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Statement of Research Philosophy

Background

I am glad to have concluded my doctoral study in early 2011 after completing the important oral defense with a unanimous PASS of "Very Good with Distinction" delivered by the Examination Committee chaired by Rector Wei Zhao. I am deeply grateful to be able to complete my doctoral study here in Macau where I was born in 1964 of a humble family with an origin from mainland China, and to have been conferred with the degree of *Doctor of Philosophy in Software Engineering* by the University of Macau (UM) in the year of her 30th Anniversary, on 2011JUN07, as indicated in my Certificate of Graduation signed by Rector Zhao.

No doubt, the doctoral degree is the very highest accomplishment that can be sought by students. It signals that its recipient is now ready, eligible, indeed obligated, to make the most dramatic shift in roles: from student to teacher, from apprentice to master, from novice or intern to independent scholar and leader. The PhD degree marks the holder as one charged to serve as a steward of the discipline and profession. It is indeed no accident that the entire process of my doctoral education culminated when all members of the university community dressed in religious robes and engaged in an act of ordination of the novice by the master(s) with a priestly hood on 2011NOV05.

Meanwhile, it is my experience that doctoral education is a complex process of formation, with the connotation of preparation for the professions. But, formation should not only point to the development of intellectual expertise, but also point to the growth of the personality, character, habits of heart and mind and the role that he or she given discipline is capable of and meant to play in academe and society. What is formed is the scholar's professional identity in all its dimensions through a process of growth that the student himself or herself must shape and direct. It is, in retrospect, convinced that when students could take more active roles, more responsibility for their own progress and development, whether by using new tools, say, the portfolios, for documenting and reflecting on learning progress; by pursuing connections between research and teaching; or by participating in departmental deliberations about the structure and effectiveness of their own doctoral program, such an experience of scholarly formation should engender the vision of doctoral education of our future.

My Framework of Research Practices

It is my conviction that completing my doctoral study is only a small part of the research behind my journey into REALSpace (the core of my doctoral thesis research on Rich Environment for Active Learning Space). The thesis work is meant to be a journey into the future of my exploring higher computing education in Macau, or at least at the University of Macau. Many of the ideas presented throughout my thesis, are constantly being followed up, reworked, and expanded. It would be pompous to say my research concludes with the conferment of my PhD degree. Instead, I have always felt that completing the dissertation has just landed me on the verge of something more: I have just begun a new cycle of research, as being demonstrated by my continuous streams of publications over this past decade of my academic work.

Indeed, reflecting on the lessons learned throughout the thesis period, I have come to appreciate the meaning of iterative inquiry - each cycle of iteration yields a greater understanding and more closely approximates the core of the whole. If I were to compare my thesis research to the formulation of the mess, there are at least three phases of activities expected in developing my next stage of research work: searching, mapping, and story telling.

1. *Searching* - This is the iterative examination that generates information, knowledge, and understanding about the system of problems and its environment. It could be considered as an act of system analysis in which I have to develop snapshots of the REALSpace system and its environment of higher learning institution, including the theme of learning-centered education. The search phase helps identify a large number of obstructions (contexts of ideas to be clarified) whose iterations must be understood in order to make sense of the essence of the mess. I have to synthesize the obstructions into themes of exploration. Each theme should be defined clearly so there is a basic clarification about what it represents.

2. *Mapping* - Mapping the mess is the heuristic process of defining some interactions of the themes, representing the emergent properties of the mess. Here I have to apply learning from soft systems methodology (SSM), scenario-based design (SBD), user experience (UX) design, and the virtual organizing context for blended learning on the basis of appreciative inquiry (AI), to make sense of REALSpace and its AKE (Appreciative Knowledge Environment) services.

3. *Storytelling* - Telling the story that reveals the desirable future as implicit in the current mess, say, after applying SSM and SBD, requires the ability to synthesize separate findings into a coherent whole. Proper packaging and communicating of the underlying message from the mess, is considered as important as the content of the mess itself. And it is critical to be able to present understanding from different perspectives of the mess.

Indeed, without some synthesizing method (enabling light) to start the search process, to modify and to verify initial assumptions, and to evolve closer and closer to a satisfactory notion of the whole, this process of discovery (research involving a cross-disciplinary approach), would be an experience as frustrating as that of the blind men trying to identify an elephant, referring to the discovery of the contextual details in REALSpace.

The ability to see the whole in REALSpace (such as the interrelation of the different human activity systems, HAS's) requires a way of thinking different from analysis; it requires systems thinking, which is based on the synthetic approach. Namely, it views any system to be created, in the context of the larger environment of which it is a part, and studies the role such a system plays in the larger whole. In contrast, analytic thinking, the essence of classical science, assumes that the whole is nothing but the sum of the parts, and understanding the structure is both necessary and sufficient to understand the whole. In this regard, the use of scenarios to conceive and to test-drive the process of requirements gathering, analysis and management for REALSpace, presents a lot of meaningful challenges. I need to implement a research program that is thoughtfully planned out, focused, and specialized building on top of the results cumulatively established. The overarching criterion is to aim for precise, sustainable, interrelated research that has depth, involving a legitimate domain (higher education) with various ill-defined information and/or knowledge requirements, explored through systems architecting of a Web environment (conglomeration of various information systems support) with different appropriate means such as soft systems methodology (SSM), and scenario-based design (SBD), in the context of collaborative software engineering (CSE).

My Current Research Agenda

A meaningful scenario to continue exploring in REALSpace is the *Course Portfolio System* for *Peer Review* (to enhance effective teaching) and for *Collaborative Analysis of Student Work* (to help improve student learning). It is a system conceived and built on the context of learning-centered design. And it is explored using a socio-technical perspective, on the Web platform, as one of many plausible sub-systems in REALSpace, to be used by faculty members from different or same department, to fulfill shared responsibility for student learning. Some essential components made available in the system for faculty members to help perform such tasks as *Peer Review* and *Collaborative Analysis of Student Work*, include the learning-centered syllabus and running/archived course portfolio from each of the courses offered in the related undergraduate or graduate programs.

Learning-Centered Syllabus (LCS)

To enable students' awareness of faculty expectations for them and the plans that have been established for their learning experience, they need more comprehensive information than the traditional syllabus provides. It is believed that the clearer the picture our students have of what is expected of them to be able to do by the end of the course, and the greater their understanding of what their role will be and of the criteria that will be used to determine success or failure, the more effective the course will be. A learning-centered syllabus is based on the question, "What information will help students succeed in this course?" Using such a syllabus can improve learning and, at the same time, avoid many of the frustrations caused by poor communication. In addition, providing students with more information about the goals of the course, and the rationale behind any new instructional approaches that might be used, can significantly reduce the resistance to change and frustrations so common with most students. The learning-centered syllabus represents a significant point of interaction, often the first, between faculty member and students. If thoughtfully prepared, such a syllabus will demonstrate

the interplay of our understanding of students' needs and interests, our beliefs and assumptions about the nature of learning and education, and our values and interests concerning course content and structure.

Rationale - The LCS represents a paradigm shift away from what we will teach to what our students will learn, so that we as faculty members will serve less as a disseminator of knowledge than as a facilitator of learning. It calls for changes in how we think about the courses we teach, how we design students' learning experiences, how we use class time and our students' time outside of class, what we expect from our students, and what they can expect from us as faculty. All these information will be captured in the course portfolio during its preparation, enactment, evaluation, and archival stages, so as to allow peer review at different times of interest for continuous course improvement.

LCS and Course Portfolio Requirements - It is understood that faculty members often invest a great deal of time in improving the content and structure of our courses, the quality of the materials we use, and the equity of our examinations. Yet, if our students do not understand their assignments, if they study the wrong content for a test, or are confused about how grades will be determined, they will not learn effectively. Such problems can be avoided with the installation of a LCS and subsequent course portfolio. In a review of the problems faced by students, a course-approval committee at the University of Maryland identified a series of important questions that were repeatedly not answered in the syllabi or course portfolios provided by the faculty to their students:

1. Why would a student want to take this course?
2. What are the course objectives? Where do they lead, intellectually and practically?
3. What are the pre-requisites? What does the faculty member assume that the students already know? Will the missing necessary skills be taught during the course?
4. Why do the parts of the course come in the order they do?
5. Will the course be primarily lecture, discussions, or group work?
6. What does the professor expect from the students?
7. What is the purpose of the assignments?
8. What will the tests test: memory; understanding; ability to synthesize, to present evidence logically, to apply knowledge in a new context?
9. Why have the books been chosen? What is their relative importance in the course and in the discipline?

Focused Systems to be Served - How to install the organizational systems for Peer Review and for Collaborative Analysis of Student Work. These are research to be elaborated before any computing support could be conceived. The continuing work requires a scalpel approach where the research must be pinpointed, specialized, systematic and interrelated, just as those stories articulated in the context of my thesis for REALSpace.

Selected Publications

Vat, K.H. (2009), "Developing REALSpace - Discourse on a Student-Centered Creative Knowledge Environment for Virtual Communities of Learning," in International Journal of Virtual Communities and Social Networking (ISSN: 1942-9010), Vol. 1, No. 1 (January - March) pp. 43-74 (http://www.igi-global.com/journals/details.asp?id=7954).

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). Information Science Reference (IGI Global Inc.): Hershey, USA, pp. 941-949.

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). Information Science Reference (IGI Global Inc.): Hershey, USA, pp. 391-397.

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; Release Feb-2008). Information Science Reference (IGI Global Inc.): Hershey, USA., pp.508-515.

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; Release Nov-2005). Idea Group Reference (Idea Group Inc.): Hershey, USA, pp. 547-555.

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; Release Nov-2005). Idea Group Reference (Idea Group Inc.): Hershey, USA., pp. 246-256.

My Loci of Academic Research

Undeniably, the mystique of the doctorate is the means of reproduction in the academy: namely, an incessant quest for knowledge through research. The denouement of the doctorate, the dissertation, is perceived to be not only a piece of original research intended to set its writer apart from all who precede him or her; it is also a celebration of the scores of scholars on whose shoulders any piece of individual scholarship rests. The doctorate as an institution should provide the stability and tradition that renders scholarship a human activity that transcends generations, cultures, and contexts. It is a symbol of innovation and a defender of the faith. In this regard, I fully identify with the late Ernest Boyer's exposition of the four domains of scholarship in his 1990 title "*Scholarship Reconsidered: Priorities of the Professoriate*":

1. *Scholarship of teaching* - This is the development and improvement of pedagogical practices. It is believed that effective teachers engage in scholarly teaching if they undertake assessment and evaluation to promote improvement in their own teaching practice. Indeed, scholarly teaching activity becomes scholarship of teaching when faculty members make their teaching public by opening it to review and critique by peers in their disciplines through publications and presentations.

<u>Selected Publications</u>

Vat, K.H. (2006), "Integrating Industrial Practices in Software Development through Scenario-Based Design of PBL Activities: A Pedagogical Re-Organization Perspective," in Journal of Issues in Informing Science and Information Technology (ISSN: 1547-5859 CD Version), Volume 3, June, pp. 687-708 (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," in Journal of Cases on Information Technology (ISSN 1548-7717), Volume 8, Number 2, April-June, pp. 82-109.

2. *Scholarship of discovery* - This is traditional research which UM considers as the scholarship of the creation of new knowledge. It requires creative and critical thought, research skills, publication in peer-reviewed journals and books, and presentations at disciplinary conferences.

Selected Publications

Vat, K.H. (2009), "Developing REALSpace - Discourse on a Student-Centered Creative Knowledge Environment for Virtual Communities of Learning," in International Journal of Virtual Communities and Social Networking (ISSN: 1942-9010), Vol. 1, No. 1 (January - March) pp. 43-74 (http://www.igi-global.com/journals/details.asp?id=7954).

Vat, K.H. (2005), "Systems Architecting of IS Support for Learning Organizations: The Scenario-Based Design Challenge in Human Activity Systems," in Information Systems Education Journal (ISSN: 1545-679x), Volume 3, Number 2, July (http://isedj.org/3/2/).

3. *Scholarship of application* - This form of scholarship involves the use of a scholar's disciplinary knowledge to address important individual, institutional, and societal problems. Scholars who engage in this type of work, also called the scholarship of engagement and outreach, must be able to solve problems of importance to diverse stakeholders such as policymakers, and community members, and to communicate effectively with their audiences in language understandable to persons without disciplinary expertise.

Selected Publications

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). Hershey, PA, USA: Information Science Reference (IGI Global, Inc.)(http://igi-global.com/Bookstore/Chapter.aspx?TitleId=46475), pp.207-225.

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). Hershey, PA, USA: Information Science Reference (IGI Global, Inc.) (http://www.igi-global.com/reference/details.asp?id=34559), pp. 48-69.

4. *Scholarship of integration* - This form of scholarship makes connections within and among disciplines. When disciplinary and inter-disciplinary knowledge is synthesized, interpreted, and connected, the work brings new insight to original research. The products include policy papers, reflective essays, research translations, popular press publications, synthesis of the literature on a topic, and textbooks.

Selected Publications

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). Information Science Reference (IGI Global Inc.): Hershey, USA, pp.27-38.

Vat, K.H. (2011), "Knowledge Synthesis Framework," in D. Schwartz and D. Teéni (Eds.), Encyclopedia of Knowledge Management, 2nd Edition (ISBN 978-1-59904-931-1). Information Science Reference (IGI Global Inc.): Hershey, USA, pp.955-966.

In the context of the University of Macau (UM), in the occasion of our new campus development, I would like to add one more scholarship, Scholarship of Leadership, in support of our 4-in-1 model of elite education be it in the undergraduate or in the graduate level:

5. *Scholarship of leadership* - This form of scholarship is meant to develop leaders for elite education. The goals are to enable faculty members to engage in curriculum directions, innovative teaching, pedagogical/educational research and development, as well as institutional leadership at all levels of education. It is an initiative/program in the making (using a figurative sense), through allowing a variety of educational methods and providing a broad curriculum in educational theory, assessment and evaluation, research design and methodologies, teaching and learning enhancement, and through reframing peculiar educational leadership, such as how best to put into practice and to evaluate outcomes-based teaching, learning, and assessment, in line with the institutional, faculty, and departmental educational goals, to produce all-round graduates with desirable attributes as expressed in the institution's mission statement.

Selected Publications

Vat, K.H. (2012), "Innovating Elite Undergraduate Education through Quality Continuous Improvement: A Learning Enterprise's e-Transformation Perspective," in Hakikur Radman and Isabel Ramos (Eds.), SMEs and Open Innovation: Global Cases and Initiatives (ISBN 978-1-61350-519-9). Hershey, PA, USA: Information Science

Reference (IGI Global, Inc.) (http://www.igi-global.com/book/smes-open-innovation/55285), pp. 146-182.

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. Hershey, PA, USA: Information Science Reference (IGI Global Inc).(http://www.igi-global.com/Bookstore/TitleDetails.aspx?TitleId=37343), pp. 259-290.

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). Hershey, PA, USA: Information Science Reference (IGI Global, Inc.) (http://www.igi-global.com/reference/details.asp?ID=34829), pp.183-206.

My Foci of Research Interests

As a teacher-researcher, my vocation is to work with students, colleagues, and collaborators to educate computing practitioners (be they become software engineers, computer scientists, instructional designers, e-learning officers, and/or educational technologists), to discover new knowledge, and to improve the prestige of the faculty members, staff, and students in the faculty. Accordingly, I have maintained an active and sustainable stream of inter-disciplinary research activities as a faculty member at UM. My main research areas are software engineering and information/instructional systems development, as well as the education of computing professionals, in the related disciplines of software engineering, computer science, information systems, or information technology, not excluding instructional design and educational technologies. Nonetheless, the gist of my research interests can be characterized by a brief description as follows:

Social Paradigm of Computing: Soft Systems Methodology (SSM), Scenario-Based Design (SBD), and Human Activity Systems (HAS) in Systems Architecting (Organizational Modeling + Software Development)

It is my observation that the engineering of software has long been associated with the scientific paradigm of computing, as the term ‘software engineering’ was first coined in the 1968 NATO conference, along the line of traditional branches of engineering, based on the scientific method of investigation whose power lies in the repeatability of its results which are often used in the context of engineering applications. Yet, the repeatability of experimental results stems mainly from the fact that the phenomena investigated must be homogeneous through time. This point highlights many a difficulty for those human phenomena which could not match that strong criterion, making complete repeatability impractical, especially in the context of organizational development. When applied in the setting of organizational software development, it is no secret to witness the inadequacy of the conventional engineering approach consisting of the following stages (Wilson, 1990), with stages 2 and 3 being plausibly iterative: 1) define the problem, 2) assemble the appropriate techniques, 3) use techniques to derive possible solutions, 4) select most suitable solution, and 5) implement the solution. This

structured approach to conceiving software solutions for organizational knowledge work, often assumes the objectives are undisputed, so that problems are confined to 'how to do it' type. Yet, it is very unlikely for human phenomena to be homogeneous through time.

Indeed, in many an organizational context, what usually makes the situations problematic is the difficulty to define precisely the objectives, or rather what the problem is, given the changing, multiple, ambiguous, and conflicting alternatives abounding. Typically, if there will be a number of people concerned with or involved in the problem situation, it is not surprising that there will be a number of legitimate problem definitions. Therefore, the method of solution, unlike the structured approach above, has to start by defining, not a problem but a situation that is problematic, namely, such a situation may not present a well-defined problem to be solved out of existence. Yet, its stages of development could be characterized as follows with plausible iterations in stages 3, 4, and 5 (Wilson, 2001): 1) define the situation that is problematic, 2) express the situation with different sets 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 as the problems to be tackled, and 7) implement the change processes.

What this means for software development in an organizational context for IT (information technology) or IS (information systems/instructional systems) support, today, especially in an age of Internet-enabled knowledge society, is that we need a social paradigm of computing that could fit into the human situation of concerns. The investigation of soft systems methodology (SSM) originated from Professor Peter Checkland in Lancaster University in England, and scenario-based design (SBD) popularized by Professor John Carroll of PSU in the US, fits into the big picture of this paradigm of software development. The use of human activity system (HAS) as an intellectual construct to hook up SSM with SBD in the context of systems architecting (organizational modeling and software development) has been my consistent research interest.

My Roadmap of Research Activities

According to Edward de Bono (1999) in his *New Thinking for the New Millennium*, the thinking of the last millennium has been concerned with 'what is' – the thinking of analysis, criticism and argument. We are advised to concentrate on thinking concerned with 'what-can-be.' This is thinking that is creative and constructive and seeks to solve problems and conflicts by designing a way forward. The emphasis is on design, not mere judgment – a theme that is worthy of our attention. On the nature of inquiry, classical science is preoccupied with independent variables. It assumes that the whole is nothing but the sum of the parts. Accordingly, to understand the behavior of a system, we need only to address the impact that each independent variable has on that system. However, increasingly we are finding out that our independent variables are no longer independent and that the neat and simple construct that served us beautifully in the past is no longer effective in real practice.

As systems become more and more sophisticated, the reality of interdependency becomes more and more pronounced. Understanding interdependency requires a way of thinking

different from analysis; it requires synthesis. Analytical thinking and synthetic thinking are quite distinct. The former comprises typically a three-step thought process. First, it takes apart that which it seeks to understand. Then it attempts to explain the behavior of the parts taken separately. Finally, it tries to aggregate understanding of the parts into an explanation of the whole. Synthetic thinking uses a different process. It puts the system in the context of the larger environment of which it is a part and studies the role it plays in the larger whole. In fact, the ability to synthesize separate findings into a coherent whole and the ability to generate information from different perspectives can be considered as an important part of thinking what-can-be.

Thereby, 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 my continual investigation, could also be conceived in terms of such activities. Indeed, the implicit contributions of Soft Systems Methodology (SSM) (Checkland & Poulter, 2010, 2006), to be continually made explicit in the body of my professional inquiry, are quite consistent with the theme of these multi-faceted activities: 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.

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 are 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 developers 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.

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 has been the intention of my professional inquiry 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.

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.

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.

My Personal Growth Plan

To continue my efforts to make respectable the contributions of software engineering as an evolutionary discipline in the direction of instructional design and educational technologies (e-learning in the context of higher education), it is my intention to set up some new research initiatives through which different emergent aspects of collaborative learning design and educational technologies in e-learning for information and knowledge management in support of college education, can be explored, integrating the contributions from such methodologies as soft systems methodology (SSM) and scenario-based design (SBD).

Rationale – Learning or instructional design and educational technology projects are inherently cooperative, requiring many soft systems analysis and development efforts to produce a useful and usable online learning support system. Learning designers and educational technologists collaborate on many fronts such as requirements specifications,

user/learner experience (UX/LX) design, and rationale management. Integral to this effort is developing shared understanding surrounding multiple artifacts, each artifact embodying its own model, over the entire development process. Instructional design collaboration can thus be understood as artifact-based or model-based collaboration. This focus on model-oriented collaboration embedded within a larger (UX or LX) process is often what distinguishes collaboration research in instructional design (e-learning) from broader collaboration research, which tends to address artifact-neutral coordination technologies: namely, the models provide a shared meaning that instructional designers and educational technologists use when coordinating their work, just as when engineers working together consult a requirements specification to determine how to design a portion of the system.

Related Topics of Interest – Topics of peculiar interest currently under my active investigation in the context of teaching and learning in higher education include the following: inquiry-based learning, outcomes-based assessment, blended learning delivery, and electronic learning portfolios.

Inquiry-Based Learning

In the educational context, inquiry-based learning (or enquiry-based learning) (Hepworth & Walton, 2009) has been recognized as a powerful tool for learning about a subject domain, and more importantly for learning how to learn, as it helps people to develop their independent learning skills. Hutchings (2007, p.13) asserted the following:

> *In inquiry-based learning, the learning is self-directed because it is driven by students' own decisions about appropriate ways in which an issue or scenario might be approached. They bring to bear on the topic any existing knowledge or experience relevant to the issues.*
>
> *No person comes to the table with no knowledge, and the examination and pooling of what is already known allow students to gain confidence, as well as to practice the habit of reflection. They carry out research and investigations into areas that they decide are essential for a proper response to the issue.*
>
> *Thus, they discover how to research by engaging in practical examples. In this way, it may be said that the process of enquiry is in the ownership of the students, so that enquiry-based learning is fundamentally concerned with establishing the context, the space, and the environment within which enquiry may best be stimulated and students can take charge of their learning.*
>
> *The process is student-centered, with the onus always on the students to take initiatives, propose routes of enquiry and follow them thoughtfully. By these means, students also acquire experience in a range of intellectual and social capabilities. These include critical thinking, reflection and self-criticism, teamwork, independence, autonomous thinking and information literacy.*

Outcomes-Based Assessment

The idea behind the context of outcomes-based assessment (Driscoll & Wood, 2007) 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 (Conzemius & O'Neill, 2001) through some collaborative analysis of student works (Boud & Falchikov, 2007). 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. When teachers and students come together to contemplate their collective input – something that had previously most been taken for granted, carried out privately by individual instructors, 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 (Suskie, 2009; Maki, 2010). 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.

Blended Learning Model

The basic principle of a blended learning model is that face-to-face oral communication and online written communication are optimally integrated such that the strengths of each are blended into a unique learning experience congruent with the context and intended educational purpose (Garrison & Vaughan, 2008). It provides a vision and a roadmap for higher education faculty to understand the possibilities of an engaging and meaningful learning experience (Sharpe, Benfield, Roberts, & Francis, 2006). The key assumptions of a blended learning design include (Garrison & Anderson, 2011; Garrison & Archer, 2007): thoughtfully integrating face-to-face and online learning; fundamentally rethinking the course design to optimize student engagement; and restructuring and replacing traditional class contact hours. This opens a wide range of possibilities for redesign that goes beyond enhancing the traditional classroom lecture; however, it must be based on a sound understanding of higher-order learning environments, communication characteristics, requirements of various disciplines, and related resources (Garrison, 2003, 2004, & 2006).

Learning e-Portfolios

The use of portfolios for teaching and documenting student work has been around for a long time in a number of fields (Stefani, Mason, & Pegler, 2007), including portfolios in both composition and creative writing, in the visual arts, and in architecture and interior design. In the context of college education, learning portfolios are those assembled by students for individual courses. They document and reflect upon the ways in which the students have met the outcomes for particular courses. Instructor's endorsement is often required to authenticate the course learning portfolios from students. Program learning portfolios are developed by students to document the work they have completed, the skills they have learned, and the outcomes they have accomplished in an academic department or program. The mentor or appraiser could add comments as feedback. It could be a requirement for graduation. Besides, students might use a selection from their

program learning portfolios to show to prospective employers, as important steps of career planning (Lorenzo & Ittelson, 2005).

Despite being effective as mechanisms for showcasing student work, the traditional paper-based portfolios were not easily shared among audiences geographically distributed, and were not easily modified for different purposes and for diverse audiences. With the advent of the Internet starting in the 1990s, we have witnessed the opportunity to experiment with the concept of electronic learning portfolios (e-Portfolios) (Penny Light, Chen, & Ittelson, 2012; Jafari & Kaufman, 2006; Cambridge, 2001). Still, whatever the major focus of engagement with students, the use of e-Portfolios inevitably adds a strong online element to the teaching and learning activities.

In particular, institutions of higher education need to provide electronic support and services; teachers need access and skills to integrate the e-Portfolio application into their overall course design, and students need a wide range of electronic abilities in order to develop their e-Portfolios. The underlying pedagogy of e-Portfolio use is considered an important link with e-learning, too. It is believed that the use of inquiry-based learning should prove promising in the final analysis.

My Perceived Significance of a Sustainable Research Commitment

As a response to the complexity of the everyday teaching and learning problem situations encountered as a member of an institution of higher education in Macau, in the midst of the knowledge economy, and at the advent of the expanding Internet technologies, it is my intention to set out to see if different ideas from the study of e-learning (instructional design with educational technologies) in the context of organizational (institutional) transformation, knowledge (pedagogical) management, and software development, could help to find ways of understanding and coping with the perplexing difficulties of taking action, both individually and in groups, to improve the situation which is created continuously and changed continually by our daily experiences. Specifically, my continual inquiry should explore the value of the bundle of ideas captured in the notion of the learning organization (university as a learning enterprise), which is investigated as a way to enable knowledge synthesis among a group of people working to achieve a common goal or a set of goals. This could be explored through the development of transformation scenarios in the midst of an organization's transition from the mechanistic hierarchical model to the organic learning organization model.

To study the electronic transformation of an organization from its bricks-and-mortar entity to its clicks-and-mortar counterpart, any investigation must put into perspective the teaching and learning activities in the interest of different communities of inquiry in a university environment, with the ultimate end of providing learning organization information systems (LOIS) support to course instructors adopting the philosophy of learning-centered education (LCE) and the practice of blended learning. In particular, specific cases of electronic course support, developed through scenario-based design, applicable to the LCE style of teaching should be of immediate concerns, as an illustration of how the individual electronic services of a rich environment for active learning (REAL) space could be conceived and established at the university.

Indeed, the process of my professional inquiry should move away from working with the idea of an obvious problem, which required solution, to that of working with the idea of a situation of concerns, which some people, for various reasons, may regard as 'in need of solution.' In the specific context of how to put the learning university online, the problem situation must also be investigated from such dimensions as the technical, the cultural and the political. Some relevant purposeful activity models should then be discussed which account for the context of human activity systems conceived as a vehicle to do organizational modeling and analysis. Also of interest is the elaboration of the changes that would improve the situation, and the accommodations between conflicting interests, which will enable actions-to-improve to be taken.

New information and communication technologies (ICTs), and above all the World Wide Web, hold out many promises for higher education institutions in terms of flexibility, efficiency, quality and access. The vision is that of a learning university with enough virtualization to support its quality knowledge activities. This professional inquiry should seek to uncover what the pursuit of that vision, from the perspective of a learning-centered organization, means for a higher education institution, in terms of knowledge development and transfer, through the efforts of hopefully different dedicated teacher-researchers acting both as an instructional designer, as an organizational architect, and as a software engineer. Therefore, among the perceived contributions of a sustainable research commitment include the following:

- Specific organizational learning to be accrued and shared among institutions of higher education, especially in Macau, in the context of documenting student learning particularly through the use of e-Portfolios;
- Pinpointed case studies of how student learning can be produced and enhanced through different pedagogical and technological designs that are enacted in a blended learning environment, characterized by the use of course or learning management systems;
- Extended understanding and interpretation of the nature of individual and collective participation in inquiry-based learning directed at growth and development in academic (teaching and learning) endeavors in pursuit of excellence (personal or collaborative knowledge creation);
- Close examination of the contextual dynamics (social, cultural, and political analysis) within which technology-enhanced learning in the specific institution of higher education takes place, and how best to respond to and improve the situation of concerns (e.g., culture and learning, educational reform, policy re-orientation).

Finally, but not the least, it is my goal to be able to see to the development and realization of the following system of relevance and excellence:

A university-own system,
operated by skilled professionals,
which, under the learning-centered initiative of college education,
develops and maintains a virtual space of learning,

called *UM REALSpace*, for students, teachers, and administrators, developed through collaborative and participatory approach, in order to contribute to meaningful student learning in relation to curriculum/learning development, and the learning-teaching-assessing (LTA) processes of college education

REALSpace – Rich Environment for Active Learning Space

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