Running head: KM LEARNING COMMUNITIES AND COMPLEXITY

"*Getting there is not a very neat circle or process*":

An illustrative view of complexity within a knowledge management learning community*

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Biographical sketches

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Abstract

This chapter bridges the thinking and practice of organizational learning, knowledge management and complexity theory by using a case study of a learning system. It describes a learning community as a complex knowledge management system and the impact of dynamic self-assessment as an intervention in order to illuminate its own complexity. A knowledge management learning community of novice human systems interveners utilized the principles of dynamic self-assessment to chart the evolution of the system, using the five characteristics of a learning organization as the self-assessment dimensions. Data was collected through observations and interviews with members of the cohort at the end of year one and the end of year two. Using a case illustration, complex interactive and adaptive processes and emergent possibilities come alive and reveal this system's unique socio-historical trajectory. Self-assessment allowed the community to intentionally tinker with its functioning, and to purposefully create open spaces of possibility.

KEYWORDS: knowledge management, learning communities, complexity theory, dynamic self-assessment, workplace learning

"*Getting there is not a very neat circle or process*":

An illustrative view of complexity within a knowledge management learning community

Knowledge management [KM] refers to any managed process leading to the effective creation, acquisition, access or transfer of valid knowledge (Blackman & Henderson, 2005). KM is a framework that includes systems, procedures, and cultures, in and through which individuals and communities create and validate knowledge. It is a means to capture and share existing individual knowledge and to collectivize it in order to create distributed knowledge that impacts the existing organizational knowledge base. KM includes practices for optimizing access to knowledge for individuals and teams operating within a given system, relevant actionable advice, imported knowledge and experiences from outside the system, and support for sustainable innovation and distributed problem-solving (Gorelick & Tantawy-Monsou, 2005; Desouza & Hensgen, 2005). However, there is a shift in emphasis within the KM field; methods and processes that promote innovative knowledge creation are replacing strategies that only stress dissemination (McElroy, 2000), resulting in second-generation KM.

Learning Communities as KM Systems

Within KM systems, knowledge is focused on: 1) capturing and cherishing what is known; 2) developing organic relationships; 3) capitalizing on the effectiveness of the knowledge about system processes; 4) maximizing the usefulness of knowledge about solutions or problem-solving routines (Earl, 2001); and 5) the production of new procedural knowledge as workplaces experience continual change (McElroy, 2000). Therefore, KM is conceived as an organic process whereby knowledge transferred creates new experts, or new practice knowledge is created in response to changing work conditions. These notions are in line with the concept of communities

of practice or learning communities [LCs][i]. LCs and second-generation KM systems value cognition as the means for generating knowledge and they both approach learning from a socially shared perspective. In this context, cognition is seen as an adaptation of the individual's consciousness to social and cultural interactions. It involves the learner as an active agent in dynamic relation with other active agents. KM systems and LCs are not bound by the limitations of any one person's cognitive capacity or experience. They are comprised of individuals in relationship actively molding and influencing each other's knowledge and reasoning processes. Therefore active agents build epistemology on the basis of what they tell and are told by others (Resnick, 1991). Given their correspondence, we combine KM systems and LCs as KM learning communities within which knowledge unfolds in the meanings, relations, and skillful executions of praxis (Wenger & Snyder, 2000). Here, cognition is seen as co-emergent with environment, individuals, and activity (Fenwick, 2004).

Generally, workplace KM learning communities attempt to generate three kinds of knowledge: 1) "knowing-why" (knowledge about the kind of work they do); 2) "knowing-how" (formal and tacit knowledge, skills, and expertise to perform the work); and 3) "knowing-whom" (knowledge about working relationships within and beyond the workplace) (Arthur, et al., 2004). When generating shared or distributed knowledge, KM learning communities engage people's intrinsic motivation (*knowing-why*) to develop and implement a shared vision and purpose. They incorporate people's skills and ways of interacting (*knowing-how*) into a shared repertoire of practice. As well, they draw on their members' social investments (*knowing-whom*) in each other to create patterns of mutual engagement. As conditions in the market place change, workplace KM learning communities also engage in the process of revising, refreshing, modifying, and innovating knowledge and practice in these three areas.

Assessing KM Learning Community Effectiveness

When considering the effectiveness of KM learning communities, there is often a tension between exploring their two major dimensions: the technical which emphasizes measurement with a linear focus on outcomes and the social which focuses on individual and group learning processes as the foundation of organizational KM (Easterby-Smith & Araujo, 1999). Currently, the most common assessment approach relies on the concept of "KM performance" to describe the improvement between an enterprise's current capabilities and those improved by KM (Tseng, 2008). Within traditional assessment methodology, performance indicators are generally costs, product quality, profit levels, and customer satisfaction (Germain, *et al.*, 2001). However, using a complexity perspective, the focus of assessments can be shifted to relationships, patterns, processes, and context.

KM Learning Communities and Complexity Theory

Complexity theory is a set of concepts that describe and model complex nonlinear dynamics and integrate biological, cognitive and social dimensions (Capra, 2005). Complexity theory illuminates learning in dynamic, complex and unstable systems. KM learning communities can be envisioned as complex adaptive systems [CAS] (Holland, 1996) that respond and adjust to changing and evolving knowledge environments. Knowledge in KM learning communities is created and embedded in the relationships between members (Fenwick, 2004). Interactions within relationships shape cognitive processes that result in system-wide, distributed, continuous learning and problem-solving (Desouza & Hensgen, 2005). This shared cognition fashions the unpredictable emergent evolution of KM learning communities that in turn shape their members (Capra, 2002). This interactive effect results in the co-emergence of knower and environment in a co-evolutionary pattern. In this way, learning is the activity, which continually embodies the

KM learning community's pattern of organization, serving to function as the means for its recurrent invention, exploration, and co-evolutionary adaptation (Capra, 2002).

Within these communities, learning is the generative mechanism for the increasing and decreasing complexity of social systems as they co-evolve within their milieu (Espejo, 2003). Within KM learning communities, there is a blurring of boundaries with distributed knowledge rippling through internal subsystems and networks, both within and across individuals and teams (Arthur, et al., 2004), and into other systems in which individuals are members. KM learning communities evolve historically. Past history and experience are added on and therefore potentially shape future trajectory. As well, throughout KM learning communities, there is an allowance of diversity that includes differences in learning styles, epistemological stances (Hofer & Pintrich, 1997), and subjective knowledge. This acceptance of difference results in the emergence of knowledge from multisubjectivity[ii] and is seen as the source of innovation (McElroy, 2000). Multisubjectivity also facilitates the flow of distributed knowledge across the system (Arthur, et al., 2004).

Since KM learning communities are self-organizing systems that have the capability for adaptation, the ability and motivation to learn live within the existing subsystems and networks of members. These learning capacities result in the ability of nodes within the system, in the form of formal teams or informal subgroups, to rapidly come together, separate, and reform in different permutations according to need, while maintaining long-term relationships with other community members throughout the rest of the system (Arthur, et al., 2004). Therefore, distributed knowledge and continuous problem-solving, produced by the dynamic processes of interacting autonomous agents, become unanticipated emergent phenomena that are non-

deterministic and nonlinear in nature. Emergence plays an essential role in the evolution of KM learning communities, which is why they demonstrate a great deal of unpredictability.

Learning is activated and linked to the disequilibrium experienced in the community (Fenwick, 2004). When KM learning communities approach the far-from-equilibrium state, they are subject to spontaneous, dramatic reorganizations. These points of instability, or bifurcation points, allow the community to branch off into an entirely new state where new forms of order may emerge (Capra, 2005). Systems capable of this kind of reorganization are dissipative structures. These types of structures illustrate the close interplay between structure on the one hand and flow and change on the other. In KM learning communities this may herald new configurations, procedures, or culture shifts to meet the requirements of effective knowledge production. Emergence is integral to the dynamics of dissipative structures, affording them the potential to evolve (Capra, 2002). Change, consequently, is understood as the self-reorganization resulting from the interconnectivity among community members, subsystems, and the environment. Connectivity amplifies nonlinearity through multiple densely connected overlapping feedback loops that link and let go and link again within the nodes and networks (Agar, 1999). The cultivation of diverse viewpoints and experimentation with alternative structures also facilitates the process of change and knowledge production.

Within complexity theory, cognition is the organizing, life-giving activity for the KM learning community since it creates self-generation and self-perpetuation as a living network. Interactions between members and with the environment are cognitive social interactions, inextricably interconnecting community life and cognition (Maturana & Varela, 1987). KM learning communities, therefore, represent the integration of the theories of complex adaptive systems (Stevenson & Hamilton, 2001), organizational learning (Argyris, 1993; Senge, 1990),

and knowledge management (Blackman & Henderson, 2005). The following case study will illustrate this synthesis.

Methodology and Methods

This case study (Stake, 1994) used a complexity perspective to illuminate the unique trajectory of a KM learning community and the nonlinear dynamics associated with a reiterative self-assessment process. We focused our inquiry on gleaning the lived experience (Kvale, 1996) of members of a KM learning community in order to reveal its complexity. Members were recruited as representatives of the community, as complex adaptive subsystems within the community, and as individual CAS (Stevenson & Hamilton, 2001).

Context

This KM learning community is embedded in a two-year Masters program entitled Human Systems Intervention [HSI], which is designed to provide expertise for work as organizational leaders and consultants facilitating change processes within human systems. HSI cohorts consist of approximately 20 to 25 members, who are given the opportunity to shape a learning community into an effective second-generation KM system designed to maximize the benefits of experiential enquiry. In order to facilitate the meaningfulness and usefulness of the LC, members work in teams of various configurations on knowledge projects. This learning methodology allows for the integration of theory, values, and skills in practical application. Knowledge extends to understanding and intervening effectively in social processes, the capacity to shape an environment, and the impact of transformative processes on environments and self.

Participants

Participants in the inquiry were members of an HSI KM learning community. Four individuals were interviewed, two women and two men, ranging in age from 24 to 56 years:

George, HB, Margaret, and Rachel[iii]. Aside from their full-time involvement in this professional education program, 3 of the 4 participants were employed as inside or independent consultants in either public or private organizations.

Data Collection and Transformation

Data was collected through interviews at two points in time: the end of year one and again at the end of year two. All interviews lasted from 60-90 minutes. Using a semi-structured guide, the interview attempted to elicit stories reflective of participants' consciousness and perceptions (Vygotsky, 1987). The interview focused on: 1) participants' experiences of community and its self-assessment; 2) the impact of their experiences on themselves as learners and as members of a KM learning community; 3) processes that influenced the interactions within the community and its ability to manage knowledge; and 4) insights into the functioning of the complex community as a KM system. All interviews were taped. As well, a co-author maintained observational, theoretical, and personal notes (Richardson, 1994) from her interactions within the KM learning community, in order to track processes and critical events, hunches or hypotheses, and observation statements about the workings of the community. Audiotapes were transcribed and rendered into text for analysis. A conceptual display (Miles & Huberman, 1994) was created illustrating the fundamental concepts, processes, and their relationships.

Illuminated Patterns of the HSI KM Learning Community

M: *So, how does a LC work?*
Margaret: *Painfully, (laughter). I think at the beginning…*

Cilliers (1998) suggests that it is not possible to tell a single, exclusive story about something that is complex; however, the following is a blending of the stories and dynamics that emerged from the interviews and the field notes. Models reduce complexity in order to achieve a level of understanding. Though the authors admit something is lost from this representation, Figure 1

characterizes a graphic slice of the interplay of the workings of a complex KM learning community.

[Figure 1 about here]

KM Learning Community Metabolic Processes

Whole systems are characterized by flows of energy and materials between and among component parts (Linds, 2006). Metabolism is the essence of life; it is that which enables a living organism to continually generate, repair, and perpetuate itself. Therefore, we chose this metaphor as the foundation for the examination of the life of the KM learning community. Metabolism includes: the continuous flow of matter, the continuous flow of energy, the elimination of waste products, and a network of chemical reactions that transforms the matter into energy (Capra, 2005; Maturana & Varela, 1987).

Continuous flow of matter: Knowledge creation. Since knowledge is the central organizing principle of this KM learning community, knowledge creation was the primary matter for the system. This included: declarative knowledge (knowing-why); procedural knowledge (knowing-how); tacit cultural knowledge (knowing-whom); subjective knowledge (linking personal experience to theory); and emancipatory knowledge (Habermas, 1971) (critical reflections of taken-for-granted assumptions). Knowledge was created within the context of members' relationships; it prompted the community to adapt and evolve in dynamic and complex ways.

> **HB:** *Well, it's messy sometimes… a LC works in an inadvertent way. It's tentative at first, it becomes more proficient about sharing information, more proficient around different learnings, a common topic... we become more open and more trusting in terms of receiving feedback, in terms of giving feedback… it's not at a steady pace… Where we might start off around a topic, we become interested in the process of learning and how it could be applied to the topic.*

In addition, members' knowledge gained from previous experiences flowed into the KM learning community and was shared throughout the system, forming the basis of future individual and community learning.

> **HB:** *One of the areas I've been able to help some people out is in terms of theory and models… a lot of the stuff with non-profit, that they may not have worked with before… So, I'm able to share different types of valid information… like how volunteer boards are set up, how non-profit boards are set up, different types of community development approaches…*

Feedback loops created additional knowledge and contributed to the learning community effectively functioning as a KM system. Members experimented with and tested relevant skills in their relationships within the cohort. Knowledge of self and one's impact on others was developed through critical reflection and additional feedback from peers. This additional knowledge enhanced the ability to develop organic relationships in community.

> **Rachel:** *… the cohort has really allowed me the space in which to try out these new behaviors… I'd learn something, or I'd be reading, or I'd be working on my project, and then we'd suddenly be working together and I would be able to try out these new things… for me the cohort was the space in which to be the way I really wanted to be.*

Continuous flow of energy: Collective conversation. Energy is a means for maintaining order in the face of challenge and it is the power to create order in the face of inertia (Bradley & Pribram, 1996). Energy also involves the mobilization of the potential for activity and the directing of activity towards collective ends. Diversity was a strong source of energy for this KM learning community.

> **Rachel:** *I have an image. It's… attributed to a sense of flow. It's kind of this energy and timelessness… Now, that doesn't always happen to sustain itself. But, I think that there's a sense of flow and energy when we're working together. And the thing is that the diversity is an asset... bringing ideas that you wouldn't have thought of; being in that diversity… learning from others. I think it's really based on an energy level. When I've worked with a group of people, and it's working really well, there's a sense of… time has stopped, but we're moving… It's kind of that optimal experience.*

In the KM learning community, potential energy also became engaged and released within social interactions. These energizing effects were evident when the members' worked on the task of knowledge creation and when they tapped into the community's emotional life, e.g. feelings associated with constructive conflict, closeness, and growing competency. The most common processes that generated and revealed the community's energy included: public reflection (Raelin, 2000) that promoted the creation of order and collective dialogue (Bohm, 1996) that allowed the community to become a dissipative structure. Interaction became even more influential when it took the form of collective dialogue of braided language and emotion (Espejo, 2003).

> **George:** *Whenever we stopped and engaged in dialogue, we grew as a group. Relationships improved, task effectiveness was enhanced.*

Therefore, the primary cultural tool for facilitating interactions and knowledge creation in this KM learning community was language: speaking, listening, and meaning-making. Conversation was how the social collective achieved and maintained patterns of organization and how it distributed and managed knowledge. Information about the collective's internal organization was gathered, processed, and distributed through the collective as a *whole*.

> **Margaret:** *It's an environment where… we learn from each other… and we listen enough to learn from each other. It also has an emotional component. I was talking about a safe environment, but also a pleasure to be with people… If it's only emotional, it can bring you everywhere, and rational… it sometimes just keeps you on one track. So, having both of them and listening to both of them was an interesting way of being.*

Within this community, the cognitive content, the emotional material, and the linguistic aspects of social interaction shaped, and were shaped by socially shared cognition, revitalizing the individual and the KM learning community.

> **George:** *I don't know if I've cleared anything away as much as rediscovered what I already knew… kind of reinvigorated my intellectual side and reinvigorated my emotional side.*

Additional sources of energy, which instigated reorganization of the KM learning community, were conflict and tension, individual and collective values and goals, and power dynamics.

> **George:** *I think a shared value was the desire to contribute to productive, effective organizations regardless of how. I think another shared value was to value each other's contributions, whatever they were… egalitarianism… the value of each person, the opinions, thoughts, feelings, and their contributions...*

In particular, values acted as moderators for interpersonal and community relationships. They operated as tacit rules for governing the cognitive and social interactions (Reilly, 2005). The values most often cited as those that promoted KM realization were respect, risk-taking, openness, perspective-taking, and presence.

> **Rachel:** *... there was this deep respect for differences in the cohort… it just allowed for differences and commonalities to exist in the same person.*

> **Margaret:** *... risk taking… trying to name what's going on. And if it's not perfectly mentioned, at least we tried to name it. The will of every member, or most members, to be part of the process. I think that's key. A generosity, also… that's one thing I'm struck by my community… generosity towards each other. Somebody said, "Showing up", and I also think that's part of the will of being there…*

> **HB:** *There was… openness. In that I don't think there were any sacred cows or taboo subjects. Really, whether or not we would do something about it is a different subject. But, I think it's pretty open in terms of sharing observations, knowledge, and that sort of thing. And I think it's positive energy.*

Finally, energy was also generated from the raw power associated with the construction of new dimensions of identity (agency, voice, and confidence).

> **Rachel:** *I think that if you're in your Buddha nature, if I can refer to Buddhism, where there's this belief that you are this perfect entity… as we're going through life, we're trying to remove the layers to get to that entity. I feel in a way that's kind of what's happened to me. I've always been this person, this Rachel, yet there's been always layers and obstacles to that person, but I've always sensed it*

> *and maybe through my two years, double layers have dissolved and I'm kind of reaching more the essence of myself.*

Waste products: Eliminating outmoded patterns. Waste products were formulated as patterns that had been subjected to or targeted for change. They included outmoded ways of thinking and being, resistance to change, and old ineffective habits. Discarding these waste products was seen as an important part of the work of the KM learning community.

> **Margaret:** *I know now the difference between when I'm in a drama queen period in my life making a big fuss over nothing… I'm starting to clear that away… That's something that stopped being fun. I didn't gain anything from that except self-destruction.*

Discarding outmoded patterns formed a space for more adaptive ways to take root.

> **George:** *… by nature I've never been the type of person that thought about asking for help… I've always felt like I'll figure it out… I can do this. I can manage this. And, one thing I learned from my affiliations with the cohort is that it's not only smart to ask for help, it helps both people when you ask for help. So, I've become much more comfortable with saying I really don't understand this or I really have no clue what's going on but I'm gonna net with some people and figure it out. And, that's something I've taken to doing at work as well, and I found it to be pretty effective.*

Networks of chemical reactions: Transformational webs of relationships. Networks are the basic patterns of organization in living systems. They are functional in enacting nonmaterial, nonlinear patterns of relationships between various processes. A key characteristic of human CAS is that living networks are self-generating, and form the basis of more systemic social interaction. They continually create, and recreate, themselves by transforming or replacing components. They undergo recurrent structural changes while preserving their web-like pattern of organization (Capra, 1996). Within this KM learning community, networks took three forms. One was engaging with the community as a collective.

> **M:** *Are there some interactions… in your cohort that helped you go through the change that you went through?*

> **Margaret:** *I would say that it's more the cohort as a cohort; in many ways, every individual did help me but it is more the group as a group.*

As well, members formed formal teams in order to carry out set tasks or projects as part of the knowledge management focus of the LC. The pattern of organization within these networks both reproduced the patterns of the larger community, and infused patterns into the KM learning community.

> **George:** *Although we were separated into subgroups, I believe that the process that each group went through mirrored the effect of the big group.*

> **Rachel:** *I definitely noticed that people had dyadic relationships and I think openness was created a lot of times in pairs. And, I'm wondering whether that rippled into the LC…*

Finally, more loosely formed nodes based on perceived need, affinity, and benefits to the KM task were formed.

> **George:** *... one of the informal groups that formed was a handful of us who come from out-of-town, so we would be there for the weekend, and usually go out and have dinner and a drink or something together. And those types of sessions where you just get together informally and talk about the day's work and what you were working on, that type of thing...*

These three kinds of relationship patterns created a dense web of reciprocal relations, both cognitive and affective, interconnecting all members. These networks and nodes generated knowledge as unanticipated, emergent phenomena, and embodied this complex adaptive system's patterns of organization.

Relational Patterns that Inhibit or Enhance Complexity

Though the metabolic dimensions were always present, they did not necessarily result in relational patterns that enhanced complexity. Some emotions and dynamics (fear, avoidance of conflict, and emotional or relational distancing) created patterns that blocked the efficient conversion of potential energy to kinetic energy in the service of knowledge production. These

configurations led to states of ossification, stasis, and predictability of the KM learning community. Other emotions (commitment and a willingness to engage in conflict) created a patterning that enhanced the conversion of potential energy into distributed knowing.

Patterns inhibiting complexity. In this KM learning community, social interaction did not always produce growth. Instead, the community sometimes displayed processes that reflected the state of the system as moving towards rigidity. In turn, these processes resulted in social interactions that emphasized protection from fear which resulted in system atrophy.

> **M:** *Say more about messy.*
> **HB:** *Not being open, not being able to deal with conflicts… It starts off tentative, and then as we get more knowledge, and knowledge of each other, more trust, we start getting to the areas where people aren't being heard, people are withdrawn, and we start to get more into the issues… I think the messy part is when we don't deal with that, because it ends up derailing.*

Fear resulted in missed opportunities for learning and was a fundamental dynamic that promoted calculated deliberation and facades. This then reduced the spontaneity, honesty and effectiveness of the feedback loops within the relationships and the networks.

> **Rachel:** *I think people, myself, were fearful, and.... I think that's what hindered... the sensation of fear and what fear entails...*
>
> **HB:** *I guess the issue of being open about what was missing in the group. About what didn't feel completely authentic in the relationships between individuals… why we weren't declaring ourselves, why we weren't willing to be in conflictual relationships…*

An inability to effectively work through conflict was the most often cited dynamic that lead to a decrease in the system's generativity and adaptability.

> **M:** *So, would you say conflict was avoided?*
> **George:** *… for most of the first year, yes. Unless someone was able to put some structure around it… it was avoided. So rather than just dialogue, we'd make three different lists and find out which one people want the most… that type of thing.*
> **M:** *And then what would happen with the diverging opinions?*

> **George:** *They just get cast off… It was just, "Let's just find out which one we think will work and go with that." And a lot of time what we'd do is just go round and round in circles until people got tired of it. And all they'd want to do is end it and go home for the night. It would get solved through default.*

As well, being involved in faux-intellectual discussions as a substitute for engaging with salient issues (i.e. relational distancing) allowed the KM learning community to distance itself from the here-and-now and this promoted scripted facades.

> **Margaret:** *The last community session… instead of talking about gender in the group, we started to talk gender at work… and it's only after that one member of the cohort said, "We never cleared that thing out. We never talked about gender." And I think that was part of the struggle, gender, and not wanting to talk about it.*

Patterns enhancing complexity. These patterns refer to interactional processes that promoted complexity and self-organization: risk taking, improvisation, emergence, spontaneity, and interdependence. These characteristics, unlike those previously discussed, allowed the members of the KM learning community to seize and capitalize on opportunities for learning. Thus, knowledge production became inextricably linked to life within the community (Maturana & Varela, 1987).

> **Rachel:** *... there was a task that we needed to see fulfilled as far as presenting our year to the cohort, and because of all that we learned up to that point, we were really finally applying what we were learning... And we were creative, and spontaneous, and people let go… I let go of certain fears, and whatever expectations, and if didn't work out… I just had confidence that it was going to. The LC was functioning itself, on its own with our interdependent energy; it became effective on its own.*

Authentic emotional engagement emerging during times of spontaneous improvised dialogue became the way in which community members built relational and systemic connectivity. This connectivity enhanced the system's ability to reorganize itself in times of perturbation in such a way as to further augment the connectivity within the nodes and networks. The most often cited

example of a process that promoted complexity was the use of collective reflection and dialogue as a means to engage with conflict.

> **M:** *Tell me about a specific time when you thought the LC was most effective?*
> **George:** *…we self-organized a discussion dealing with our effectiveness as a group.*
> **M:** *What was happening at that time?*
> **George:** *This came as a result of a conflict around values, vis-à-vis the role of a consultant. We had quite a blow up… and decided to do something about it…*

In the face of patterns that supported predictability and atrophy, risk-taking played a key role in dismantling the ossifying configurations.

> **M:** *What are some of the things that helped the LC develop?*
> **HB:** *Individuals who took risks, started to disclose concerns that they had with the way the community was working…*

Nonlinear Dynamics

Interactions in complex systems are characterized by nonlinear dynamics (Cilliers, 1998). Nonlinearity refers to the principle that the whole is not necessarily equal to the sum of its parts. Dissipative nonlinear dynamic systems are capable of exhibiting self-organization and chaos, illustrating the close interplay of structure and flow / change. As well, nonlinearity is a process in which a relatively small change can lead to significantly different system states (Human-Vogel & Brown, 2005). Since small changes are amplified as they feed back on each other, this produces complex patterns of unanticipated consequences that make it impossible to predict long-term behavior (Linds, 2006).

> **George***: I am not so sure that there is formula as to how it works. Each group will evolve according to its reason for being. I do believe that a learning community must evolve of its own accord; it cannot be mandated or established according to a predetermined plan.*

In this KM learning community, nonlinear dynamics were promoted in various ways: historical patterns, intentional tinkering into structural and relational configurations, the adoption

of facilitative roles, and the creation of open spaces of possibilities. This allowed the community to reconfigure itself, and permitted the KM learning community to operate on the edge of chaos. Furthermore, nonlinear dynamics extended beyond the boundaries of the KM learning community and rippled out into other CASs.

Historical patterns. Complex systems have a history. They not only evolve through time, but their past is co-responsible for present behavior (Cilliers, 1998). Patterns of human interaction produce further patterns of interaction (Stacey & Griffin, 2005). History can also include practices incorporated into the KM learning community's patterns of relating, embodied knowledge within the networks and nodes (Espejo, 2003) and a series of the system's structural changes (Maturana, 1987). This KM learning community evolved historically in that its past, both its history and prior experience, was added onto it patterns of relating; this shaped the community's possible trajectories.

> **HB:** *Everything that we've done has been cumulative. So, we wouldn't have gone there if there wouldn't have been frustration over feeling heard, or frustration over perceptions of how much influence or how much power we had. The trigger to that particular expression of dissent was the outcome of everything else that we'd gone through. But that particular statement… precipitated where we went with it. And what we've done since…*

The subsequent evolution of the community depended upon the critical choices its members made around which pattern to reorganize the KM learning community (Mitleton-Kelly, 2003).

Intentional tinkering. Interventions by members of the community demonstrated the intentional performance of an action designed to perturb, influence or shape the community. Those interactions that were performed with the intention of furthering knowledge production and learning resulted in opening up spaces of possibility (Fenwick, 2004). The KM learning community displayed the properties of a dissipative structure, in that it was an open system capable of operating far from equilibrium. As well, it was capable of self-reorganizing to higher

levels of order. Intentional tinkering served to activate the fluctuating states of chaos and order within the system.

> **Margaret:** *We know where we wanted to go… But, how to get there is a very big challenge for us because we're inventing as we go along. We don't have models; we just know that we want a certain way.*

In particular, the community used the structural process of self-assessment of its patterns and effectiveness as an opportunity to exercise intentional tinkering.

> **Rachel:** *I believe what helped was that each individual had to decide that they were there, and present, and wanted to be part of the community. For whatever reason… some people were very there and present and willing to make it happen.*

As will be discussed later, dynamic self-assessment provided an historical structure that would activate chaos and promote higher levels of organization.

Roles. Certain facilitative roles (Fenwick, 2004) fulfilled by members of the community tended to promote intentional tinkering. The most common roles observed were: the noisemaker, the interpreter, the mapmaker, and the facilitator. The *noisemaker* either observed disturbances or planned them. He or she would amplify these perturbations by highlighting contradictions and silences or by encouraging members to experiment with different paths to see where they might lead.

> **Rachel:** *Lots of time people would say that I sometimes made them upset and angry but they would go back to it later and felt that I was not right, but that it was kind of an interesting thing to do and as a result they realized that it would just push them into a learning curve sometimes.*

This role created opportunities for the KM learning community to experience disequilibrium. Depending upon the structural choices of the community, disequilibrium could produce open spaces of possibility resulting in new knowledge and more effective levels of organization.

The *interpreter* assisted individuals to name what was unfolding around and inside of them. Frequently this took the form of observing and naming in the moment dynamics and patterns that promoted ossification and stasis, thus strangling emerging possibilities.

> **Margaret:** *Somebody else in the group took the leadership at that point, saying, "Whoa, we're swirling. Let's stop doing that".*

The interpreter helped the KM learning community to transform outmoded patterns of behavior and eliminate them as waste products.

The *mapmaker* traced and created meaningful cognitive and social interactions within the community and the networks. He or she would help members make communal sense of the patterns emerging among the complex networks. In essence, this role functioned like an historian, highlighting patterns of effective relating, webs of embodied knowledge, and useful structures. As well, this role could amplify generative disturbances by drawing attention to the possibilities these create, and help divert patterns that may create undesirable conditions, unsafe spaces, or power inequities (Fenwick, 2004).

> **HB:** *I've been able to help out there… basically to ask perhaps some uncomfortable questions. Start a thought process...*
> **M:** *You got good feedback about that?*
> **HB:** *Yes*

The *facilitator* helped the community navigate through disequilibrium it experienced. He or she helped the KM learning community members to forestall the impulse to predict, contain, and control social interactions and to remain more flexible and adaptable, in order to work through disequilibrium creatively.

> **Margaret:** *There's one who has the power of wisdom. Every time he talks people… things change when he speaks because it's so appropriate and so wise and so calming…*

This role allowed the community to experiment with different patterns of relating and to be courageous and inventive in its experimentation.

The community saw these roles as fundamental to the process of becoming an effective KM learning community. However, it was not just the role itself that encouraged complexity. An important element was the way in which the role was enacted. The values that functioned as sources of energy for the social interactions informed the enactment of the role. Especially salient was the value of presence, that crisp awareness of one's current process and a willingness to be met and known. Presence was the subjective measure of an individual's emotional sense that he or she was a part of an environment.

> **George*:*** *My role was like that of anyone in the group… be open, listen, respond…*

Bifurcation: Open spaces of possibility. Bifurcation in a complex system occurs when a system destabilizes temporarily and subsequently evolves to a higher form of self-organization. Bifurcations are necessary since systems would be unable to self-organize without them (Human-Vogel & Brown, 2005); in addition, bifurcations become the birthplace of emergent nondeterministic possibilities.

> **Rachel:** *I think it really comes down to the community making that time available for itself… creating that space for things to happen.*

Intentional tinkering became the initiator of bifurcated openings. Sustained collective dialogue held open spaces for the coherent movement of explicit and tacit knowledge (Stevenson & Hamilton, 2001). These open spaces were times of reflective self-examination and conversation. They created opportunities for experimentation with alternate structures or relational patterns and allowed future possibilities to emerge (Espejo, 2003).

> **M:** *Tell me about a specific time…*
> **George:** *Easy, when we had to self-organize into groups* [for a project]. *A melee ensued. This represented a confluence of issues: values, task vs. process, inter-*

> *group relationships… a whole stew of conflict-laden issues. It was cathartic, though, in that it triggered a good dialogue about the issues at hand… It was a necessary event…*

Knowing evolved through the creation and recreation of the KM learning community as a result of the choices offered by the open spaces of possibility. A key factor in the creation and selection of these choices were the individual CAS within the KM learning community.

> **Rachel:** *I've opened up myself more. I feel more grounded, so I think the first thing that changed is the relationship I have with myself which ultimately has changed the relationship I have with others… how I moderate my impact on others, and how I can now have a sense of how others are impacting me and then I can really kind of sense how I'd like to respond or not respond.*

Ripple effects. Knowledge cannot be contained in any one dimension of a system, for knowledge is forever spilling into other systems (Fenwick, 2004). In this KM learning community, this rippling was apparent; the perturbations experienced in the community extended to other CAS outside its boundaries, accentuating their blurred nature.

> **George:** *The first thing that comes to mind is who I've become is someone who's interested in continuing to become the best that he can be.*
> **M:** *And that's different from before?*
> **George:** *Well it's different in that I was, before, being somewhat complacent. I'd achieve a certain position at work and… I didn't have the same aspirations that I do now, and my aspirations are not necessarily focused on my job. They're about how do I contribute more to the world around me.*

The greater the interdependence of the members of the community, the wider the disturbance of the perturbation is felt. Knowledge generated in the KM learning community became available to and shared with other CAS, spreading tendrils of distributed cognition throughout the systems (Mitleton-Kelly, 2003).

> **HB:** *If as a result of my being in the LC I acquire new skills, and new ways of behaving, then people I come into contact with also have the benefits of those. So there're benefits for the people that I interact with, benefits for the people that other members of the community interact with… and something that I've observed at work… being more aware of different learning styles, communication styles has resulted in a greater level of comprehension around what we are trying to*

accomplish at work with projects that I lead; it has also led to exploring different phases of organizing around tasks.

Dynamic Assessment

Dynamic assessment has two underlying assumptions: 1) human learners are open systems and 2) the purpose of assessment is capacity development (Elliott, 2000; Greenberg, 2000; Lidz, 1997). It presupposes that substantive changes can occur if feedback is provided across an array of increasingly complex tasks (Swanson & Lussier, 2001). This standpoint makes dynamic assessment compatible with a complexity perspective. Dynamic assessment allows for multiple opportunities to demonstrate competence in several contexts across network cultures and it can facilitate the novice-expert transition (Jenson, 2000).

Within this context, reiterative dynamic self-assessment focused on the learning community as an effective KM system. It examined knowledge acquisition as a reciprocal co-implicating process at the system level, an approach that privileged community knowledge. Since dynamic self-assessment was ongoing and recursive in this KM learning community, it reproduced the dynamics of workplace learning. It allowed individuals the opportunity to shape the community to their self-identified objectives; in turn, it made space for the community to shape effective KM practices.

Community Self-Assessment

The HSI cohort was introduced to the activity of self-assessment early in year 1. Community members were presented with various models of assessment, including the framework of dynamic assessment. The KM learning community was then offered the challenge of performing ongoing dynamic self-assessments of its progress and potential. The community undertook the task to map out its path of evolution, to identify what it needed to become a more effective KM learning community, and to implement interventions and actions that would enhance its

development. The cohort used The Five Disciplines (Senge, *et al.*, 1994) as criteria for self-assessment: shared vision, personal mastery, team learning, systems thinking, and mental models. These five dimensional criteria were deemed essential elements of systems that can truly learn and create knowledge (Senge, 1990). They were considered comparable to dimensions for assessing the development of organizations (Patton, 1999). The KM learning community continually defined and redefined what these dimensions meant in terms of its own unique context.

Catalytic Impact of Assessment

A living organism is an open system whose overall structure is maintained in spite of ongoing flow and changes of components (Capra, 2005). Reiterative dynamic assessment became the structural means for this KM learning community to hover at the edge of chaos. However, creating chaos was not about creating unpredictable situations in which members were challenged beyond their means (Human-Vogel & Brown, 2005); it was about creating open spaces of possibilities and bifurcation points. During the times of self-assessment, intentional tinkering became purposeful. Self-assessment was a way for the community to exchange energy, matter, and information with its environment. As well, it allowed the KM learning community to become a dissipative structure providing opportunities for self-reorganization.

> **George:** *The figural event for me was the weekend that we spent with R and G…*
> **M:** *What was happening at that time?*
> **George:** *We talked about leadership, gender, age groups… it was a big event and spawned much after class interaction.*

Being a dissipative structure pushed the KM learning community into a state far from equilibrium; it permitted the creation of new emergent structures, patterns, and mental models. The assessment-dissolving-reorganization cycle illustrated the close interplay between order and

chaos. The farther from equilibrium the LC was, the greater the complexity and the higher the degree of nonlinearity (Capra, 2005).

> **Rachel:** *... what made it into a working LC. I think it was bringing it back to community. It was when we planned an intervention. We saw something that was happening and were like, "Oh my god, what the hell is happening?" And we would put it out there… an intervention in that community that would stop people in their tracks, and ask them to look at something in that time.*

When two systems coincide, the perturbations of one system ripple into the other. Change occurs through disturbances amplified through the multiple, densely connected, overlapping feedback loops within and among the nodes and the networks of the CASs.

> **Rachel:** *I will say that because what's happening in my LC now, I feel is somehow benefiting my work environment… How do I make that link? I have noted that different communities are responding differently 'cause I'm different because of what's happening…*

As this KM learning community approached a state far from equilibrium, the waves of disequilibrium washed over both the KM learning community itself and the individual CASs. The resulting reorganization spawned a unity of action and identities that could not have been achieved independently by either (Fenwick, 2004). Knowledge existed in the interstices of this complex ecology.

> **Rachel:** *I'm wondering whether it's around wholeness… So maybe output exists in the process… it's like a higher sense of being… It's actually having those questions that you didn't have before… simultaneity, where once you ask the question things change.*

Dissipative structures do not necessarily effectively contain and transmute energy. If unconstrained, an excessive dissipation of energy could result in disorganization (Bradley & Pribram, 1996). Using the five disciplines as the criteria for the process of dynamic self-assessment focused this KM learning community's attention and created a loose guide to organize the concerted action during self-reorganization.

> **George:** *Assessment was a participatory process where… we co-created a shared description or understanding of a moment in time. It was mutual, and equal.*

These 5 criteria acted as constraints bounding the dissipation of energy and channeled that energy into high levels of order.

> **George***: If learning is construed as knowledge and behavioral change over time, then the community existed to support this activity. This included a public declaration of one's intent, supported by feedback. The community learned about itself through shared assessment and feedback.*

In the KM learning community, reiterative dynamic self-assessment created explicit and intentional opportunities for the appearance of emergent properties generating synergy (Montuari & Purser, 1999). This was primarily achieved through language as feedback loops, to create, maintain, and transform conventions and structures by which the KM learning community constituted its life (Barrett, 1999). Moment-to-moment interactions happened through conversations in shared interactive spaces or structural networked contexts. Multisubjectivity was a key dimension that distinguished the dialogue, and allowed dynamic self-assessment of the system to function as a feedback loop.

Reiterative dynamic self-assessment shaped an ambiguous problem space, which created and contained the disequilibrium needed for self-organization. Environments only trigger structural changes; they do not specify or direct them (Capra, 2002). Structural changes were directed by the tinkering prompted by the self-assessment resulting in nonlinear patterns of organization.

> … the most important aspect of information is whether its influence on behavior enhances the ability of the system using it to adapt. And this ability… is most likely to be enhanced if the information itself actually corresponds to the reality of the system's environment (Firestone & McElroy, 2005: 197).

Reiterative dynamic self-assessment provided such correspondence by selecting those processes that fit the environmental constraints in which the KM learning community lived and functioned. The space between monitoring and evaluating was the point at which matches and mismatches were identified, and subjected to intentional tinkering.

Conclusion

There is a general but ingrained assumption that all learning is a deliberate activity and can, therefore, be planned and achieved. In reality, learning is also spontaneous, unsystematic, and unintentional (Huysman, 1999). Examination of this case illustrates that unexpected, powerful knowledge was created, not just by specifying knowledge targets, but also by creating emergence. The KM learning community underwent recurrent structural changes, prompted by reiterative dynamic self-assessment, public reflection, and dialogue while preserving its web-like pattern of organization. The components of the network continually produced and transformed one another by self-renewal and the creation of new structures and connections. These components altered the future behavior of the community itself and of its individual members. By providing spaces of emergent possibilities, KM learning communities can tap into improvised, spontaneous knowledge opportunities.

Additionally, achievement curves in self-organizing KM systems do not increase over time. Rather they are characterized by phase transitions (Stadler, et al., 1996): linear increasing (cognition is optimized and structures are transferred into performance), stagnation (learning plateaus), and significant sudden improvements (critical fluctuations caused by structural destabilization and re-assembly into a higher state of order). This progression suggests that it is important in KM learning communities to allow members, nodes, and networks to find their own

self-organized rhythm. This also includes the explicit permission to make mistakes, since these may produce an unexpected nonlinear result with significant ripples.

To survive and thrive, a KM learning community needs to explore its spaces of possibilities and generate variety in terms of knowledge, solutions, and relational patterns. The search for a single and optimum strategy is neither possible nor desirable. Any strategy can be optimum only under certain conditions for limited periods of time. When those conditions change, the strategy may no longer be optimal (Mitleton-Kelly, 2003). Feedback processes can produce complex patterns of reactions, where one aspect of feedback has a compounding influence on the next iteration. Within this KM learning community the feedback structures of reiterative self-assessment, public reflection, and dialogue, allowed entity and medium to merge: members of the community were both inside the community as constituents, and outside the community as observers and input formulators, providing feedback on its "adequate conduct" (Maturana, 1987). This process allowed KM learning community members to both plan and learn in a co-implicating dynamic. In essence, encouraging a LC to reiteratively self-assess unites creator and creation.

Reiterative dynamic self-assessment allowed the KM learning community to engage in a collective and explicit community building-destroying-rebuilding process moving from pseudo-community through chaos into real community, hovering in the creation space at the edge of chaos (Stevenson & Hamilton, 2001). As individuals engage in dialogue with the world, and with each other through behavior, relationships, and conversations, they continually create spaces of possibility, the metaxic in-between (Linds, 2006). This in-between is not empty but alive with energy and opportunity for (re)creation.

> **HB:** *... every time we get together… every time we have a conversation… every time we work with other people, and help them work on something they want to*

work on and support their learning and ability to feel free to express themselves, the community gets stronger and stronger. Every interaction, one day at a time… So, was it bad, yeah; is it better, yeah; will it get better yet, yeah… it's just ongoing.

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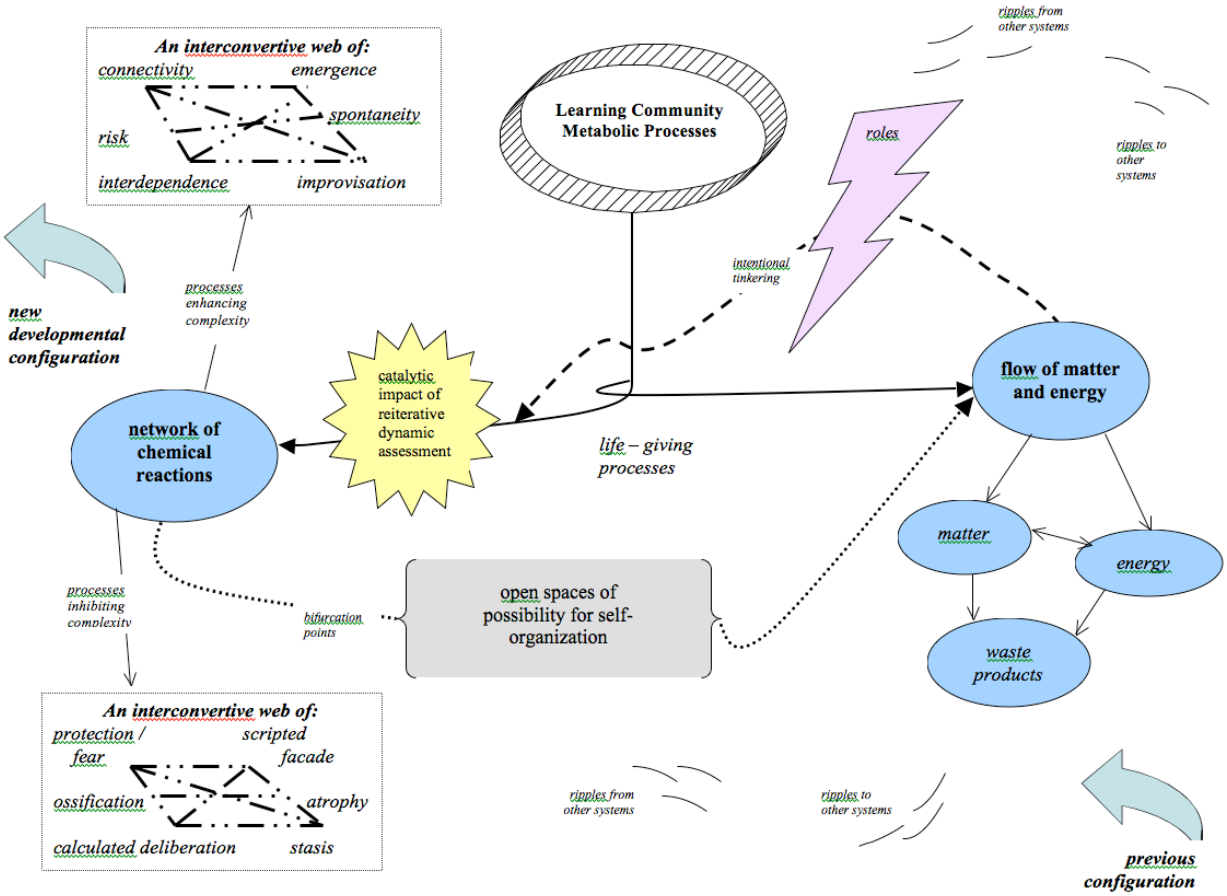
Figure 1.

A KM learning community as a living evolving complex system



Endnotes

[i] Though the authors acknowledge that these two types of communities can differ significantly, within this paper, these terms are used interchangeably.

[ii] This is the collectively created and shared understanding constructed by community members who are working on a KM task with multiple and differential levels of understanding and expertise. Multisubjectivity is an important component of self-regulation and self-organization.

[iii] All participants are identified by pseudonyms.