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A Holistic Approach to Knowledge Risk

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Abstract. *In the knowledge economy, knowledge becomes a strategic resource for any company contributing significantly to achieving its competitive advantage. Knowledge risk is associated with any knowledge activity which is done under the pressure of uncertainty. Researchers focus their attention especially on the following types of knowledge risks: knowledge loss, knowledge leakage, knowledge spillover, knowledge outsourcing, knowledge gaps, and improper use of knowledge. All the researchers analyze knowledge risk by using for knowledge the metaphor of stock-and-flow, which implies that knowledge is considered in its explicit form as being rational. According to the theory of knowledge fields, which is based on the metaphor of knowledge as energy, we consider a holistic approach comprising the rational knowledge field, emotional knowledge field, and spiritual knowledge field. In this perspective, the risk is associated with each knowledge field such that the whole phenomenon of knowledge risk becomes more complex. The purpose of this paper is to present a holistic approach to the knowledge risk based on this theory of knowledge fields and the energy metaphor for knowledge. It is a conceptual analysis based on metaphorical thinking and literature background. Our findings lead to a larger perspective in understanding and using the concept of knowledge risk in knowledge management.*

Keywords: *knowledge fields; knowledge loss; knowledge leakage; knowledge spillover; knowledge risk.*

Introduction

Knowledge risk is developing as a new area of research within the knowledge management and intellectual capital (Durst & Aisenberg Ferenhof, 2016; Durst & Wilhelm, 2013; Massingham, 2010; Sumbal et al., 2018; Zieba & Durst, 2018). Knowledge is seen as a strategic resource which contributes to the competitive advantage and it is vital for any company to evaluate knowledge risk and find solutions for its mitigation (Grant, 1996; Spender, 2014). Knowledge risk can be defined as being “the measure of the probability and severity of adverse effects of any activities engaging or related somehow to the knowledge that can affect the functioning of an organization on any level” (Zieba & Durst, 2018, p.256). Thus, knowledge risk implies knowing the probability of those events which lead to negative consequences in knowledge management. From a rational perspective, knowledge risks can manifest as knowledge loss, knowledge leakage, knowledge spillover, knowledge outsourcing, knowledge gaps, and obsolete knowledge (Acs et al., 2009; Ahmad et al., 2014; DeLong, 2004; Jennex, 2014; Joe et al., 2013).

Although the research has been focused mostly on the rational aspects of knowledge risks, we should accept the fact that both the concepts of *risk* and *knowledge risk* involve also an emotional perspective (Bratianu, 2018a; Bratianu & Orzea, 2014). The risk is always associated with *uncertainty*, which reflects a state of incomplete knowledge about an event or about the future. Holton (2004) considers uncertainty as a state of not knowing whether a proposition is true or false. “Everything about the future is uncertain, as is most of the past; even the present contains a lot of uncertainty due to your ignorance, and uncertainty is everywhere about you” (Lindley, 2006, p.7). Moreover, uncertainty is a personal matter since it is about an individual perception of a given event in a given context. It is well-known that the same event generates different perceptions in different individuals, and thus uncertainty related to it is different for them. Lindley (2006, p.1) posits that “it is not *the* uncertainty but *your* uncertainty”. Statements about uncertainty do not reflect an objective property of events but a relationship between an individual and the real world. Thus the perception of uncertainty is fully subjective, and any risks associated with it have a subjective component. This duality of subjective-objective interpretation of uncertainty and risk is emphasized also by Holton (2004, p.19): “According to objective interpretations, probabilities are real. We may discover them by logic or estimate them through statistical analyses. According to subjective interpretations, probabilities are human beliefs. They are not intrinsic to nature. Individuals specify them to characterize their uncertainty”.

We may reach to the *risk* concept starting with *belief* (Holton, 2004; Kahneman, 2011; Lindley, 2006). Belief reflects a relationship between an individual and the reality around him. “Belief is not a property of that world because your degree of belief may reasonably be different from mine. Rather, belief expresses a relationship between you and the world” (Lindley, 2006, p.12). The measure of the strength of one’s belief is given by a *probability*. Thus, the concept of *probability* can be introduced as statistical evidence of some random events or as a measure of the strength of one’s belief in the appearance of a given event (Knight, 2006). For instance, we can compute the probability of getting the head of a coin when we flip it for a large number of times, but we believe that today there are 60% chances of rain by looking at the clouds on the sky. Both the statistical evidence and our beliefs about any events depend on the knowledge we have. But we never will have a complete knowledge base about events, leaving thus uncertainty to influence our thinking and decision-making. “We are never certain; we are always ignorant to some degree. Much of the information we have is either incorrect or incomplete” (Bernstein, 1998, p.207). In this information context, the probability may quantify *perceived* uncertainty (Holton, 2004).

For many people is not the *risk* but the *exposure* to possible consequences of decision-making which matters. These consequences may have negative effects on the course of action and that is the real issue people care about. Thus, risk entails two essential components: exposure and uncertainty. “Risk requires both exposure *and* uncertainty” (Holton, 2004, p.22).

To approach knowledge risk from a holistic perspective which implies rationality, emotionality, and spirituality, it is necessary to change the paradigm of knowledge understanding by changing its metaphorical basis (Andriessen, 2006, 2008; Cornelissen et al., 2008; Lakoff & Johnson, 1999). The main metaphors used in the

literature for explaining the concept of knowledge are the iceberg metaphor (Nonaka & Takeuchi, 1995), and stock-and-flow (Bolisani & Oltramari, 2012; Davenport & Prusak, 2000; Jashapara, 2011; Nonaka et al., 2008). According to these metaphors, knowledge is considered in one of the two forms: explicit knowledge and tacit knowledge. *Explicit knowledge* is actually the rational knowledge, the knowledge that can be expressed by using a natural or symbolic language. *Tacit knowledge* is personal and is generated by direct experience. It is processed by the cognitive unconsciousness such that we are not aware of how much we know. Explicit knowledge is about *what* we know, while tacit knowledge is about *how* we do things. The basic limitation of these metaphors is the induced idea of *linearity* which applies to physical objects (Bratianu, 2018b; Bratianu & Vasilache, 2010). The *knowledge as energy metaphor* (Bratianu & Andriessen, 2008) opens a new perspective on understanding knowledge and introducing the idea of knowledge as a field.

The purpose of the present paper is to present a holistic view of the knowledge risk concept and to link it to the organizational knowledge dynamics. After a brief survey of the literature concerning *knowledge risk*, the paper will present the basic ideas of the energy metaphor and the new dimensions of this concept, i.e. emotional and spiritual knowledge risks.

Literature review

Knowledge loss

Knowledge loss is the most important knowledge risk for any organization since it influences directly the dynamics of organizational knowledge. "There is a huge challenge in terms of the aging workforce as a large number of employees near retirement will soon leave the industry, thus begetting a profound knowledge loss" (Sumbal et al., 2018, p.1573). If we consider ΔK the variation of the organizational knowledge level in a given period of time, then we have (Bratianu et al., 2011):

$$\Delta K = \Delta KC + \Delta KA - \Delta KL \quad (1)$$

In this equation, ΔKC represents the variation of knowledge creation in a given period of time, ΔKA is the variation of knowledge acquisition and ΔKL is the variation of knowledge loss. Knowledge sharing does not appear in this equation because it does not contribute to the variation of the level of organizational knowledge but at its distribution within the organization. Thus, the variation of knowledge loss may change significantly the equilibrium of the organizational knowledge when many workers retire in the same period of time, taking with them their experience and expertise. For instance, DeLong (2004, pp.18-19) remarks what had happened at Boeing after an early retirement bad strategy: "After Boeing offered early retirement to 9,000 senior employees during a business downturn, an unexpected rush of new commercial airplane orders left the company critically short of skilled production workers. The knowledge lost from veteran employees combined with the inexperience of their replacements threw the firm's 737 and 747 assembly lines into chaos". Thus, knowledge loss may create serious production and financial problems (Durst and Wilhelm, 2011; Joe et al., 2013; Martins & Martins, 2011).

A classic example of *knowledge loss risk* is the NASA story (DeLong, 2004; Mahler & Casamayou, 2009). More than \$24 billion was invested in NASA over the 10 years to research and produce the spacecraft and the whole system for launching it, aiming at landing the first astronaut on the moon. At its pick, 400,000 were working on the Apollo project. By 1972 five more Apollo missions proved that NASA could safely explore the moon. As Mahler and Casamayou (2009) remark, after about 30 years of working to these unique projects, due to many structuring and re-structuring with downsizing, events which made many scientists and engineers to accept early retirement programs, or leave for other jobs, NASA lost a significant critical knowledge in designing and building spatial vehicles. The same conclusion is formulated by DeLong (2004, p.11): “In an era of cost-cutting and downsizing, the engineers who designed the huge Saturn 5 rocket used to launch the lunar landing craft were encouraged to take early retirement from the space program. With them went years of experience and expertise about the design trade-offs that had been made in building the Saturn rockets”.

Sumbal et al. (2018) present a research focusing on the critical knowledge loss in the domain of oil and gas industry. *Critical knowledge* is that knowledge which is essential in realizing a certain product or service. Critical knowledge contributes directly to competitive advantage and its loss will lead to a competitive vulnerability for a given company. Knowledge managers should identify and quantify critical knowledge for each business domain and they should develop methods to retain this knowledge when experts retire or just leave for other companies. Unfortunately, many companies don't have systematic procedures to assess the knowledge of departing employees. In the oil and gas industry, critical knowledge is about discovering these resources and bringing them up economically. When experts in these areas of knowledge are retiring, the company should use different procedures to retain a good part of this critical knowledge, and reducing the organizational knowledge loss.

Knowledge loss can be a result of several phenomena, retirement is the most important. The other phenomena can be: turnover – the knowledge source leaves the company, probably to join another one; disability – the knowledge source is lost as a result of an accident, when his ability to work is impaired; job change – the knowledge source leaves his current position for another position within the company (Jennex, 2014). Assessing the risk (R) of knowledge loss should include not only the probability for a certain individual to leave the company (P), but also the importance of his knowledge for the production chain (I) and the quality of that knowledge (Q). That can be written symbolically as follows:

$$R = P \times I \times Q \quad (2)$$

The importance of the knowledge source in the production chain and its quality are related to the criticality of that knowledge. At the limit, if the knowledge lost is critical for the production chain, then the company may lose its competitive advantage for that product or service. According to Massingham (2008), the knowledge loss produced by an employee who leaves the company may have three consequences:

- Loss of contribution to the organizational memory;
- Loss of relational knowledge with the internal and external social network;
- Loss of work performance resulting in decreased organizational productivity.

Analyzing each of these categories of knowledge loss we may remark that the resulting loss is much more than just rational knowledge. It implies also emotional and spiritual knowledge which sometimes is integrated into social capital (Bratianu, 2013, 2018c). Knowledge risk can be reduced through different methods of capturing and retaining knowledge from those individuals who will leave the company.

Knowledge retention is a complex process through which organizations can reduce the knowledge loss with people who retire or just leave them. DeLong (2004) analyzes the knowledge retention strategies and groups them into four main categories: a) human resources, processes, and practices; b) knowledge transfer practices, including knowledge sharing and intergenerational learning; c) knowledge recovery initiative; and d) IT applications to capture, store and share information and knowledge. All of these strategies can be supported by developing a dynamic organizational culture able to stimulate knowledge and skills retention. For instance, "Shell Chemical has recognized that it can't develop, retain, and deploy its highly skilled professionals – and their critical knowledge – without a robust process to track the current status of the organization's skill base. Shell implemented its global technical skills resource management process to ensure an adequate level of technical resource to support its long-term globalization objectives" (DeLong, 2004, p.61).

To reduce the risk of knowledge loss in many organizations there are programs designed for phased or flexible retirement aiming at retaining older workers in various forms and creating a necessary time for assessing their critical knowledge. That knowledge can be captured and integrated into some knowledge bases, or a good part of it can be transferred to other workers through sharing or mentoring processes. *Mentoring* is an old process by which knowledge from a more knowledgeable individual is passed progressively toward a less knowledgeable one. It is well-known the mentoring done by Aristotle for the young Alexander. Today, *mentoring* evolved into *coaching*, which becomes in business a kind of micromanagement helping small business managers and entrepreneurs to learn and grow in their enterprises. Mentoring is based on the willingness of older or more experienced people to teach younger ones, transferring to them not only cognitive knowledge but also emotional and spiritual knowledge. According to Hatton-Yeo and Telfer (2010, p.6), "A key element that differentiates mentoring from other forms of learning and support is that it is specifically designed to benefit all participants. Research consistently finds that mentors report having benefited as much from the process as those they have been mentoring".

Knowledge retention can be best increased by developing a culture of *intergenerational learning* (Lefter et al., 2011). This process is adequate especially to those organizations which are age layered, like universities. The age layered structure developed as a result of promotion stages and the pyramid-like professional hierarchy. Bratianu et al. (2011) performed a research project on intergenerational learning within some Romanian universities and revealed the importance of developing strategies to increase knowledge retention through this social process. Intergenerational learning may happen naturally in the academic environment due to the generosity of some old professors to share their experience and expertise with their younger colleagues. However, the effectiveness of intergenerational learning becomes significant when there is a high level of awareness at the rectors' level and

they design strategies to implement intergenerational learning throughout their universities, overcoming the bureaucratic barriers (Bratianu & Bejinaru, 2017).

Another way of stimulating knowledge sharing and intergenerational learning is storytelling (DeLong, 2004; Prusak et al., 2012). It may happen occasionally in organizations, but it should be transformed into a cultural tradition. Storytelling is a holistic knowledge transfer since it involves emotional and spiritual knowledge beyond cognitive knowledge.

Knowledge leakage

Knowledge leakage has been considered by some authors (Durst et al., 2015) as a form of knowledge loss, but from a risk point of view, it is different. Knowledge loss is a lost part of the organizational knowledge as a result of departing employees. The risk is generated by not having anymore that critical knowledge when it will be needed in the production process. Knowledge leakage is a metaphor for that knowledge which escape from a certain confinement or boundary and used by others, with possible negative effects for the owners of that knowledge, especially when it comes to competitive advantage (Ahmad et al., 2014; Mohamed et al., 2017; Parker, 2012). The risk of knowledge leakage is high when it happens with new ideas and technologies and when there is a certain secret concerning the new products or service a company is preparing for the market. When knowledge leakage happens the knowledge is not lost for the initial owners, thus it cannot be classified as a form of knowledge loss.

Knowledge leakage is related to business intelligence since in many situations it is not the leakage of knowledge but the effort to extract that knowledge from the given confinement and transferred to another possible user of that knowledge. Knowledge leakage happens with rational knowledge but it cannot happen with tacit knowledge, which is encrypted in personal experience. Knowledge leakage can be reduced by restricting the access of employees to certain areas of research and by introducing severe measurements for protecting all the knowledge created in that confinement. For instance, Steve Jobs used to create such kind of confinement working spaces and to ask people involved in these new projects to keep a strict secret on their work (Isaacson, 2011).

Knowledge spillover

Knowledge spillover is a metaphor for the knowledge that spills over the boundary of a company towards other companies as users of that knowledge, which may lead to the risk of reducing or losing the competitive advantage (Durst & Zieba, 2017; Inkpen, 2000; Tseng et al., 2011). Knowledge spillover is considered to have a certain influence on innovativeness and growth of companies or industries. Companies may try to decrease the risk associated with knowledge spillover by patenting strategies or by imposing some restrictions to employees working for new products and services. Some researchers underline to show that the risk of knowledge spillover is high in the case of networks or alliances since these collaborations involve a high rate of knowledge flows. Also, the risk of knowledge spillover is high when a company implements a strategy of open innovation because to stimulate outside individuals to participate in

such a process the company must provide a series of details concerning the purpose of launching a certain campaign.

Sometimes, organizations use knowledge spillover phenomenon in a very conscious way to stimulate a feedback from other organizations or people with respect to the opportunity and usefulness of starting some new projects or implement some new ideas. They put on their site's information concerning their new plans or intentions for starting new projects to test the reaction of other people or organizations. Another interesting example can be the famous Massachusetts Institute of Technology from the U.S.A. that created an open platform for all the university programs and delivered courses not only for their students but for anybody interested in them. Although it appears as a strange action, it is a very intelligent one since many experts from different fields may react with suggestions to improve these programs and courses.

Other knowledge risks

In the literature, there are examples of other risks, but their research is not so developed. We mention knowledge attrition or obsolescence risk, knowledge hiding risk, knowledge hoarding risk, knowledge forgetting risk and knowledge waste risk (Durst & Zieba, 2017; Sumbal et al., 2018; Zieba & Durst, 2018). However, we may remark that knowledge hiding can be interpreted as a risk only when there is an organizational culture stimulating knowledge sharing. Otherwise, knowledge hiding is part of the normal organizational life since knowledge sharing is not a generalized phenomenon. In the same perspective, we may say that knowledge waste is not a source of knowledge risk; it is only a result of a less efficient knowledge management.

As we shown in the introductory part of this paper, knowledge risks are associated with knowledge uncertainty for a given context, and from this point of view, the roots of uncertainty will generate different types of knowledge risks. Business and business strategies always are characterized by uncertainty and their associated knowledge risks. The knowledge management problem is to develop methods of identifying these types of risks and assessing their degree, such that managers can design practical ways for risks mitigation.

Methodology

This is a conceptual paper based on a critical literature analysis and metaphorical thinking in developing a holistic perspective for understanding, identifying and assessing knowledge risks in organizations. The holistic perspective means to go beyond rational knowledge and to imagine a framework which includes rational, emotional, and spiritual knowledge. Metaphorical thinking is useful in providing a new and more powerful metaphor in explaining knowledge and knowledge risk. That is the *knowledge as energy metaphor* introduced by Bratianu and Andriessen (2008).

Metaphorical thinking helps us to enrich the semantic domain of a less known or less understood concept by using an analogy with another concept which is well-understood and well-explained (Lakoff & Johnson, 1999). Knowledge is a concept without any correspondent as a physical object in the real world, and thus its semantic

domain depends greatly on the metaphors used to explain it (Andriessen, 2008). A metaphor is composed of a source domain where we considered the semantic domain of the well-known concept and a target domain where we consider the less-known concept. Based on our experience and interpretation we extract the main semantic attributes from the source domain and map them onto the target domain, enriching this way the less-known concept. As Andriessen (2008, pp.5-6) remarks, “the unconscious choice of metaphor has an enormous impact on how we reason about knowledge, what is highlighted and what is hidden, what is seen in organizations as problems and what is understood as solutions”.

Knowledge metaphors

Knowledge as objects or stock-and-flow

Metaphors used in the first phases for knowledge were based on tangible *objects* and *stocks*. Thus, knowledge could be accumulated, stored, distributed and measured like objects (Andriessen, 2006; Borgo & Pozza, 2012; Davenport & Prusak, 2000; Leonard-Barton, 1995). As a special object, Nonaka and Takeuchi (1995) used in the source domain the *iceberg*. This metaphor introduced in an intuitive and simple way the idea of explicit and tacit knowledge, although an iceberg is solid and there is no dynamics between the visible part over the water and the hidden part under the water. Thus, the iceberg metaphor cannot support the knowledge creation dynamic model developed by Nonaka and his colleagues (Nonaka & Takeuchi, 1995).

The metaphor used extensively today for knowledge explanation is the *stock-and-flow* metaphor (Davenport & Prusak, 2000; Nissen, 2006; Nonaka et al., 2008; O'Dell & Hubert, 2011). By changing the choice for the source domain from objects to fluid, flow, or stock-and-flow researchers induced the idea of knowledge dynamics. “We can denote knowledge stock as the amount or ‘level’ of knowledge possessed at a particular time in an organization, while knowledge flows identify knowledge that is transferred from one economic player to another. According to this interpretation, knowledge flows can affect the amount of knowledge stocked by the two players” (Bolisani & Oltramari, 2012, p.280). The idea of knowledge flow is very simple and most of the researchers adopted it to present their models of organizational knowledge dynamics. However, the stock-and-flow metaphor kept the idea of tangibility and induces that of linearity in all models of knowledge and intellectual capital measurements (Bratianu, 2018c).

Knowledge as energy

Unlike objects, stocks, and flows, energy is a *field* and brings in new properties which can be mapped on the target domain of knowledge. First, as a field, energy is *intangible* and this property is essential for understanding the nature of knowledge and the logic we have to use in evaluating it. Second, energy manifests in different forms, among them being: mechanical energy, thermal energy, and electrical energy. Third, one form of energy can be transformed into another form of energy through irreversible processes in concordance with the law of entropy (Georgescu-Roegen, 1999). These three main properties can be mapped on the target domain and transferred to the

knowledge (Bratianu & Orzea, 2010). Thus: 1) Knowledge is a field; 2) Knowledge manifests in different forms – rational, emotional and spiritual knowledge; 3) One form of knowledge can be transformed into another form of knowledge.

Based on the energy metaphor, Bratianu (2015a) developed the theory of knowledge fields which can be summarized as follows. Knowledge is a field and manifests in different forms. The fundamental forms of knowledge are rational knowledge, emotional knowledge, and spiritual knowledge. Each of these forms of knowledge can be transformed into another form of knowledge. Knowledge dynamics is much more than just a flow; it is a continuous transformation from one form into another one. This new perspective on knowledge dynamics is more powerful than Nonaka's model since it reveals emotional knowledge and spiritual knowledge as well-defined forms of knowledge and not some unidentifiable parts of the tacit knowledge.

Rational knowledge is the result of rational thinking and practically equates with explicit knowledge since it is expressed by using a natural or symbolic language. *Emotional knowledge* represents the wordless emotional states of our body by processing the information received from the sensory system (Damasio, 2012; Frith, 2007). Hill (2008, p.2) remarks that people use emotional knowledge in their decision-making process, especially when they are in the marketplace: "Breakthroughs in brain science have revealed that people are primarily emotional decision-makers". Spiritual knowledge reflects our beliefs and values, and our basic philosophy about life and work. While rational knowledge is a reflection of the external world we are living in, and emotional knowledge is a result of the processed information about our emotional states, spiritual knowledge reflects our need about the meaning of our life. "We need a sense of meaning and driving purpose in our lives. Without it we become ill or we die" (Zohar & Marshall, 2000, p.17). Organic growth of any company is based on a solid organizational culture and a robust value system (De Geus, 1999; Womack and Jones, 2003).

The energy metaphor reveals that knowledge is a complex field composed of the rational, emotional, and spiritual knowledge. Also, that knowledge dynamics goes beyond flows and incorporates transformations of knowledge from one field into another one. For instance, in any decision-making, emotional knowledge and spiritual knowledge are transformed into rational knowledge, as a result of interaction between the reflective and intuitive systems of thinking (Bratianu & Vatamanescu, 2018; Frith, 2007; Hill, 2008; Kahneman, 2011).

A holistic framework for understanding knowledge risk

In the last years, the economic and management literature has largely stressed the importance of knowledge as a strategic resource for company's competitiveness (Barney, 1991; Bolisani and Bratianu, 2018; Grant, 1996; Nonaka and Takeuchi, 1995). However, planning and achieving competitive advantage means to switch from deterministic to probabilistic thinking and to consider uncertainty as a major obstacle in long-term decision-making (Bratianu, 2015b; Durst and Wilhelm, 2013). Strategizing implies knowledge risk analysis and designing alternatives to minimize the negative consequences of those probable risks (Spender, 2014). The present

framework for knowledge risk analysis is given by the explicit-tacit knowledge dyad based on the iceberg metaphor, which means that it cannot explore the emotional and spiritual knowledge components of the organizational knowledge spectrum.

The present paper suggests that knowledge risks should include not only the rational knowledge risks but also the emotional knowledge and spiritual knowledge risks. Thus, the new framework contains three dimensions: *rational knowledge, emotional knowledge, and spiritual knowledge*. Having an extended framework, knowledge risks appear in their complexity of influencing all the aspects of the managerial decision-making, from reflective to intuitive processes (Baron, 2000; Blake, 2008; Kahneman, 2011). Also, new phenomena may appear and explore by having this three-dimensional framework.

Within the new framework, risk can be conceived of having three components: *rational risk, emotional risk, and spiritual risk*. However, these components differ in their magnitude and consequences, a fact for which at the limit we may consider only the dominant component. For instances, *knowledge loss* is a very complex phenomenon which contains all the components mentioned above, but their magnitude depends on the specific loss and a specific context. A good example is Apple company, founded as Apple Computer Inc. at 1 April 1976 by Steve Jobs and Steve Wosniak. Forced by investors to have an experienced manager as CEO, Steve Jobs succeeded to convince John Sculley to join Apple as CEO. Due to different business visions and personality traits, very soon Sculley complained about Jobs's behavioral "being unproductive and uncontrollable. After a failed power struggle with then – CEO John Sculley, Jobs quit before he could be fired" (Kahney, 2008, p.7). As a result, Apple registered a huge knowledge loss with all its components (i.e. rational, emotional, and spiritual). The rational knowledge loss manifested in a lack of new business ideas; the emotional knowledge loss manifested in a significant change in the organizational culture and the motivational system; the spiritual knowledge loss was may be the most important since Jobs had a unique business philosophy based on consumer's enthusiasm in using Apple's products and on a compelling vision (Issacson, 2011; Kahney, 2008). Without all the knowledge associated with Steve Jobs, Apple lost its competitive force and started a dangerous downfall. When Steve Jobs returned to Apple in 1997 with an enhanced managerial knowledge and a new business vision for the company, he transformed Apple from the brink of bankruptcy into one of the most powerful and famous companies in the world.

Another example of complex *knowledge loss* can be NASA with all its transformations and restructuring after the incredible success of sending the first man on the moon on 21 July 1969 (DeLong, 2004; Mahler and Casamayou, 2009). By stimulating early retirement and restructuring NASA with any new CEO and cutting down the budget, the risk of *emotional knowledge* and *spiritual knowledge* produced huge damages to the whole organization.

Emotional knowledge risk is frequently found in organizations when fear of the unknown is generated by changes in organizations, or in their management (Baesu & Bejinaru, 2015; Bejinaru & Baesu, 2013). For instance, changing the managerial style from democratic to autocratic when a new CEO is focusing on profit maximization generates a significant change in the organizational culture and the positive emotional

knowledge is lost. The reverse situation is also generating changes in the organizational culture. These situations are frequently generated in the business environment by mergers and acquisitions (Benefield, 2005; Bratianu, 2013; Bratianu & Anagnoste, 2011).

A typical *spiritual knowledge risk* is related to the change of the values system associated to the top management when there are significant changes in the governance of the company. That is because "Values are what we care about. As such, values should be the driving force of our decision making" (Keeney, 1992, p.3). In order to reduce this knowledge risk which produced many financial and environmental disasters, companies should develop their corporate social responsibility at the standards requested by communities and new legislation and a sustainable spiritual leadership (Benefield, 2005; Lange & Washburn, 2012).

Conclusions

Knowledge risk becomes a new and important research direction within the evolved knowledge management process. The purpose of this paper is to critically analyze the literature background in this research area and suggest an extended framework for knowledge risk understanding and research. Most of the papers published so far focused on knowledge loss, knowledge leakage, knowledge spillovers and improper use of knowledge. However, regardless of the complexity of these phenomena, the authors referred to the rational knowledge expressed by explicit knowledge and some of them to tacit knowledge, without any details concerning its components.

Based on the energy metaphor and the theory of knowledge fields, the present paper focuses on the three fundamental forms of knowledge (i.e. rational, emotional, and spiritual) and on their role in understanding the complexity of knowledge risk. That means an extension from the two-dimensional approach based on explicit and tacit knowledge to the three-dimensional approach based on rational, emotional and spiritual knowledge. In this new approach, knowledge loss refers not only to rational knowledge but also to emotional knowledge and spiritual knowledge. The enlarged framework opens new opportunities for understanding and exploring the complexity of the domain of knowledge risks, especially in the context of a turbulent business environment.

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