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Knowledge Dynamics

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Abstract. *The purpose of this paper is to present a new perspective on knowledge dynamics. This perspective is based on the energy metaphor and the theory of multifield knowledge spectrum. That makes a significant step forward with respect to all the other knowledge dynamics models, which are based on the stocks and flows metaphor since the new perspective uses the entropy principle from thermodynamics and not the Newtonian logic. While the metaphor of knowledge flows leads to the physical motion in space, the metaphor of knowledge energy allows us to interpret dynamics as an irreversible transformation between two well-defined fields. Also, the paper presents the entropic transformation of the potential organizational knowledge into the operational organizational knowledge performed by organizational integrators.*

Keywords*: knowledge field, rational knowledge, emotional knowledge, spiritual knowledge, transformation.*

Introduction

Before starting any discussion about the knowledge dynamics it is necessary to accept as a basic hypothesis the fact that thinking is a metaphorical process (Lakoff & Johnson, 1980, 1999; Moser, 2000). That is demonstrated by all the new discovery of cognitive sciences, based on which Lakoff and Johnson (1999, p.3) assert that:
(a) The mind is inherently embodied.
(b) The thought is mostly unconscious.
(c) Abstract concepts are largely metaphorical.

Our mind is using metaphors as a means to improve our understanding of new concepts, especially when they reflect intangible entities, by using well-known tangible objects. As Pinker (2008, p.241) underlines, "*Conceptual metaphors point to an obvious way in which people could learn to reason about new, abstract concepts. They would notice, or have pointed out to them, a parallel between a physical realm they already understand and a conceptual realm they don't yet understand*".

Andriessen (2006, 2008, 2011) and Andriessen and Boom (2007) focus on the consequences of our metaphorical thinking on understanding and trying to define the concept of *knowledge*, and reveal the fact that using the concept of *knowledge* is related unconditionally by the metaphor used in defining it: "*Knowledge is not a concept that has a clearly delineated structure. Whatever structure it has it gets through metaphor. Different people from different cultures use different metaphors to conceptualize knowledge. They may be using the same word; however, this word can refer to totally different understandings of the concept of knowledge*" (Andriessen & Boom, 2007, p.3). That means that when we operate with the concept of *knowledge* we have to understand the framework of the conceptual metaphor, including its limitations.

The purpose of this paper is to present a new perspective on *knowledge dynamics* which opens new directions for research and applications in the fields of knowledge management, intellectual capital, and organization studies. The structure of the paper is as following: section 2 presents some basic ideas used to explain the knowledge dynamics models in the literature; section 3 presents the Nonaka's knowledge dynamics model and its limitations; section 4 presents the new ideas introduced by the energy metaphor and thermodynamics in understanding the multifield theory of knowledge; section 5 presents the main ideas of the entropic model of knowledge dynamics. Finally, there are some conclusions and future directions for research.

Metaphors and meanings used for knowledge dynamics

Aino Kianto (2007) analyzes for the first time in a comprehensive and systematic way the dynamic dimension of intellectual capital, which can be used for understanding the knowledge dynamics concept, since knowledge constitutes the core ingredient of intellectual capital. Kianto (2007, p.344) remarks the fact that there are two different approaches to explaining the nature of the intellectual capital: "*on the one hand, it can be understood as a static asset or stock of the firm; on the other, it can be framed as a dynamic capability, or a flow*" (our emphasis). It is clear that in the first approach the basic metaphor used is "knowledge as a stock", and in the second approach the basic metaphor is "knowledge as a flow". In the first case, knowledge is conceived as a possession or owned property of the firm. In the second case, knowledge is conceived as an emerging result of the ongoing interactions between the firm's employees. The essence of the flow metaphor is explained clearly by Nissen (2006, p.XX): "*To the extent that organizational knowledge does not exist in the form needed for application or at the place and time required to enable work performance, then it must flow from how it*

exists and where it is located to how and where it is needed. This is the concept of knowledge flows". In the author's view, *knowledge flows* represents more than just a metaphor, it explains the phenomenon of how knowledge moves through an organization.

Ikujiro Nonaka and Hirotaka Takeuchi (1995) used in their theory of knowledge dynamics the *iceberg* metaphor, which assigns the visible part of the iceberg to the explicit knowledge and the hidden part which is underwater to the tacit knowledge. It is a very intuitive metaphor but it is static. In order to support their dynamic model, they introduced the idea of knowledge as a *process* which has been developed in more details some years later (Nonaka, Toyama & Hirata, 2008). According to the new interpretation, "*The most prominent feature of knowledge, compared with physical resources and information, is that it is born of human interaction. It is not a self-contained substance waiting to be discovered and collected. Knowledge is created by people in their interactions with each other and the environment*" (Nonaka et al., 2008, p.7). Thus, knowledge is a result of social interaction in a given context. According to the analysis of Kianto (2007), that is the first interpretation of dynamic intellectual capital: interaction of resources in value creation process. The second interpretation is that of activities in which intangibles are imbedded and demonstrated. "*The focus of this interpretation is on the particular activities in which intangible resources are used, acquired and developed in organizations*" (Kianto, 2007, p.349). Finally, the third interpretation is that of the process of changing intangibles in the effort of realizing a competitive advantage. As underlined by Kianto (2007, p.351), "*The dynamic capability approach focuses on understanding the sources and processes leading to the competitive advantage during conditions of rapid change*". Although there are three different interpretations to the dynamic dimension of knowledge and intellectual capital, they are based on two metaphors: knowledge flows and knowledge processes. Both metaphors are supported by the Newtonian logic, although processes may go sometimes beyond it. That means that the main limitations of these interpretations of knowledge dynamics come from the followings:

- Flow suggests a motion in space, respectively a motion of knowledge through the entire organization. However, the authors using the flow metaphor do not explain the forces which generate and control the knowledge flow.
- Linearity, since the Newtonian laws of motion, are based on linear thinking (Bratianu, 2007, 2009). That is a severe limitation since knowledge is nonlinear and cannot be understood and evaluated by using linear models.

- Knowledge processes refer mostly to explicit knowledge, or to the conversion of tacit knowledge into explicit knowledge, which reflects rational thinking.

These above limitations will be found in the models proposed for explaining the organizational knowledge dynamics and also in the attempt to evaluate intellectual capital based on the Newtonian logic.

Knowledge dynamics in the vision of Ikujiro Nonaka

Ikujiro Nonaka (1991, 1994) developed the first comprehensive model for knowledge dynamics based on the metaphors discussed in the previous section. This model has been developed further by Nonaka and his colleagues being today the most known model for organizational knowledge dynamics (Nonaka & Takeuchi, 1995; Nonaka & Konno, 1998; Nonaka et al., 2000; Nonaka & Toyama, 2003; Nonaka et al., 2006; Nonaka et al., 2008; Nonaka & Von Krogh, 2009; Nonaka et al., 2014). The theory developed by Nonaka and his colleagues is based on two fundamental forms of knowledge: explicit knowledge and tacit knowledge. *Explicit knowledge* is that form of knowledge that can be expressed in a natural or symbolic language and transferred in verbal and written communication in any social context. *Tacit knowledge* is more difficult to define since it reflects our experience and unconscious cognitive work: "*Tacit knowledge is highly personal and hard to formalize, making it difficult to communicate or to share with others. Subjective insights, intuitions, and hunches fall into this category of knowledge. Furthermore, tacit knowledge is deeply rooted in an individual's action and experience, as well as in the ideals, values, or emotions he or she embraces*" (Nonaka & Takeuchi, p.8).

The interaction between these two forms of knowledge in a given social context called Ba constitutes the fundamental idea of the proposed knowledge dynamics model. Ba is a Japanese word for "space". However, Nonaka and his colleagues extend the semantic of this concept to comprise also all the intangible features of such a space may have when people are engaged in knowledge creation. "*We define Ba as a shared context in motion, in which knowledge is shared, created, and utilized. Ba is the foundation for knowledge-creating activity… Although it may be easier to see Ba as a physical space, such as a meeting room, it should be understood as a multilevel interactive state that explains the interactions that occur at specific time-space*" (Nonaka et al., 2008, p.34). In Ba, there is a continuous transformation and transfer of knowledge through four basic processes: socialization, externalization, combination, and internalization (SECI).

Socialization is considered as an initial process of knowledge creation since it stimulates learning through exchange of tacit knowledge. In the view of Nonaka and Takeuchi (1995), creating and exchanging tacit knowledge represents the most important process of knowledge dynamics within the Japanese companies. Experience is a rich source of knowledge creation at the individual level and the responsibility of knowledge management is to stimulate the exchange of it as tacit knowledge. *Externalization* is the next sequence, in which the acquired new knowledge by an individual is transformed into explicit knowledge through a mental process. "*It is a quintessential knowledge-creation process in that tacit knowledge becomes explicit, taking the shapes of metaphors, analogies, concepts, hypotheses, or models*" (Nonaka & Takeuchi, 1995, p.64). *The combination* means exchanging explicit knowledge in a given social context by using a natural or symbolic language. Through combination, knowledge advances from individual level to the group and organization levels. This way it is expanded, amplified and restructured to generate new organizational knowledge. The combination is the only process that can be easily analyzed due to its tangible manifestation. *Internalization* is the last process of this model. It is the process in which explicit knowledge is transformed into tacit knowledge at the individual model. Thus, it may be considered as the reverse process of externalization. Internalization is a learning process realized in a given social context Ba. Following the four processes of socialization-externalization-combination-internalization for several times knowledge describes a spiral which suggests its continuous amplification and development.

The SECI model achieved a large acceptance due to its simplicity and intuitiveness. There is nothing difficult in understanding the model, with the exception may be the Ba concept which reflects the specific Japanese thinking. However, due to its simplicity the SECI model has been criticized by many authors (Bereiter, 2002; Bratianu, 2010; Glisby & Holde, 2003; Gourley, 2006; Gourley & Nurse, 2005; Ribeiro & Collins, 2007). Recognizing the merits of the Nonakian knowledge dynamics model we have to remark that its limitations come mainly from the limitations of the metaphors used for explaining knowledge, especially the iceberg and flow metaphors which are Newtonian in their nature. If we want to approach our understanding of knowledge to the complexity of real life we have to go beyond the Newtonian logic and to open the door of thermodynamics. That means to develop new metaphors and interpretations of knowledge dynamics. As Leif Edvinsson (2002, p.106) remarks, what we need today is to create "*New metaphors, new models, new organizations. In the knowledge economy organizations must re-create themselves as intelligent enterprises. Intelligent enterprising is what we must now seek at every organization turn*".

The multifield theory of knowledge

The new model of knowledge dynamics is based on the *energy metaphor* proposed by Bratianu and Andriessen (2008) and developed further by Bratianu (2011, 2013, 2015), and Bratianu and Orzea (2013a). The metaphor has *energy* in the source domain and *knowledge* in the target domain, which means that it transfers some of the main attributes of energy toward the knowledge. The main attributes transferred from the energy domain are the following:

(a) Energy is a field. It is a non-substance manifestation of matter.
(b) Energy can be found in nature in different forms (i.e. mechanical energy, thermal energy, electrical energy, nuclear energy etc.).
(c) One form of energy can transform into another form.

The first attribute leads us to the assertion that *knowledge is a field*. That means that knowledge can be viewed more easily as being intangible since a field cannot be seen, and cannot be touched like a physical object. The second attribute of energy leads us to the idea that knowledge may be considered in different forms. We defined three fundamental fields of knowledge: *rational knowledge*, *emotional knowledge*, and *spiritual knowledge*. These forms have different nature and they can be found at any level in the organization structure from micro to macro levels. The third attribute suggests that any of the defined knowledge fields can transform into another knowledge field, generating these way a complex manifestation of knowledge. Thus, the fundamental knowledge fields are in a continuous interaction and transformation. Thus, the meaning of *knowledge dynamics* has been extended beyond the two forms of tacit and explicit knowledge and the processes of externalization and internalization approaching this way the complexity of human mind and of organizational knowledge.

Rational knowledge is represented mainly by explicit knowledge since it is the result of the conscious cognitive brain. In fact, knowledge has been identified for centuries in Europe and America as being rational knowledge. Commenting on this philosophical view expressed by Plato and his followers, Bertrand Russell (1972, p.153) remarks: "*It follows that we cannot know things through the senses alone, since through the senses alone we cannot know that things exist. Therefore knowledge consists in reflection, not in impressions, and perception is not knowledge*". René Descartes synthetized this conception of rational knowledge into a sentence which became famous: *Cogito, ergo sum!* which means that I think, therefore I exist. His explanation came as follows: "*Even bodies are not properly speaking known by the senses or by the faculty of imagination, but by the understanding only, and since they are not known from the fact that they are*

seen or touched, but only because they are understood, I see clearly that there is nothing which is easier for me to know than my mind" (Descartes, 1997, p.147). The Cartesian dualism of body and mind has been so powerful that even today many authors discussing knowledge have in their mind only rational knowledge (Bratianu, 2015). Rational knowledge is considered to be objective and this attribute made it suitable for developing scientific and technological knowledge. Also, education in the western countries has been conceived in objective terms and stressed the importance of science and technology which means the primacy of rational knowledge.

Emotional knowledge emerged as a component of *tacit knowledge* especially after the work of Michael Polanyi (1983). In his seminal book about the tacit dimension of knowledge, Polanyi considers our direct experience with the environment as a source of knowing. It is a bodily experience which generates emotional information through perception, information which becomes then emotional knowledge. "*I said that by elucidating the way our bodily processes participate in our perceptions we will throw light on the bodily roots of all thought, including man's highest creative powers*" (Polanyi, 1983, p.15). Unlike the European philosophy based for centuries on the Cartesian dualism of body and mind, the Japanese philosophy of life has been developed on the idea of oneness of body and mind, supported by three pillars (Kaufman, 1994; Nakagawara, 2004; Nonaka & Takeuchi, 1995; Nonaka et al., 2008):

(a) Oneness of humanity and nature.
(b) Oneness of body and mind.
(c) Oneness of self and others.

Each of these pillars plays an important role in the Japanese education and in their way of life and work. It is interesting to reflect on the following idea: "*While most Western views of human relationships are atomistic and mechanistic, the Japanese view is collective and organic. It is within this context of an organic worldview that the Japanese emphasize subjective knowledge and intuitive intelligence*" (Nonaka & Takeuchi, 1995, p.31). Thus, for the Japanese culture, tacit knowledge plays an important role and Japanese companies made use successfully of it. Emotional knowledge and cultural values belong to tacit knowledge (Nonaka & Takeuchi, 1995). However, treating tacit knowledge as a garbage can where managers put anything that cannot be explicit knowledge creates serious problems in researching emotional knowledge and spiritual knowledge. That is why we consider that changing the iceberg metaphor with the energy metaphor opens new opportunities for emotional knowledge research and practice (Bratianu & Orzea, 2013b). Emotional knowledge is the result of processing the information generated by our emotions and feelings (Caruso & Salovey,

2004; Damasio, 1994, 1999, 2012; Ekman, 2003; Gardner, 1983; Gladwell, 2005; Goleman, 1995; Hill, 2008; Kahneman, 2011; LeDoux, 1999; Pinker, 1997). The difference between emotions and feelings is well-explained by Damasio (1999, p.42): "*I have proposed that the term feeling should be reserved for the private, mental experience of an emotion, while the term emotion should be used to designate the collection of responses, many of which are publicly observable*". Thus, Damasio (1999) emphasizes the fact that the representation of the external environment in our brain is possible due to the emotional information we receive through our body and its sensory system. This information is processed by our emotional intelligence (i.e. intrapersonal and interpersonal intelligence according to multiple intelligence models proposed by Gardner, 1983). In a synthesis, emotional intelligence is defined by Salovey and Caruso (2004, p.197) as being "*The capacity to reason about emotions, and of emotions to enhance thinking*".

Spiritual knowledge constitutes the third fundamental form of the knowledge field (Bratianu, 2013, 2015). If rational knowledge reflects the objectivity of the physical environment we are living in, and emotional knowledge reflects the subjectivity of our body interaction with the external world, spiritual knowledge reflects our understanding of the meaning of our existence. As Maxwell (2007, p.274), "*We have to learn to see aspects of the world around us: stones, people, trees, sky. Equally, we have to learn to see meaning and value in the world around us, in our environment, in events, in human actions and lives*". Individuals working together in a company share their values and beliefs about life, work, and future generating in time an organizational culture. Spiritual knowledge and spirituality should not be reduced to religion. As Zohar and Marshall (2004, p.29) remark, "*The spiritual in human beings makes us ask why we are doing what we are doing and makes us some fundamentally better way of doing it. It makes us want our lives and enterprises to make a difference*". Spiritual knowledge and spiritual intelligence generate for any organization the spiritual capital which is a fundamental component of the intellectual capital (Zohar & Marshall, 2000, 2004). Great companies are great not because of their profit but because of their intellectual capital (Collins & Porras, 2001; De Geus, 2002; Song & Lee, 2014). Spiritual knowledge is essential in any decision making process since rational arguments are strongly influenced by the values settings of managers since they are moral beings (Mathur & Kenyon, 1998). If we assign a positive meaning to the values which are in concordance with the work and management ethics, then we may consider as being negative or antivalues those which against the first mentioned. Successful management is based on positive values and rational decision making, while business failures are caused by decisions based on antivalues and personal interests. Thus, spiritual knowledge which reflects positive values and positive spiritual intelligence is essential in conceiving

successful strategies and in achieving competitive advantage. Spiritual knowledge is intrinsically related to the concept of Corporate Social Responsibility, a concept requesting a responsible governance and a vision driven by social values and not profit maximization (Basu & Palazzo, 2008; Benston & Hartgraves, 2002; Branson, 2011; Lange, 2008; Pinto et al., 2008; Wang et al., 2011).

The new dynamics of knowledge

The multifield theory of knowledge is based on the assumption that at both the individual level and organizational level there are three basic fields of knowledge: rational, emotional, and spiritual. The new dynamics of knowledge is based on the basic assumption that these three fields of knowledge are in a continuous interaction and knowledge from each field can be transformed into the knowledge of any other field. Also, we may consider the transformation of tacit knowledge into explicit knowledge, regardless of the nature of that form of knowledge. For explaining each of these fundamental transformations we will use the energy metaphor, exploring its full potential (Bratianu, 2011, 2015).

The transformation of tacit knowledge into explicit knowledge and vice versa. These transformations follow from the metaphor in which we assign potential mechanical energy to the tacit knowledge and kinetic mechanical energy to the explicit knowledge. A good example can be the watermill, where the potential energy of water is transformed into kinetic energy when it is falling down over a wheel and is turning it producing mechanical work. This transformation has been considered by Nonaka and Takeuchi (1995) in the SECI model but they could not explain it because they used the iceberg metaphor, where the iceberg is solid without any possibility of performing any transformation of the type potential – kinetic energy. This transformation may be used also in explaining the transformation of the total potential organizational knowledge into effective or operational organizational knowledge through the work of integrators (Bratianu, 2008, 2015).

The transformation of rational knowledge into emotional knowledge and vice versa. For this type of knowledge transformation, we will consider the transformation of mechanical energy into thermal energy, according to the thermodynamics laws. For mechanical energy, we assign rational knowledge and for thermal energy, we assign emotional knowledge. Thus, we may consider the transformation of rational knowledge into emotional knowledge and vice versa, a transformation which happens frequently in

the making decisions as demonstrated by cognitive science. According to Hill (2008, p.2), "*Breakthrough in brain science have revealed that people are primarily emotional decision makers…Emotions are central, not peripheral, to both marketplace and workplace behavior*".

The transformation of rational knowledge into spiritual knowledge and vice versa. For this type of knowledge transformation, we will consider the transformation of mechanical energy into electrical energy in concordance with the laws of electricity. For mechanical energy, we assign the rational knowledge and for electrical energy, we assign spiritual knowledge. In physics, this transformation is known as the piezoelectric effect, a phenomenon in which a variation of a mechanical field induces a variation of an electrical field generating an electrical current. In knowledge dynamics, rational knowledge is used in formulating value judgments, and values are used currently in the decision making process. The concept of Corporate Social Responsibility reflects very well this type of knowledge transformation.

The transformation of emotional knowledge into spiritual knowledge and vice versa. For this type of knowledge transformation, we will consider the transformation of thermal energy into electrical energy and vice versa. The transformation can be illustrated by the physical phenomenon of the thermocouple, when a variation of a thermal energy field generates electricity by using a couple of two conductors made of different materials. In psychology, this phenomenon can be illustrated by the Budhists monks who try through hard physical and mental work to reduce their negative emotions in order to increase their state of happiness. Mathieu Ricard (2007), the French Budhist monk who is considered by many people the happiest person in the world, explains what happiness means to him: "*By happiness I mean here a deep sense of flourishing that arises from exceptionally healthy mind. This is not a mere pleasurable feeling, a fleeting emotion, or a mood, but an optimal state of being. Happiness is also a way of interpreting the world, since while it may be difficult to change the world, it is always possible to change the way we look at it*" (Ricard, 2007, p.19).
An illustration of the new knowledge dynamics structure is shown in Figure 1.

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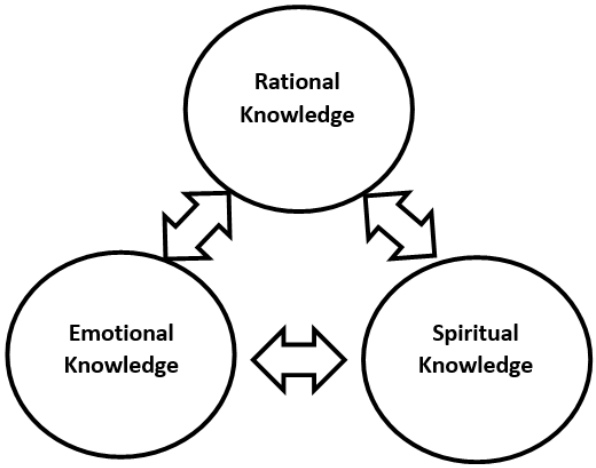

Figure 1. The knowledge dynamics structure

Conclusions

The paper purpose is to present a new perspective on knowledge dynamics which goes beyond the well-known model proposed by Ikujiro Nonaka and his colleagues. While the Nonaka's model is based on the *iceberg* metaphor and the *stocks and flows* metaphor, the new perspective is based on the *energy* metaphor. The new framework is based on the following assumptions: (a) knowledge is a field; (b) there is three fundamental fields of knowledge: rational, emotional, and spiritual; (c) knowledge from one field can transform into knowledge from any other field. Thus, these fields are in a continuous interaction and transformation. For a better understanding of these transformations, we can use the energy metaphor and make the following assignments: potential energy – tacit knowledge; kinetic energy – explicit knowledge; mechanical energy – rational knowledge; thermal energy – emotional knowledge; electrical energy – spiritual knowledge. Transferring the main attribute of energy and the main principle of transformation coming from thermodynamics in the knowledge domain we get a deeper understanding og knowledge dynamics which overcome many barriers from the knowledge dynamics model proposed and developed by Ikujiro Nonaka and his colleagues.

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