBN 0-07-043585-5) (pp.102-111). New Delhi, India: Tata McGraw-Hill.

1.9.5 Refereed Conference Papers

From the year 2000 to the year 2006, I have participated in thirty-one international conferences, presented and published my research papers in those conferences, with the conference proceedings acquired for archival purpose. All the papers published are categorized as refereed papers, accepted after reviews by two or more reviewers in the fields of computer science education, information technology education, information systems education, which are closely related to my research work in

software engineering education. Listed below are my published papers arranged by year in the sequence from 2006 back to 2000.

Year 2006

- Vat, K.H. (2006). Integrating soft systems methodology into the teaching of human-computer interaction: A constructivist design based on problem-based learning. Presented and published in the *CD-Proceedings of the Society for Information Technology and Teacher Education International Conference* (SITE2006), Mar. 20-24, Orlando, Florida, USA.

- Vat, K.H. (2006). Nurturing self-directed work tams in the education of information systems professionals. Presented and published in the *CD-Proceedings of the Ninth Annual Conference of the Southern Association for Information Systems* (SAIS2006), Mar. 11-12, Jacksonville, Florida, USA (http://sais.aisnet.org/2006/Vat-SAIS2006-paper.pdf).

Year 2005

- Vat, K.H. (2005). Teaching a collaborative model of IS development through problem-based learning. *CD-Proceedings (ISSN: 1542-7382) of the 2005 Information Systems Education Conference* (ISECON2005), Oct. 6-9, Columbus, Ohio, USA. (Currently Accessible from http://isedj.org/isecon/2005/5112/index.html)

- Vat, K.H. (2005). On the importance of human activity systems in organization modeling for IS development. Presented and published in the *CD-Proceedings of the Eighth Annual Conference of the Southern*

Association for Information Systems (SAIS2005), Feb. 25-26, Savannah, Georgia, USA (http://sais.aisnet.org/sais2005/vat.pdf).

Year 2004

- Vat, K.H. (2004). Toward a learning organization model for student empowerment: A teacher-designer's experience as a coach by the side. Presented and published in the *Proceedings of the 2004 IADIS International Conference on Cognition and Exploratory Learning in Digital Age* (CELDA2004), Dec. 15-17, Lisbon, Portugal, pp.131-140.

- Vat, K.H. (2004). Systems architecting of IS support for learning organizations: The scenario-based design challenge in human activity systems. Presented and published in the *CD-Proceedings (ISSN: 1542-7382) of the 2004 Information Systems Education Conference* (ISECON2004), Nov. 4-7, Newport, Rhode Island, USA (Recipient of the ISECON2004 Distinguished Merit Award -> http://isedj.org/isecon/2004/3245/index.html).

- Vat, K.H. (2004). Conceiving a learning organization model for sustainable development: The IS manager's perspective based on soft systems methodology. Presented and published in the *Proceedings of the IEEE International Engineering Management Conference 2004* (IEMC2004), Oct. 18-21, Singapore, pp. 500-504.

- Vat, K.H. (2004). Putting the university online: A learning organization model for electronic transformation. Presented and published in the *Proceedings of the 3rd International Conference on ICT and Higher Education (e-University 2004)*, Aug. 31 - Sep. 2, Bangkok, Thailand, pp.135-148.

- Vat, K.H. (2004). On the idea of soft systems methodology for IS development: A perspective based on purposeful action. Presented and published in the *Proceedings of the International Conference on Computing, Communications and Control Technologies* (CCCT2004), August 14-17, Austin, Texas, USA, pp. 227-232.

- Vat, K.H. (2004). Conceiving scenario-based IS support for knowledge synthesis: The organization architect's design challenge in systems thinking. Presented and published in the *Proceedings of the 10th International Conference on Information Systems Analysis and Synthesis* (ISAS2004), Orlando, Florida, USA, July 21-25, pp.101-106.

- Vat, K.H. (2004). Towards a learning organization model for PBL: A virtual organizing scenario of knowledge synthesis. Presented and published in the *CD-Proceedings of the Seventh Annual Conference of the Southern Association for Information Systems* (SAIS2004), Feb. 27-28, Savannah, Georgia, USA (http://sais.aisnet.org/sais2004/VAT.pdf).

Year 2003

- Vat, K.H. (2003). Toward an actionable framework of knowledge synthesis in the pursuit of learning organization. Presented and published in the *CD-Proceedings of the 2003 Informing Science + IT Education Conference* (InSITE2003), in Pori, Finland, Jun. 24-27, pp.1085-1100.

- Vat, K.H. (2003). A context-based organization modeling for e-learning initiatives. *Proceedings of the 2003 Information Resources Management*

Association International Conference (IRMA2003), May 18-21, Philadelphia, Pennsylvania, USA, Vol.2, pp. 651-652.

- Vat, K.H. (2003). An IS-based architectural modeling for learning organization: A conceptual walkthrough. Presented and published in the *Proceedings of the Sixth Annual Conference of the Southern Association for Information Systems* (SAIS2003), Mar. 7-8, Savannah, Georgia, USA, pp. 55-62.

Year 2002

- Vat, K.H. (2002). Virtual organizing as a strategic learning approach to organization transformation. Presented and published in the *Proceedings of the 2002 International Conference on Systems, Development and Self-Organization* (ICSDS2002), Nov. 30 - Dec. 1, Beijing, China, pp. 134-139.

- Vat, K.H. (2002). On the importance of organization modeling for IS education. Presented and published in the *CD-Proceedings (ISSN: 1542-7382) of the 2002 Information Systems Education Conference* (ISECON2002), Oct. 31 - Nov. 3, San Antonio, Texas, USA (http://isedj.org/isecon/2002/244b/index.html).

- Vat, K.H. (2002). Engineering component-based knowledge applications for e-learning organizations: The software architects' challenge in organizational transformation. Presented and published in *Proceedings of the Sixth World Multi-Conference on Systemics, Cybernetics and Informatics* (SCI2002), in Orlando, Florida, USA, July 14-18, Vol. 1, pp.262-267.

- Vat, K.H. (2002). Teaching architectural approach to quality software development through problem-based learning. Presented and published in the *CD-Proceedings of the 2002 Informing Science + IT Education Conference* (InSITE2002), in Cork, Ireland, Jun. 19-21.

- Vat, K.H. (2002). Conceiving service-based architecture and process for quality software education. Presented and published in the *Proceedings of the 2002 Information Resources Management Association International Conference* (IRMA2002), May 19-22, Seattle, Washington, USA, Vol.1, pp. 817-820.

- Vat, K.H. (2002). Developing e-learning architectures for communities of practice: A knowledge perspective. Presented and published in the *CD-Proceedings of the 2002 World Conference on Networked Learning in a Global Environment: Challenges and Solutions for Virtual Education* (NL2002), May 1-4, Berlin, Germany.

- Vat, K.H. (2002). Developing learning organization strategy for online education: A knowledge perspective. Presented and published in the *Proceedings of the Fifth Annual Conference of the Southern Association for Information Systems* (SAIS2002), Mar. 1-2, 2002, Savannah, Georgia, USA, pp. 291-298.

- Vat, K.H. (2002). Developing component-based e-commerce applications for learning organizations: An inter-enterprise architectural response to organizational transformation. Presented and published in *CD-Proceedings of the Third World Congress on the Management of Electronic Commerce*, Jan. 16-18, Hamilton, Ontario, Canada.

Year 2001

- Vat, K.H. (2001). Towards a learning organization model for knowledge synthesis: An IS perspective. *CD-Proceedings of the 2001 Information Systems Education Conference* (ISECON2001), Nov. 1-4, Cincinnati, Ohio, USA (http://isedj.org/isecon/2001/09a/index.html).

- Vat, K.H. (2001). Teaching HCI with scenario-based design: The constructivist's synthesis. Presented and published in *Proceedings of the Sixth Annual ACM Conference on Innovation and Technology in Computer Science Education* (ITiCSE2001), Canterbury, U.K., Jun. 25-27, pp. 9-12.

- Vat, K.H. (2001). Addressing IT/IS personnel shortfall: Some PBL students' findings and recommendations. Presented and published in *Proceedings of the Fourth Annual Conference of the Southern Association for Information Systems* (SAIS2001), Mar. 2-3, Savannah, Georgia, USA, pp. 52-60.

- Vat, K.H. (2001). REAL: Towards a WWW-enabled course support environment for active learning. Presented in the *International Conference on Learning and Teaching Online* (LTOL2001), Jan. 10-12, Guangzhou, China (Paper No. 291).

Year 2000

- Vat, K.H. (2000). Designing Web information systems for Internet commerce through the virtual organization model. Presented and published in *Proceedings of the 2000 International Software Development and*

Management Conference (ISD&M2000), Dec. 14-15, Hong Kong, pp.193-206.

- Vat, K.H. (2000). Online education: A learner-centered model with constructivism. Presented and published in *Proceedings of the Eighth International Conference on Computers in Education* (ICCE 2000), Nov. 21-24, Taipei, Taiwan, pp. 560-568.

- Vat, K.H. (2000). Designing knowledge infrastructure for virtual enterprises in organizational learning. Presented and published in *Proceedings of the Tenth Annual Business Information Technology Conference* (BIT 2000), Nov. 1-2, Manchester, England, (CD-ROM Paper No. 45).

- Vat, K.H. (2000). Training e-commerce support personnel for enterprises through action learning. Presented and published in *Proceedings of the 2000 ACM SIGCPR Conference*, Apr. 6-8, Chicago, Illinois, USA, pp.39-43.

- Vat, K.H. (2000). Teaching software psychology: Expanding the perspective. Presented and published in *Proceedings of the Thirty-first SIGCSE Technical Symposium on Computer Science Education*, Mar. 8-12, Austin, Texas, USA, pp.392-396.

1.9.6 Qualification of My Publications

The publications I produced over the past ten years as enumerated above are affiliated with a number of academic institutes, professional bodies and international publishers including the following:

- Association for the Advancement of Computing in Education (AACE)

- Association of Computing Machinery (ACM)
- Association of Information Systems (AIS)
- Association of Information Technology Professionals (AITP)
- Consortium for Computing in Small Colleges (CCSC)
- Idea Group Inc. (publisher of IRM Press, Idea Group Publishing and Idea Group Reference)
- IGI Global Inc. (publisher of Information Science Reference)
- International Association for Development of Information Society (IADIS)
- Institute of Electrical and Electronics Engineers (IEEE)
- International Institute of Informatics and Systemics (IIIS)
- Information Resources Management Association (IRMA)
- Informing Science Institute (ISI)
- Natural and Artificial Intelligence Systems Organization (NAISO)

Specifically, I have arranged to put together the following groups of publications affiliated with each of the academic bodies above, with suitable annotations to qualify the conferences, and the publications.

AACE

- Vat, K.H. (2000). Online education: A learner-centered model with constructivism. Presented and published in *Proceedings of the Eighth*

International Conference on Computers in Education (ICCE 2000), Nov. 21-24, Taipei, Taiwan, pp. 560-568.

The ICCE conference is organized through the Association for Advancement of Computers in Education, and the specific ICCE2000 conference was organized under the auspices of the Asia-Pacific Chapter of AACE. This conference is devoted to promote educational uses of technology in the service of enhanced learning. It is one of the mature conferences in the area of educational technology, or the application of IT in education. The acceptance rate for ICCE2000 where my paper was published was close to 40%.

ACM

- Vat, K.H. (2001). Teaching HCI with scenario-based design: The constructivist's synthesis. Presented and published in *Proceedings of the Sixth Annual ACM Conference on Innovation and Technology in Computer Science Education* (ITiCSE2001), Canterbury, U.K., Jun. 25-27, pp. 9-12.
- Vat, K.H. (2000). Teaching software psychology: Expanding the perspective. Presented and published in *Proceedings of the Thirty-first SIGCSE Technical Symposium on Computer Science Education*, Mar. 8-12, Austin, Texas, USA, pp.392-396.
- Vat, K.H. (2000). Training e-commerce support personnel for enterprises through action learning. Presented and published in *Proceedings of the 2000 ACM SIGCPR Conference*, Apr. 6-8, Chicago, Illinois, USA, pp.39-43.

The first two conferences were organized by the ACM Special Interest Group (SIG) in Computer Science Education (CSE), and the third conference by ACM SIG in Computer Personnel Research (CPR), currently combined with ACM SIG in management information systems (MIS). These are internationally renown conferences with an acceptance rate close to 30% in the education of computer science, software engineering and information technology, with the SIGCPR conference particularly interested in the human issues in computer sectors.

AIS

- Vat, K.H. (2006). Nurturing self-directed work teams in the education of information systems professionals. Presented and published in the *CD-Proceedings of the Ninth Annual Conference of the Southern Association for Information Systems* (SAIS2006), Mar. 11-12, Jacksonville, Florida, USA (http://sais.aisnet.org/2006/Vat-SAIS2006-paper.pdf).
- Vat, K.H. (2005). On the importance of human activity systems in organization modeling for IS development. Presented and published in the *CD-Proceedings of the Eighth Annual Conference of the Southern Association for Information Systems (SAIS2005)*, Feb. 25-26, Savannah, Georgia, USA.
- Vat, K.H. (2004). Towards a learning organization model for PBL: A virtual organizing scenario of knowledge synthesis. Presented and published in the *CD-Proceedings of the Seventh Annual Conference of the Southern Association for Information Systems* (SAIS2004), Feb. 27-28, Savannah, Georgia, USA.
- Vat, K.H. (2003). An IS-based architectural modeling for learning organization:

A conceptual walkthrough. Presented and published in the *Proceedings of the Sixth Annual Conference of the Southern Association for Information Systems* (SAIS2003), Mar. 7-8, Savannah, Georgia, USA, pp. 55-62.

- Vat, K.H. (2002). Developing learning organization strategy for online education: A knowledge perspective. Presented and published in the *Proceedings of the Fifth Annual Conference of the Southern Association for Information Systems* (SAIS2002), Mar. 1-2, 2002, Savannah, Georgia, USA, pp. 291-298.
- Vat, K.H. (2001). Addressing IT/IS personnel shortfall: Some PBL students' findings and recommendations. Presented and published in *Proceedings of the Fourth Annual Conference of the Southern Association for Information Systems* (SAIS2001), Mar. 2-3, Savannah, Georgia, USA, pp. 52-60.

These are annual conferences organized by the Southern Association for Information Systems (SAIS), a subsidiary of the Association of Information Systems (AIS). The acceptance rate has been consistently set close to 45% to the best of my knowledge.

AITP

- Vat, K.H. (2005). Teaching a collaborative model of IS development through problem-based learning. *CD-Proceedings (ISSN: 1542-7382) of the 2005 Information Systems Education Conference* (ISECON2005), Oct. 6-9, Columbus, Ohio, USA. (Currently Accessible from http://isedj.org/isecon/2005/5112/index.html).
- Vat, K.H. (2002). On the importance of organization modeling for IS education. Presented and published in the *CD-Proceedings (ISSN: 1542-7382) of the 2002*

Information Systems Education Conference (ISECON2002), Oct. 31 - Nov. 3, San Antonio, Texas, USA (http://isedj.org/isecon/2002/244b/index.html).

- Vat, K.H. (2001). Towards a learning organization model for knowledge synthesis: An IS perspective. *CD-Proceedings of the 2001 Information Systems Education Conference* (ISECON2001), Nov. 1-4, Cincinnati, Ohio, USA (http://isedj.org/isecon/2001/09a/index.html).
- Vat, K.H. (2005). Systems architecting of IS support for learning organizations: The scenario-based design challenge in human activity systems. *Information Systems Education Journal (ISSN: 1545-679x)*, Volume 3, Number 2, July (http://isedj.org/3/2/).
- Vat, K.H (2003). Architecting of learning organizations: The IS practitioners' challenge in systems thinking. *Information Systems Education Journal (ISSN: 1545-679x)*, Volume 1, Number 26, December (http://isedj.org/1/26/).

The ISECON conference is the flagship conference organized by the Education Special Interest Group (EDSIG) under the AITP Foundation for Information Technology Education. It is the premier conference for information systems education, with an acceptance rate close to 45%, dealing with different issues closely related to my work in software engineering education, and the 2005 conference (ISECON2005) was the twenty-second conference on the road. The international refereed journal "Information Systems Education Journal (ISEDJ)" is published online by EDSIG.

CCSC

- Vat, K.H.(2001). Web-based asynchronous support for collaborative learning. *Journal of Computing in Small Colleges (official publication of Consortium for Computing in Small Colleges, CCSC)*, Volume 17, Number 2, December, pp. 310-328 (Available from http://portal.acm.org/dl.cfm: Search "JCSC, Vol. 17, No. 2").

  The Journal of Computing in Small Colleges (now renamed The Journal of Computing Science in Colleges) is the flagship journal produced by the Consortium for Computing in Small Colleges (now renamed Consortium of Computing Science in Colleges). It is a journal dealing with the topics of educational concerns in Colleges, especially those related to information technology, such as technology-enhanced learning.

IADIS

- Vat, K.H. (2004). Toward a learning organization model for student empowerment: A teacher-designer's experience as a coach by the Side. Presented and published in the *Proceedings of the 2004 IADIS International Conference on Cognition and Exploratory Learning in Digital Age* (CELDA2004), Dec. 15-17, Lisbon, Portugal, pp.131-140.

  The CELDA is an annual international conference held by IADIS. It is a conference devoted to discussing the various issues of cognition and exploratory learning behind the education of information technology, information systems, computers science, and software engineering.

The acceptance rate was set to 35% in the conference where my paper was published.

IEEE

- Vat, K.H. (2004). Conceiving a learning organization model for sustainable development: The IS manager's perspective based on soft systems methodology. Presented and published in the *Proceedings of the IEEE International Engineering Management Conference 2004* (IEMC2004), Oct. 18-21, Singapore, pp. 500-504.

  This conference was organized by the IEEE Engineering Management Society (EMS), the IEE Management Professional Network, and the IEEE EMS Singapore Chapter.

IIIS

- Vat, K.H. (2004). Conceiving scenario-based IS support for knowledge synthesis: The organization architect's design challenge in systems thinking. Presented and published in the *Proceedings of the 10th International Conference on Information Systems Analysis and Synthesis* (ISAS2004), Orlando, Florida, USA, July 21-25, pp.101-106.

- Vat, K.H. (2004). On the idea of soft systems methodology for IS development: A perspective based on purposeful action. Presented and published in the *Proceedings of the International Conference on Computing, Communications and Control Technologies* (CCCT2004), August 14-17, Austin, Texas, USA, pp. 227-232.

- Vat, K.H. (2002). Engineering component-based knowledge applications for e-learning organizations: The software architects' challenge in organizational transformation. Presented and published in *Proceedings of the Sixth World Multi-Conference on Systemics, Cybernetics and Informatics* (SCI2002), in Orlando, Florida, USA, July 14-18, Vol. 1, pp.262-267.

These are international conferences, sponsored by IIIS, with a relatively high acceptance rate, close to 50%. The ISAS conference is quite organized with a dedicated focus in information systems analysis and synthesis, which is quite consistent with my ongoing research. Yet, the quality of the CCCT and SCI conferences are mixed with a large number of tracks intended to attract a large crowd. My papers published in those conferences could stand by themselves anyway.

IRMA

- Vat, K.H. (2005). Developing a learning organization model for problem-based learning: The emergent lesson of education from the IT trenches. *Journal of Cases on Information Technology (ISSN 1548-7717)*, 8 (2):82-109.
- Vat, K.H. (2003). A context-based organization modeling for e-learning initiatives. *Proceedings of the 2003 Information Resources Management Association International Conference (IRMA2003)*, May 18-21, Philadelphia, Pennsylvania, USA, Vol.2, pp. 651-652.
- Vat, K.H. (2002). Conceiving service-based architecture and process for quality software education. Presented and published in the *Proceedings of the 2002*

Information Resources Management Association International Conference (IRMA2002), May 19-22, Seattle, Washington, USA, Vol.1, pp. 817-820.

The International Conference on Information Resources Management is the premier conference of IRMA held annually to attract scholars and researchers around the world to discuss issues related to management of information resources, including the education of information systems, information technology, and software development. The acceptance rate is found to be close to 60%. The Journal of Cases on Information Technology is an important publication of IRMA, detailing cases of IT applications and their development. Acceptance in this Journal must have the feedback of three reviewers, plus the recommendation from the Associate Editor. It is quite a prestigious journal in the field.

ISI

- Vat, K.H. (2005). Modeling human activity systems for collaborative project work: An IS development perspective. *Journal of Issues in Informing Science and Information Technology (ISSN: 1547-5859 CD Version)*, Volume 2, June, pp. 49-65 (http://2005papers.iisit.org/I05f65Vat.pdf).
- Vat, K.H. (2004). On the idea of organization transformation: The IS/IT design challenge in systems thinking. *Journal of Issues in Informing Science and Information Technology (ISSN: 1547-5859 CD Version)*, Volume 1, June, pp. 0941-0950 (http://articles.iisit.org/120vat.pdf).
- Vat, K.H. (2003). Toward an actionable framework of knowledge synthesis in the

pursuit of learning organization, Presented and published in the *CD-Proceedings of the 2003 Informing Science + IT Education Conference (InSITE2003)*, in Pori, Finland, Jun. 24-27, pp.1085-1100.

- Vat, K.H. (2002). Teaching architectural approach to quality software development through problem-based learning. Presented and published in the *CD-Proceedings of the 2002 Informing Science + IT Education Conference* (InSITE2002), in Cork, Ireland, Jun. 19-21.

The InSITE conference is an annual international conference organized by the Informing Science Institute (ISI). It deals with the areas of information technology education and the specific issues of informing clients. It is applicable to the context of my action research in educating mature software developers because so many projects fail because of the inability to have good communications with clients. The acceptance rate of InSITE is consistently set close to 40%. The international refereed journal "Journal of Issues in Informing Science and Information Technology" is published by ISI. Papers of high quality from InSITE are to be published in this journal after critical revision.

NAISO

- Vat, K.H. (2002). Developing e-learning architectures for communities of practice: A knowledge perspective. Presented and published in the *CD-Proceedings of the 2002 World Conference on Networked Learning in a Global Environment: Challenges and Solutions for Virtual Education* (NL2002),

May 1-4, Berlin, Germany.

This conference was an international NAISO congress on networked learning, held at the Technical University of Berlin, Berlin, Germany. The conference was of high quality, especially from the papers presented and published along the theme of challenges and solutions for virtual education, and my paper was included in the CD-Proceedings as a Short Paper. The acceptance rate for NL2002 was close to 50%.

UNIVERSITY-AS-SPONSOR CONFERENCES

- *Siam University, Bangkok, Thailand*

  Vat, K.H. (2004). Putting the university online: A learning organization model for electronic transformation. Presented and published in the *Proceedings of the 3rd International Conference on ICT and Higher Education* (e-University 2004), Aug. 31 - Sep. 2, Bangkok, Thailand, pp.135-148.

- *McMaster University, Hamilton, Ontario, Canada*

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- *Tsinghua University, Beijing, China*

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- *South China Normal University, Guangzhou, China*

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- *Hong Kong Polytechnic University*

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- *IRM Press*

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1.9.7 Acknowledgements for Your Reading and Feedback

I sincerely hope that this thesis could serve well as a vehicle to

communicate to the audience my current understanding of what it means to do learning-centered education, especially in the undergraduate software engineering curriculum amidst the challenge of the twenty-first century. I am conscious of my own limitations in presenting my views, and I very much welcome your feedback after your thoughtful reading of the material contained herewith. As a closing, please allow me to share some thought of knowledge contribution in this final section of the chapter.

- *Knowledge as a possession*

  Through formal education, I have been deeply influenced by this knowledge-as-possession approach, which refers to knowledge as an important resource of any organization. This thinking may be traced to the philosophy of modernism (also called positivism-empiricism) (Cooper & Burrell, 1988; Reed, 1993). As a philosophy of scientific enquiry, modernism emphasizes the role of observation, measurement, and testing in science. It depicts the whole world as a set of tangible, physical things. Indeed, the world is analogous to a huge set of building blocks of different shapes, colors, and sizes. Each type of block represents some aspect of the world, from atoms to animals. Careful observation of the world will enable the researcher to gain knowledge of what is in the world. Knowledge is gained by observing the different elements as well as their interconnections to each other. The sort of knowledge that people want to acquire is knowledge about what the world consists of, what the different things are that exist in

the world, how the world works, and how the different components are interrelated. Meanwhile, once a person has acquired knowledge, he or she possesses a representation of part of the world, a sort of blueprint, which can then be passed on to others. That knowledge, which is depicted as an entity, can be stored, expanded, and distributed. Once people have knowledge, they have an understanding of how the world works and can predict what will happen. People who possess knowledge have the power to control what will happen in the world, and therefore, to change the way the world works in order to attain goals identified as necessary or desirable or in order to correct problems or deficiencies in the way things work. That is the foundation on which our traditional engineering education is rooted; namely, before we could take effective action, we must have an accurate model of the world, which we gain by acquiring knowledge. Consequently, our teaching is organized as a continuing presentation of important facts, procedures, methods, and models, transferring to our students a subset of the body of knowledge constituting the discipline. Our curricula are specifications of these presentations. Our research programs are a search for new facts, laws, and models that might one day be manifested in our curricula.

- *Knowledge as participative knowing*

  At the beginning of the 21st Century, our traditional understanding of a university as a campus where a faculty of scholarly experts have gathered, where libraries, laboratories, and other shared physical

facilities have been established, and where students seclude themselves for several years in order to prepare themselves for adulthood in civilization and participation in a profession, may have to be adjusted. Libraries are going digital and are becoming accessible by network: powerful computers and instruments can be accessed remotely. The campus is no longer an exclusive domain of access to knowledge. It has been observed that students do not want to prolong their stays on campus. Though they still see the diploma as an important credential to a better job, they believe that to be more valuable to employers, they need less theory and more practice. The number who work part-time and take courses part-time is increasing. What does that mean for the university? What can we, teacher-researchers, do about it? In the universities, we regard research as a formal process of generating new knowledge for accretion to the human store of knowledge. We consider research to be the first step in a linear pipeline that transfers new ideas into products, say, the education of our students transforming them into professionals in their selected domains. It is my belief that the flow through the pipeline, though a slow and rigorous process, must accommodate the social nature of knowing which leads to questions about organizations as social groups and about what organizations know and how people use knowledge. Such questions require us to consider the notion of knowledge creation much more thoughtfully, including what knowledge is and how it is used in everyday life. Scholars like Polanyi (1973), Schutz (1972) and Gadamer (1975),

have expressed their ideas from a tradition of Western intellectual thought referred to as “interpretive understanding,” which associates knowledge with the way people understand or see things; namely, with the way they interpret their circumstances. Compared with the modernist view of knowledge as a thing that can be possessed in the form of “facts about the world,” the interpretive tradition relates knowledge to peoples’ understanding. Understanding is considered as interpretation, and interpretation as a social process in which people come to make sense of things in the context of their relationships with other people and against the background of the diverse meanings that are given to things by groups with different languages and varied cultures (Addleson, 1995). Since knowing, as interpretation, relies on meanings that people give to things, in particular social circumstances, this view of knowledge is also called social constructionism (Berger & Luckman, 1967; Mangan, 1987). Through social constructionism, instead of regarding knowledge as something derived from the world, the world is a reflection of how social groups have learned to see it. The world is the meaning people give to things. Knowing is to understand those meanings and making sense of the world in order to make one’s way in life. It is in this context of social constructionism that my ideas of student learning are born that we need to teach students how to make connections (Addleson, 2000) between organizing to learn and organizing to know. In the process, the teacher-researcher will constantly be making decisions regarding the goals to be achieved and the resources needed, and reflecting on

whether or not the goals were met.

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