REFLECTION AND REFRACTION FOR KNOWLEDGE MANAGEMENT SYSTEMS

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─Abstract ─

As a well-established and important concept for management of knowledge, reflection can be complemented with a new conceptualization of refraction. Refraction can then be comprehended as more cross-cultural, creative and critical types of reflection, learning and knowledge management. This work then aims to bring together different aspects and improve the general comprehension and applicability of a reflection-refraction framework, benefiting from literature review of different disciplines. In the paper, accordingly, first theories on reflection, second conceptualizations of refraction, and based on these two a framework on reflection and refraction applicable to the interplay between learning, knowing, practicing and managing are presented.

Key Words: *Reflection,   Refraction,   Learning   Theories,   Knowledge Management and System Science*
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1. INTRODUCTION
Reflection is an important concept for management of knowledge. For instance, Nonaka & Toyama (2004) incorporates reflection into their conceptual framework for the conversions between tacit and explicit knowledge among different societal entities (as individual, group and organization and with environment) as part of the Socialization-Externalization-Combination-Internalization (SECI) processes

of knowledge creation. However the underlying dynamics and interactions enabling such flow of knowledge among entities that can be very different deserve further analysis and articulation in order to apply these concepts into practice.

Medeni (2008) respectfully attempts to complement concept of reflection with a new conceptualization of refraction. Suggested as an important phenomenon in cross-border interactions among different societal entities, refraction is identified as a more cross-cultural, creative and critical types of reflection that are mostly missed in cross-cultural management of knowledge, and transfer of knowledge between education and practice. The framework of refraction and reflection is also applied into virtual games (Medeni et al 2008) and e-government development (Medeni 2009).

Built upon the existing literature on refraction, this work aims to bring together different aspects and improve the general comprehension and applicability of reflection-refraction framework. The foundations of theoretical framework will be strengthened by incorporation of previously separate materials from different sources, such as reflection theory of SEAL (Spiral of Experience-based Action Learning), modeling of chaordic systems, as well as ideas of philosophers such as Platon. Accordingly, the paper will first present relevant theories on reflection, next conceptualizations of refraction. Based on these theories and conceptualizations, then a specific section is dedicated to understanding of learning / knowing and practicing / managing as each other's experienced refractions and reflections.
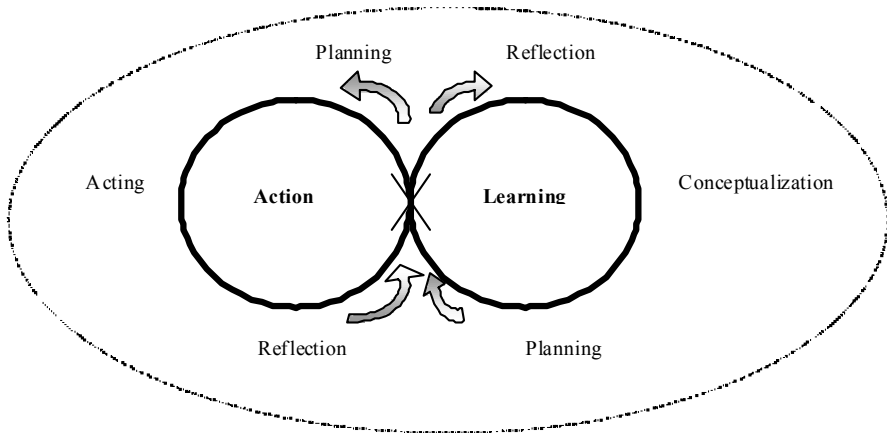
2. THEORIES ON REFLECTION

2.1. SEAL (Spiral of Experience-based Action Learning)
Mumford argues (1998) that doing tasks and learning are similar activities, two cyclic processes that go through the same stages, and this resemblance should result in effective learning as a process outcome. In other words, the "twin supports of practical availability and process compatibility" between tasks and learning make it possible to learn from actual practice However, the resemblance does not explicitly explain much about how actual experience leads to learning. *Reflection on the experience* is needed to relate the actual practice with the mental processes that lead to real learning. Accordingly, knowledge conversion in learning starts and ends with actual experience, which is represented as the task cycle. Meanwhile, knowledge conversion in action incorporates a thinking stage, which implies its own cycle of learning, as the thinking should result in some type

of understanding and learning in order to benefit the next stage of planning. Here, actual experience (experiencing something) becomes a learnt (gained) experience, and there are two interdependent but different knowledge-creation spirals, learning and action, whose meeting point is the experience (Medeni & Medeni 2005) (Figure 1).

Figure - 1:　　　　**SEAL (Spiral of Experience-based Action Learning)**

X: Experience

Based upon Mumford's task and learning cycles (Mumford 1998) and Kolb's experiential learning cycle (Kolb & Rubin 1991), as well as furthering Nonaka and Takeuchi (2005)'s knowledge creating spiral and Medeni's Community of Practice Ellipse (2004), the SEAL model (Medeni & Medeni 2004) is considered to be one of the important theories of learning (Goel 2011). The model has also inspired Koops (2010) for his Serious Gaming Lemniscate Model for acquiring knowledge through simulation games.

2.2. Reflective and Elliptic Model of Experiential Learning and Practice

Using the mathematical/geometric features of the ellipse, and conceptualizing the practice of management and learning, both as a product and process, reflective model of experiential learning and practice can also be developed. This is somewhat related to discussions of soft and hard systems methodology (Checkland 1999, Medeni 2004), in which, simplistically, the former stresses the process and the latter signifies the product. Initially desired, the ideal is to be able to obtain both the process and product.   Second, if we place learning and management (or) practice as the two loci in an ellipse, the resulting figure provides a useful expression for the attainment of process and product.   This

elliptical diagram is recognition of the equal importance of both learning and practice, moving beyond the perception of previous circular models like learning cycles, or singular spiral models as suggested in knowledge creation. Moving along the ellipse, one can obtain the process, then process and product together, and finally the product by itself, which is transferred to the other side with a reflective object passing through the middle of the whole figure. In this way we can visualize both the spatial and temporal meanings of the possible transfer of the rich experience and knowledge gained from learning and practice. What determines to be transferred or not is the power associated with experience and knowledge (Figure 2).

Here, underlying that there are two knowledge-creating spirals instead of one spiral or two constant centers is important. These two spirals are spatial and temporal (one moves clock-wise, the other moves anti-clock wise) reflections of each other, resembling the image of a moving object in a mirror. The integration of these two reflective spirals also corresponds with lemniscates or chaordic (Chaotic & Ordered) systems, as often recalled together with Lorenz Attractor (Figure 3).

Figure - 2   Reflective and Elliptic Model of Experiential Learning and Practice
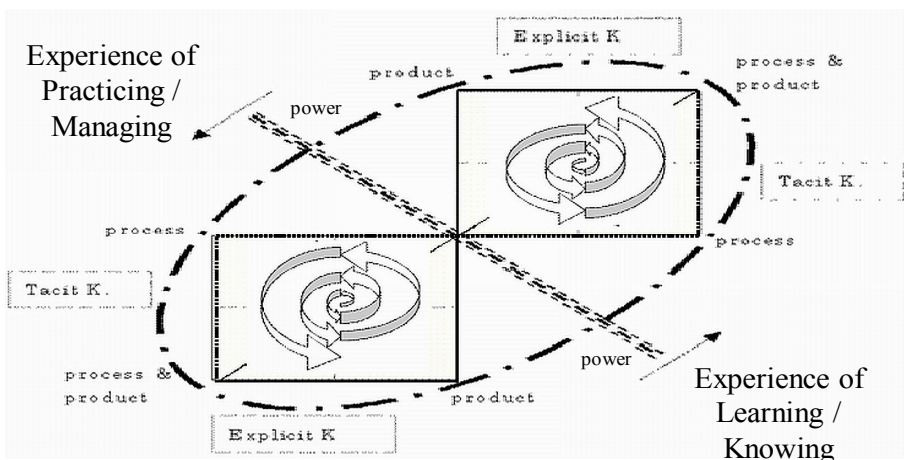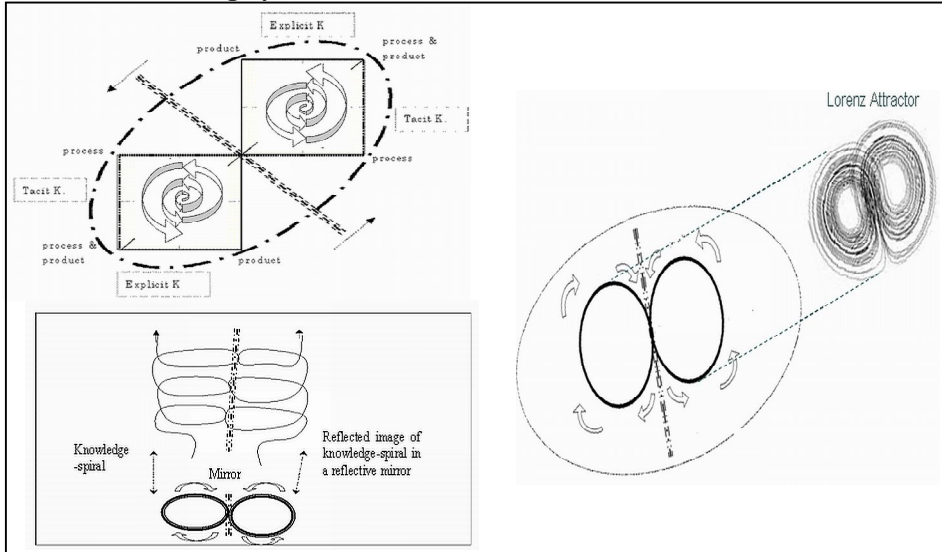
Figure - 3   **Experienced Reflections as a Chaordic (Chaotic & Ordered) Knowledge-Creating System**

3. CONCEPTUALIZATIONS OF REFRACTION

Plato argued that all physical reality experienced by human beings in the material world are actually only imperfect and refracted reflections of a perfect world (that exists elsewhere in the universe). (Willner, Hero, Weiner, 2006). Benefiting from Plato and Hegel, and Heidegger' ideas, Eldred (2007) discusses how (it can be seen that) the singular self is refracted on the other and thus 'broken in' on the world through the dialectic between singularity and universality.

Medeni (2008) conceptualizes refraction as a cross-cultural, critical and creative type of reflection. Accordingly, reflection and refraction exists together and complement each other. Meanwhile, they function together as important dynamics for knowledge conversions between tacit and explicit knowledge. Accordingly the adapted SECI model is illustrated below:

Table- 1: **Reflective & Refractive Interactions in Knowledge Conversions (Based on Nonaka & Toyama 2004, p. 98, Figure 4.2)**

Kn. Conversions	Reflective & Refractive Interactions (Knowledge Conversations)
Socialization	individuals, as identified with associated groups & organizations, socialize within environment across individual & organizational boundaries
Externalization	individuals bound as group by situated boundaries of organization articulate their knowledge across personal boundaries within environment
Combination	groups elaborate collectively across boundaries of groups bound to form organization within environment
Internalization	individuals experience, experiment and then contemplate across personal, group, organizational and environmental boundaries

Similarly, reflections and refractions can be used to explain and apply into related learning and knowing, as well as practicing and managing issues. Linking also with system theories, we can provide a relevant framework in the next section.

4. LEARNING / KNOWING AND PRACTICING / MANAGING AS EACH OTHER'S EXPERIENCED REFRACTIONS AND REFLECTIONS

Reflective and refractive interactions are equally important, when we consider individuals as agents and actors in their actual work and personal life, or as members of their respective communities of practice, or as members of work groups and other social formations. Moreover, the free and creative thinking associated with reflection and refraction coincides with the 'emancipatory' nature of the term, as an important social dimension. This stresses being critical and evaluative towards an outcome that is transformative and liberating in effect, not only for the individual but also for society (Medeni 2008, Habermas 1973, 1972; Mezirow 1990; Reynolds 1998).

The characteristics of the education/theory and work/practice contexts are so different, that the knowledge refracts significantly during the in-between transfer. Specifically, the transfer of knowledge from educational context to the workplace is a very problematic concern in the real world. Improving our conceptualization of knowledge transfer with the incorporation of refraction and reflections could prove to be useful for addressing this problem. Learning to be refractive and reflective can support individuals and institutions so that the learned knowledge, which can ideally be internalized, thus tacit, and specific to a different educational

environment, can be converted into useful knowledge that reflects the characteristics of real life, accommodating various conflicting, contextual issues related with institutional and personal life.

Accordingly we can also imagine and conceptualize two knowledge-creating spirals as interdependent of each other, one for learning and the second for practice (or generally any two environments characteristically different from each other), as we have illustrated in Figure 3. Their interdependence is constructed by reflection and refraction, which enables the transfer of knowledge from learning to practice or vice versa. In other words, the knowledge spirals could be the reflection and refraction of one another.

To exemplify, for instance, the left bottom side of the figure above (Fig. 3) exhibits the conceptualization of one knowledge spiral as a simple reflection of the other in a reflective object like mirror. Again for simplification purposes, we consider refraction as within the umbrella phenomenon of reflection.

In the illustration, the upper part is a 3 Dimensional (3D) visualization, while the bottom part is a 2 Dimensional (2D) projection on a plain surface. The upward spiral in 3D looks like an endless cyclic movement in 2D. Finally, the cyclic movement in the left spiral/circle is clockwise, whereas in the right spiral/circle, it is anti-clockwise, which together creates a continuous horizontal-8 figure, resembling the infinity symbol, in 2D. What is also worth-noting is that the conceptualization of reflection here is not only the reflection of a physical object, but the metaphorical reflection of a knowledge-creating process that proceeds in time and produces an outcome, as well, as we have discussed above. Accordingly; if the clockwise move symbolizes the natural proceeding of time from past to present and future, then its reflected image, the anticlockwise move, symbolizes the reversed flow of time from future to past, while reflection plays the role of establishing the link between these two flows, i.e. making use of the reversed flow in order to make sense of the real flow, which could be one interpretation of reflection.

Leaving this interpretation aside, what the above figure implies is that the two knowledge-creating spirals of practice and learning are simply conceptualized as one knowledge-creating spiral and its reflected image, while their interdependence is the mere result of an exact, one-to-one reflection. However, such reflection would exhibit a simplified or ideal case, as it is more realistic to think that the

reflection would be mostly refracted, and these refracted reflections would replace any exact linear correspondence with more dynamic, non-linear approximations.
In such modeling, reflection and refraction construct the practice-learning link and interaction, which includes concerns like what we learn from practice, how we apply our learning into action, or how we construct our knowledge, and accumulate our experience. These concerns highlight that how we reflect and refract is not simple, but a lot more dynamic, and chaotic; and a modeling about reflection and refraction should address this chaos. In fact, the inclusion of refraction within the conceptualization of reflection is an initial premise for such a non-linear, more dynamic modeling.

Then, considering learning and practice as two interdependent knowledge-creating spirals that are reflected and refracted on each other is a stepping-stone that can be used to establish a complex system of reflective and refractive mindset. In fact, interestingly, the reflected (and refracted) knowledge-spirals of learning and practice resemble the butterfly flaps of the Lorenz Attractor, as an indicator for the existence of such a chaotic system for a reflective and refractive mindset.

With respect to this, a reflective and refractive mindset is modeled as a chaotic system, whereas learning and practice are conceptualized as the two attractors, to which the system evolves after a long enough time. Within this system, reflection and refraction establishes the link and the continuity between the two knowledge-creating spirals that over time converge to their chaotic attractors of learning and practice.

5. CONCLUSION
This work has brought together different aspects of a reflection-refraction framework, aiming to improve its general comprehension and applicability. The foundations of theoretical framework have been enhanced by incorporation of previously separate materials from different sources and disciplines with an application focus on the systematic interactions and interrelations among learning, knowing, experience and management.

Systems science can provide further support for the development of such framework. For instance, nonlinear dynamical systems that exhibit mathematical chaos are deterministic and thus orderly in some sense, while the cases of most interest arise when the chaotic behavior takes place on an attractor, since then a large set of initial conditions will lead to orbits that converge to this chaotic region. "Sensitive dependence on initial conditions" is the essence of chaos. The

meaning of this statement about chaotic systems in Wikipedia for us is the confirmation of what Nonaka and Takeuchi discuss that there is order in chaos, which is a significant characteristic of knowledge-creation. By defining the relevant parameters regarding the attractors of learning and action, and the phenomena of reflection and refraction, we could model and demonstrate a knowledge-creating system in reality in the future studies.

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