35 TRAINING INFORMATION SYSTEMS PROFESSIONALS TO BALANCE AT THE EDGE OF CHAOS IN A TECHNICAL WORLD

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Abstract

Balancing traditional information systems tertiary education curriculum with creative, intuitive, and process-based learning is the challenge we face as tertiary educators in equipping information systems professionals of the 21st century with the knowledge, skills, and understanding required to manage at the edge of chaos. Merry (1995) suggests that as well as the knowledge, which is out-dated fast in times of accelerated change, the ability to manage self-organized systems that change spontaneously to meet the ever-changing is required. Merry also suggests that we can borrow ideas from chaos theory and apply them to human activity systems and, if periods of chaos in human systems have within them some hidden pattern of behavior of the total system, then we may find ways to uncover the pattern and thus be better able to deal with the situation. Balancing at the edge of chaos requires stability, flexibility, and personal mastery in order to handle the turmoil that occurs in dynamic, ever-changing systems, for it is at the edge of chaos where there is the widest range of behaviors from which to choose. Strategic information systems in organizations will need to be self-organizing. Educating students to accept the evolutionary nature of information systems design is paramount.

Keywords: Information systems, chaos, change, self-organization, action research.

Introduction

Chaos theory suggests that a system in a dynamic state has a particular patterned order in the way in which it changes as a whole even when the future behavior of its components is unpredictable. There may also be sensitive dependencies on initial conditions. The challenge in educating information systems professionals is to equip them with appropriate skills to develop, maintain, and evolve information systems that support complex human activity systems in business and that will provide current knowledge to organizations that are continually evolving. Not only are traditional technical skills required for the multi-faceted activities of information systems, but also the skills to learn, live, and work in a chaotic world. Senge (1990) lists personal mastery and building shared vision as necessary skills for the learning organization. Barrentine (1993), Hansen and Christensen (1995), Merry (1995), Sonnnenberg (1994), and Zukav (1989) all express the necessity for professionals in a chaotic world to develop interpersonal skills to function effectively in this turbulent age.

In this paper, findings from ongoing action research conducted in the previous five years in extending human potential within third-year undergraduate information systems theoretical and project papers is discussed. This research is ongoing, process-oriented, reflective, systems-oriented, and qualitative. The link to chaos theory has evolved, and continues to evolve, during the course of the research.

Knowledge, 21st Century Gold

Merry suggests that knowledge is the most valuable resource of this age. Typically, we are dealing with a nonlinear human world with knowledge born out of linear science, which only exacerbates problems. Living in the knowledge of the past in a world that is bursting into a nonlinear future contains a major threat to the way in which organizations operate. Knowledge should be current and ever-changing, not out-dated. In addition to information systems professionals requiring in-depth knowledge of both client domain and technical, skills-based expertise, they require the ability to span different mindsets. Working and learning in groups with "live" projects enables them to develop a deeper understanding of the depth and breadth of knowledge required.

The Limits of Knowledge

As human beings, we are limited creatures. The structure of society, the particular culture in which we live, the importance placed on rational functioning and intellectualism, the scant attention paid to emotion, physicality, and spirituality all limit the knowledge available to us. We find it easier to stay within our own personal comfort zone and experience resistance in pushing our personal boundaries. However, we need to overcome this resistance if we are to develop into human beings who can live comfortably with evolutionary change. Paradoxically, going outside personal comfort zones can sharpen rational mental processes. Centuries of reductionism has underlined the need to categorize the world into limited sets (Capra and Steindl-Rast 1991). Our

limiting nature has narrowed the acceptable communication bandwidths to written and oral communication. Electronic communication in supporting mainly written communication narrows the bandwidth still further. It is not easy to face the small personal changes that can increase markedly the solution space within organizations. Creativity, on the other hand, does not happen in a vacuum—it must be bounded.

Data, Information, Knowledge, Understanding, and Wisdom

Information systems professionals need to be information designers rather than information seekers and finders, where the task of gathering data, especially electronically, can become an addictive activity. Information is made and unmade in communication. We pass all information through our own filters, changing the message to fit our own internal maps of reality before we pass our version of the message (Ward 1984). Information describes an ordered reality. Information can be "found" by those who have honed their observational skills and techniques. Information varies across time and space, from culture to culture, and from person to person. Information is an instrument of power. Information helps impose order on a chaotic reality. Therefore, an information system can be viewed as a controlling and structuring mechanism for placing order on chaotic reality. The challenge is to match this control and structure mechanism to the underlying pattern in the chaos of reality. The problem (Maturana and Varela 1992; Star 1993) is that we live in a world of multiple realities. This research suggests that relaxing controls, straying outside the bounds of rigid project management, and allowing students to set their own boundaries allows for a richer solution space.

Information Systems

Information systems are a controlling structure in an organization which should be part of an organization's strategic plan. Avison and Fitzgerald (1995) define a formalized information system as a means of providing information on a regular basis and in a predefined manner which should reflect philosophical view of the organization. Information systems development, traditionally, in adopting an information systems development methodology uses linear and technical tools with little attention to the complex human activity system it is to support. The way in which the information system is modeled should reflect the dynamics of the organization. If we consider organizations to be complex human activity systems, then the information systems professional's challenge is designing an information system that is as uncluttered and straightforward as possible while still maintaining the ability to match and reflect the dynamics of the complexity of the organization. To maintain organizational sustainability, complex systems should have the ability to reorganize themselves, not by some outside force but rather the ability to create the form of its own future. Merry suggests that self-organizing systems spontaneously change into more elaborate forms. More refined forms, which may become more straightforward as part of the evolutionary process, seem more appropriate. In dealing with "real" projects in the wider community, students learn the importance of strategic and political solutions alongside developing technical solutions.

Information Systems Development Methodologies

Avison and Fitzgerald define an information systems development methodology as

> [A] collection of procedures, techniques, tools and documentation aids which will help the systems developers in their efforts to implement a new information system. A methodology will consist of phases, themselves consisting of sub-phases, which will guide the systems developers in their choice of techniques that might be appropriate at each stage of the project and also help them plan, manage, control and evaluate information systems projects. An information systems development methodology is usually based on some philosophical view.

In this definition, the underlying theme is that information systems development methodologies must be broken into stages or phases. It is apparent that the influence of science and reduction, the competitive nature of business in the western world, are taken for granted and human beings' limited capacity to understand the gestalt have gone unquestioned as basic assumptions. It also appears that the structure of any particular methodology influences the behavior of the resulting system, both the design process and the final product. In extending and relaxing the boundaries of this definition, while at the same time maintaining the rigor, more creative and holistic solutions can be found. Encouraging students to be independent thinkers, to question theories, and to guide their exploration with careful supervision provides the opportunity for them to look beyond mechanistic, technical solutions.

Chaos

When viewed holistically, repetitive amplification, which enhances differences, particularly amplification that enhances positive differences, gives rise to resonant energy and systems in which emergent properties have the greatest effect. Too many uncertainties can engulf a person, hence the need for developing inner awareness and strength. Traditionally, organizations have been seen as bulwarks against uncertainty. A healthy system fluctuates in and out of balance and out of chaos emerges new forms. Chaos gives us a message that the old ways are no longer adequate. We are moving into an age (Merry 1995) where changing organizations need to transform from rigid to changing structures, from one traditional organizational form to many varied forms of organizations where the boundaries are blurred. For instance, we need to move from traditional hierarchical organizational structures to a variety of networks. Handy (1990) suggest that directed networks with a small number of directors in a loosely-coupled organization is one future course. Semler (1993) has involved employees in participatory decision-making, doing away with middle-order management and bureaucratic record keeping. Balancing the transition from central control to semi-autonomous work units and from competition to cooperation where both teams and individuals are empowered is required. The practice of building management of change into organizations, particularly in the strategic plan where the information system for the organization is integrated and evolutionary, creates a balance between the dynamism of the organization and the inherent, more static nature of the information system. A very

important skill for information systems professional in evolutionary systems design is conflict resolution. Harmonizing working patterns emerge through the conflict resolution process, replacing negative stress-filled situations with positive, motivated workers, producing optimal solutions. Positive energy is released when people feel creative and creative output is the result of flow (Csikszentmihalyi 1979), which is nurtured in a positive environment, where current reality is viewed as an ally not as an enemy. In this research, the development of interpersonal skills to deal with the "people problems" as they arise expands the solution space to include knowledge of how to resolve difficult political situations within teams and with clients.

Educating Information Systems Professionals for the 21st Century

In addition to traditional technical skills, information systems professionals for the 21st century need a collection of personal, interpersonal, and meta-thinking skills that include:

1. Higher-order thinking skills. An effective way to impart higher-order thinking skills is in exposing students to systems thinking. Learning the basics of general systems theory, particularly systemic thinking, provides a basis for developing a holistic, multifaceted view of problem situations. Systems thinking, particularly systemic thinking, equips us with the ability to see wholes, to see interconnections, and to see relationships between parts. Systems thinking gives us a valuable tool to synthesize rather than to analyze. The General Systems Theory community differentiates between a "hard" systems approach and a "soft" systems approach. "Hard" systems are those that rely on initial theory formation, a set of rules or guidelines, mathematical or logical expression of the theoretical model, and definite outcomes. This approach is typical of operations research, systems engineering, systems analysis, cybernetics, and information technology. "Soft" systems, however, are those where there is no definite outcome, where it is difficult, if not impossible, to formulate a theory, and where the whole is considered rather than the parts. Any system that involves people-interactions is, of necessity, a "soft" system. Recognizing the interconnectedness of people, organizations, institutions, and community is an excellent way of increasing the ability to conceptualize. It also exposes students to the recursive nature of systems thinking.
2. Communication skills, both external and internal. Clear and open external communication is required not only within systems development teams, but also with clients and organizations. Equally importantly, internal communication skills are required to develop the self-responsibility and internal integrity required to work effectively in the 21st century. Internal communication skills are discussed further under personal skills required for information systems professionals. Sonnenberg maintains that communication is objective, comprehensive, relevant, credible, cuts through information clutter, open, thorough, prioritized, timely, consistent (actions consistent with words), appealing, frequent, reinforced (through multiple communication channels), coordinated, participatory, and measurable. Final-year project students working in groups have the opportunity to develop such communication skills reinforced with systems thinking, peer evaluation, group and individual

journaling, formal presentations and documentation, and frequent supervisor meetings. Students soon discover that feedback and openness is essential. Communication does not happen effectively until we learn to listen non-judgmentally, acknowledging the other person with integrity, honesty, and openness, and giving feedback as required. Students also need to learn to operate appropriately in a business world where there is a limit to communication bandwidth.

3. Personal skills required by information systems professionals. Barrentine, Fielden (1994), and Sonnenberg all suggest that both inner and outer listening skills are essential for clarity in communication. Self-observation and self-reflection enable learning from each situation, spiraling into deeper understanding. The focus on changing parts of the mind shifts the emphasis from critical training in rational skills to areas where new growth can blossom (Ornstein 1991). The most important skill we can develop in ourselves as educators, and hence impart to our students, is self-observation. Self-observation enhances the capacity to change the way we think. Associations can be made between voluntary acts and their consequences. Developing self-observation gives us greater control over how we react and interact with other people, written material, and the environment. If the skill of self-observation is closely followed by learning the skill of critical self-reflection, then we notice first what happens, question why we react the way we do, see past patterns repeating, and look for new, more informed, ways of thinking and doing. We then have the ability to go beyond unconscious mind-shifts. Not only can we train the rational mind in this way, but also we can learn to use the intuitive mind to tap the collective unconscious (Fielden 1993; Goguen 1991). We can learn what part of the mind is the most appropriate for the task in which we are currently engaged. The intuitive mind needs the right environment in which to work well (Goldberg 1983); however, the environment for the intuitive mind is not one that is highly regarded in the Western world, particularly in technical education. Tools for self-reflection include meditation, relaxation, visualization, walking, running, swimming, and music. What this quiet time in the day does is to allow insights to emerge; it cannot be forced and does not respond to time pressure. This is one of the universal learning processes. Developing emotional intelligence (Goleman 1996) includes increasing self awareness, personal decision-making, managing feeling, handling stress, empathy, communication, self-disclosure, insight, self-acceptance, and personal responsibility. Encouraging groups to resolve conflicts as they occur and providing a role model as a mediator for conflict situation (Fielden 1995) is one way to improve emotional intelligence. Senge lists personal mastery as one of the disciplines required in the learning organization while Torbet (1991) explores the necessity for spiraling self-development and increased self-awareness in interactions with others. These skills include recognizing threats to self and others and dealing appropriately with emotional responses, developing self responsibility, honoring feelings in self and others, developing inner awareness skills including reflective practices, learning to recognize long-term implications as well as short-term goals, learning to resolve conflict and to recognize when outside assistance is required (sometimes the emotional involvement and ego-attachment to the problem situation is too great for those within the team), learning to be positive and to

encourage this in others, learning to give and receive nonjudgmental evaluation and learning to balance technical skills with personal mastery.

4. Reassessing personal goals and rewards. This is difficult to achieve in a competitive, goal-oriented academia, however, success can be found by encouraging mutual support both within and between groups working on final semester projects.
5. Coping with change. Final year students work all year on a "real" project for the local community, business, or government. There is valuable experience in learning to cope with change and resistance to change—both by the students and by their client. Learning to deal with the process of change decreases vulnerability within systems (Boulding 1989). Bridges (1991) suggests that there is a transition stage, a neutral zone between the end of one phase and the beginning of the next, in which the end of the previous phase can be released before the next one is engaged. This implies that the change process is linear, clearly defined, acknowledged, and accepted. For students in dealing with the change process this is rarely the case. The importance of self-organization and self-responsibility in times of change is encouraged. Also, skills in finding optimum levels of change are developed. Learning to view change and/or failure as an opportunity to reflect on what has happened to improve present and future process is incorporated in an evolutionary prototyping approach. Setting appropriate role models as we educate students to be information systems professionals includes letting go of control, allowing chaos to happen, and shifting the responsibility for learning to the student. The traditional authoritarian control is no longer appropriate. In negotiating learning contracts, setting up assignments and projects *with* students, rather than *for* them, we enter into new and largely unchartered territory. Senge talks about personal mastery being one of the qualities required for a new generation of organizations equipped more adequately for coping with rapid change. Becoming aware of inner processing for both academic and student is essential for more flexible learning.
6. Releasing ego attachment. This is vital for peer assessment in teamwork to be effective. Ego uses the past as a reference point to the present and past thought is finite. The present is filled with infinite possibilities. Surrendering ego choice also helps us to see the peace that surpasses understanding and allows intuition to work (Maslow 1968). Ego attachment, on the other hand, stops creative flow.
7. Empowering self and others by being positive, ownership of problem solution and process. If, as we impart knowledge, we also impart our own fears, then this will affect students' ability to learn. Myths about papers considered to be hard by the student body can also affect the way in which students learn. In much the same way those classes that are known to be a challenge, such as a final-year project paper, are also viewed by many as the best learning experience—if the paper is facilitated appropriately. When interpersonal skills are developed, group dynamics explored, conflicts settled as they occur, and positive suggestions for change made, and when the academic-in-charge demonstrates commitment, then the time in the unit for the students is more productive and more enjoyable, and results in a better learning experience. Student feedback suggests that learning how to work with other people in a group, under pressure, and enjoying themselves at the same time, were the most valuable learning experiences.
8. Integrating social impacts into final year project work by evaluating ethical and moral dilemmas encountered in project work. We also need to learn to trust others

and learn together, for when we start any joint project or venture, we find that the group effort is greater than the sum of the individual efforts. (That is, if the group bonds together to achieve a common aim. Groups that cannot bond, for whatever reason, actually achieve less than the sum of the individuals.)

9. Dealing with complexity. "Real life" situations in which we become involved are rarely simple. The most complex problems of all are the ones with which traditional science cannot cope. Maslow said, "If all you have is a hammer, then you will see the world as nails." If we increase our skill base—and not just mental skills—and know our body, emotions, and soul better (and as educators, we do that as part of the responsibility that goes along with the job), then we are much more appropriate role models for our students. Senge suggests that personal mastery is one of the necessary skills for coping with a more complex world. We can also improve our mental ability by learning more about systems thinking and lateral thinking, learning to trust our intuition and learning the art of critical reflection. We can learn to be aware of the incredible impact of our ego on any interactions we have with others. As educators, when we lock ourselves away in some esoteric research field, and distance ourselves from others—students, staff, and family alike—we are neither providing good role models nor are we gaining personal mastery.
10. Integrating critical reflection. There is always the temptation to dismiss subjectivity as "fuzzy," "touchy-feely,""soft," or not rigorous enough. It is critical reflection that maintains the rigor in subjective research. Every experience becomes an opportunity on which to observe, reflect, learn, and act. Every action can be regarded as the opportunity to watch for outcomes, whatever they might be. Developing critical reflection means that we are less likely to dismiss the outcomes that don't fit with previous notions. Critical reflection is a valuable tool for becoming more flexible in the ways in which we think and learn.
11. Effective role models. Effective role models, not just intellectually but also showing integrity in the service provided, showing a special sense of purpose that underlies visions and goals.

Not only do these skills equip information systems professionals to work more efficiently and effectively, they are also life skills.

Conclusion

> Yet to characterize the mind as primarily rational is an injustice; it sells us short, it makes us misunderstand ourselves, it has perverted our understanding of our intelligence, our schooling, our physical and mental health. Holding up rationality, and its remorseless deliberation, as the model of the mind has, more importantly, set us along the wrong road to our future. Instead of the pinnacle, rationality is just one small ability in a compound of possibilities. [Ornstein 1991]

In addition to traditional technical skills, information systems professionals of the 21st century need to

1. understand the learning process as a meta-skill and to develop flexibility in thinking;

2. develop an awareness of the difference between the long-term implications of imposed solutions and the spontaneous changes of self-organizing systems;
3. have a deep understanding of self and others in complex human activity systems;
4. be adept in questioning underlying cultural, political, and intellectual assumptions;
5. be tolerant, compassionate, and at ease with multiple realities in complex systems;
6. value people as agents of change and technology as the tool;
7. value subjective involvement in technological areas;
8. allow time to explore new ideas and to reflect on possible processes and outcomes; and
9. develop balanced approaches both structurally and creatively to managing change at the edge of chaos.

As long as we can be at peace within ourselves and find the core of our being, then we can become effective information systems professionals balancing at the edge of chaos. This research has shown that students who extend their human potential as they develop as information systems professionals are more likely to cope with accelerating technological change.

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