

*Pre-print version of*  
*De Toni A. F., Fornasier A., Nonino D., (2017)*  
*“The nature and value of knowledge”,*  
*Kybernetes, Vol 46 Iss 06, Pages 966-979.*  
*<http://dx.doi.org/10.1108/K-01-2017-0016>*

# THE NATURE AND VALUE OF KNOWLEDGE

Alberto Felice De Toni, Andrea Fornasier, Fabio Nonino

## Abstract

### *Purpose*

*This paper aims to explain and discuss the complex nature and value of knowledge as an exploitable resource for business.*

### *Design/methodology/approach*

*The authors propose a conceptual explanation of knowledge based on three pillars: the plurality of its nature, understood to be conservative, multipliable and generative, its contextual value and the duality of carrier incorporating business knowledge, objects or processes. After conceptualizing the nature of knowledge, the authors offer a metaphor based on the classic transformation from “potential” to “kinetic” energy in an inclined plane assuming that the conservative nature of knowledge makes it act as energy.*

### *Findings*

*The metaphor uses the concept of potential and kinetic energy: if energy is only potential, it has a potential value not yet effective, whereas if the potential energy (knowledge) becomes kinetic energy (products and/or services), it generates business value. In addition, business value is a function of the speed acquired and caused by the angle of inclined plan, namely, the company’s business model. Knowledge is the source of the value and can be maintained and regenerated only through continuous investments. Several years later the value extraction reaches a null value of the company (potential energy) which will cease to act (kinetic energy) for triggering both the value generated and the value extracted.*

### *Originality/value*

*The paper proposes an initial attempt to explain the meaning of the transformation of knowledge using a metaphor derived from physics. The metaphor of the energy of knowledge clearly depicts the managerial dilemma of balancing a company’s resources for both the generating and extracting value. Similarly, future study should try to associate other knowledge peculiarities to physical phenomena.*

## 1. Introduction

The importance of knowledge as a competitive weapon in the competition among enterprises is widely recognized. The field of knowledge management (KM) is devoted to the study of knowledge as a source and driver of competitive advantage for companies.

Strategic philosophies such as the Resource-Based View (Penrose, 1959; Wernerfelt, 1984) and the Knowledge-Based Theory of the firms (Grant, 1996; Spender, 1996) place the creation, combination and application of knowledge at the center of the development of an enterprise's dynamic capabilities (Teece et al., 1997). According to these theories, a company's growth and competitive advantage are linked to high-level know-how, specific or inimitable knowledge and to the creation of new knowledge aimed at constantly increasing competitive advantage (Grant and Spender, 1996). So how do we proceed to effectively create, combine and apply knowledge and which practices are the best are questions at the back of every manager's mind but which are not easy to answer.

KM is quite a recent management discipline definable as an umbrella term for a wide spectrum of academic orientations (Alvesson and Karreman, 2001). The most important studies focused on models of knowledge creation, such as the famous socialization, externalization, combination, and internalization (SECI) model of Nonaka (1994), or placed emphasis on the management of knowledge by developing methodologies and technologies for the acquisition, storage, sharing and application of knowledge, i.e. Holsapple and Joshi (2002) or Tiwana (1999) model. Finally, a significant number of studies have focused on the measurement of knowledge proposing appropriate measuring instruments, such as the model by Edvinsson (1997).

Leaders should initiate KM projects based on the organizational objectives and on technological and economic behavioral constraints. As highlighted in the Earl's knowledge strategies framework (2001), the so-called "technocratic" schools base their study on information or management technologies, which provide extensive support and influence knowledge workers in daily activities. "Economic" schools are more oriented toward marketing research considering the value of exploitation of knowledge-intellectual capital in terms of its revenues. Finally, the other schools are called "behavioral": managers and people play a central role in proactively creating, sharing and using knowledge assets considered as resources.

Both scholars and managers consider knowledge a two-sided coin. Each connotation attributed to knowledge must include the complementarity connotation that knowledge is tacit and explicit, it originates within and outside the company, it is abstract and concrete, centralized and distributed, both process and product. If you have an attribute, its opposite will be there as well. Effectively managing knowledge means knowing these complementarities and being able to move between these trade-offs (De Toni and Fornasier, 2012).

One of the most stimulating debates concerns the definition and the explanation of what knowledge is. How is it possible to manage something which is not clearly definable?

Starting with these considerations, along with the peculiarities of knowledge compared to other resources (land, labor and capital), we suggest a conceptual explanation of knowledge based on

three pillars: the plurality of its nature, conservative, multipliable and generative, its contextual value and the duality of carrier incorporating business knowledge. After conceptualizing the nature of knowledge, we propose a metaphor based on the classic transformation from “potential” to “kinetic” energy in an inclined plane assuming that the conservative nature of the knowledge allows it to act as the energy. Then the metaphor was used to interpret and explain a real case based on the managerial dilemma of generating value versus extracting value from companies. In the final section, research and managerial implications are discussed and future research directions proposed.

## **2. Main characteristics and value of knowledge for business**

Friedrich Hayek (1948) in his essay, “The Use of Knowledge in Society”, considers knowledge a dispersed, limited and individual resource. In his view, the main issue economic theories must address is the process of knowledge acquisition and use in idiosyncratic business scenarios characterized by partial and dispersed information. Knowledge never exists in a concentrated or integrated matrix but solely as a fuzzy set of dispersed bits of incomplete and frequently contradictory information possessed by separate individuals. How is it possible to optimize resource allocation for the use of a resource, namely knowledge, which no one entirely owns?

If knowledge is dispersed and remains unaltered, a coordination system, once established, would remain perfectly balanced and routines of this system would imitate the model of rational choice (Schumpeter, 1942). But the learning ability of individuals generates a continuous dispersion of knowledge in the social systems and this requires an incessant search for coordination and reconstruction of the cognitive networks. Knowledge increases and evolves with heightened specialization thus making the adoption of a rational choice model extremely difficult and ineffective (Loasby, 1999). This explains the success of web search engines that allow for simple reconstruction of cognitive networks, thus enabling fragment re-aggregation of dispersed knowledge.

Another fundamental factor analyzed by studies on the economics of knowledge is “specialization”. The increase of the division of intellectual labor in sciences leads to the development of scientific knowledge. Increase in productivity is not given only by the efficient development of different skills, but also by their creation and improvement as a direct consequence of specialization. The division of labor, therefore, facilitates the creation of knowledge that occurs through the individual. Knowledge increases through the division of knowledge, including its separation into “what” and “how” (know what and know-how). If knowledge grows through generative processes which take place in human minds, this new knowledge will become increasingly dispersed causing asymmetric information. According to Loasby (1999), knowledge, although multipliable, still has to be considered “scarce” from the point of view of those who do not possess it, thus creating information asymmetry.

Rullani (2004), who considers knowledge as a “rebel resource” compared to the three classical resources (land, labor and capital), has proposed a different perspective. In his view, knowledge can be multiplied so as not to be scarce. Knowledge, unlike other resources, is not consumed with use, rather it multiplies. Each new use over the first one does not imply new costs, generating new useful value. Therefore, knowledge is not a scarce resource having a zero (or almost null) marginal cost for reuse.

Shifting from economics to management, scholars and managers represent knowledge in various ways, namely, as:

- an object, which can be stored and manipulated;
- a process, of learning and action that is focused on the application of experiences;
- a capacity, with the potential to influence future actions;
- a state of mind, that allows individuals to expand their personal knowledge and apply it to organizational needs; and
- a condition to access information, knowledge is organized to facilitate access and retrieval of content and this perspective can be seen as an extension of knowledge as an object (Alavi and Leidner, 2001).

As regards the last point, Watson (1999) argues that knowledge is not the ability to perform specific actions, but the ability to use information. Learning and experience are therefore an ability to interpret and determine which information is needed in the decision-making process.

Different views of knowledge lead to different views of KM (Carlsson et al., 1996). If knowledge is seen as an object or it is linked to accessing information, then KM is the process of construction and management of the stock of knowledge. Instead, if knowledge is a process, then KM is the management of processes of creation, accumulation, sharing and application of knowledge.

A growing number of scholars support the paradoxical nature of knowledge both as an object and as a flow so companies should manage it not only considering its content, but also in the context and narrative (Snowden, 2002). Knowledge can be compared to a photon, which has been studied both as a wave and as a particle. Knowledge is not an object or a system, but an ephemeral active process of relationships. If you own this perspective, then no one can own your own knowledge. It cannot be stored, nor can intellectual capital be measured and cannot be managed (Stacey, 2001) This extreme position is opposed to Kantian epistemology according to which knowledge is perceived as an object, something which is absolute, waiting to be brought to light through scientific research (Snowden, 2002).

The different views of what is knowledge have also found a thriving spread in the use of metaphors. Metaphors have received great attention in the KM research domain, as demonstrated by previous literature and recent special issues as the one edited by Andriessen (2011) regarding the systematic use of metaphor and its implications for behavior, especially in the field of KM. In the publication "Metaphors We Live", whose abstractions have been reprinted in Nonaka's seminal three volumes on KM, Lakoff and Johnson(1980) identified a number of conceptual metaphors widely used in KM literature for their ability to transfer meaning from the source domain to the target domain. In a systematic metaphor analysis of three seminal KM texts, Andriessen (2006) identified 22 different metaphors used in relation to knowledge as being explanatory of its conceptual nature. Moreover, in a subsequent study, Andriessen (2008) demonstrated that the choice of metaphors for knowledge has great influence on what is diagnosed as KM problems in organizations and on what is developed as KM solutions by using the metaphors of knowledge as water and knowledge as love.

As we will explain and clarify, in our opinion many of the concepts discussed by scholars can find a possible synthesis by considering knowledge as an entity characterized by:

- a plural nature, which explains its rebel behavior;
- a contextual value, which explains the role on the environment; and
- a duality of knowledge carriers, which explains the different incorporation mechanisms.

Finally, the physics metaphor of the energy of knowledge will explain the nature and business value of knowledge as our work develops along the line that metaphor plays a role not only in language, but also in the conceptualization and meaning making of intangibles.

### 3. The plurality of knowledge

Managers must take note of the rebellious and overflowing nature of knowledge and consequently operate to take advantage of this precious resource. As previously stated, knowledge is not a common resource, but a “rebel” since it does not diminish but increases over time. Knowledge, therefore, poorly fits the classical economic theories based on the “scarcity” of resources having a zero (or almost null) marginal cost for reuse, while each use of land, labor and capital subtracts resource to alternative uses.

In our opinion, knowledge ought to be considered an entity with a plural nature. Sometimes knowledge behaves like the other resources (material or energy) subjected to the laws of conservation (respectively of matter or energy) acting as a conservative quantity, but in other cases acting as a multiplicative quantity or a generative quantity. When an idea is discussed and shared among two people, the idea remains a single entity but both of them have the idea, so knowledge is multiplicative in the sense that multiple parties can simultaneously use it. Furthermore, combining different knowledge ends up creating new knowledge, so it is a generative entity. The more knowledge flowing in an environment, the more it assumes a multiplicative nature – as it spreads among the actors who populate that context – and a generative nature, since the flow of knowledge triggers the combination and the creation of new knowledge. The flow of knowledge and level of spread and self-generating generally depends on three factors, which are the antecedents causing the plural nature of knowledge:

- 1 the will for protection, rather than sharing knowledge;
- 2 the ease of access to knowledge, related to the means of propagation; and
- 3 the transaction costs of knowledge.

As regards the will to protect knowledge in a business context, the most common strategy is patenting to prevent third parties from using the new knowledge, but also in extreme cases such as the Coca-Cola recipe, which is bound in secrecy and protected in a safe deposit box in Atlanta, GA. Patenting and protection makes knowledge a resource that cannot spread and thus becomes conservative.

The second antecedent is ease of access given the means for the propagation of knowledge, the width of the context for its potential reuse and rate of spread. As regards factories, historically knowledge spread throughout the workshops, then – during the industrial revolution – into machines, which incorporate reproducible knowledge and allow enormous economies of scale and, after mechanization and automation, knowledge is conveyed inside the whole factories to be then dispersed throughout the industrial districts. Nowadays knowledge spreads via the internet thanks to ever-increasing access and speed of replication. In the course of time, the medium of propagation has changed. At the beginning, propagation took place through craft tools, then machines, then through the organization of factories, followed by the territorial districts and finally via the internet. The consequence is that the pool of dissemination and reuse of knowledge has gradually enlarged. Through all these steps, knowledge has been freed by the need to incorporate it into media (tools, machines, organization and industrial districts) and has begun to circulate throughout the network in a virtual shape, relying on software code and languages. Internet allows a non-proprietary, instantaneous and global propagation of knowledge. As knowledge is generated through relations, the more a system is open, the less knowledge can be considered conservative. Moreover, open systems increase the recycling of knowledge, i.e. taking knowledge ideated for a purpose and applying it to a different domain.

Transaction costs are the third antecedent that changes the nature of knowledge from conservative to generative. For example, the higher the cost of a training course, a book, a download, etc., the narrower the context of potential dissemination and consequently the spread of knowledge.

Figure 1 shows the three different natures of knowledge with reference to the three factors described above. In the lower left quadrant, knowledge is a conservative entity, characterized by low willingness to share, low ease of access and high cost of transaction. In this situation, the flow of knowledge is limited to a closed context. The central quadrant identifies knowledge as a multiplicative entity, characterized by high willingness to share, high ease of access and low cost of transaction. The more the environment is open, the more knowledge spreads. In the top right, we posit the knowledge as a generative entity, characterized by high willingness to share, high ease of access and low cost of transaction. The flow of knowledge acts in a predominantly open environment, where knowledge not only spreads but is also combined to generate new knowledge.

If the context in which knowledge flows is closed, or knowledge is protected by patents or secreted, or economic agents use ineffective means and languages for propagation or transaction costs are high, knowledge ceases to flow freely and widely (with a multiplicative and generative nature) and knowledge becomes conservative. Therefore, according to the above considerations, we believe it is appropriate to assign knowledge a plural nature: conservative, multiplicative and generative. The plural nature effectively describes the transactions of knowledge that occur in real processes, both social and economic. For example, when knowledge produces value, then it is normally patented and sold as part of a product, this turns knowledge from a generative entity to a conservative one.

Figure 2 shows several features that differentiate the three classes of knowledge. Knowledge of a conservative nature is situated in a context where existing knowledge is quantitatively constant by maintaining and diffusing only well-established ideas without generating new ones. Knowledge of a multiplicative nature is situated in a context in which agents exchange and share ideas with the

result of spreading at an increasing rate thus strengthening replication. An increasing amount of knowledge that flows in a business context is not linked to product/service/process/organizational innovation, since innovations come from knowledge of a generative nature. For example, in a consulting firm, expertise can be handed down from a senior to a junior member. The company will increase its capability in managing projects that require the same expertise (the company will have “more strings to its bow”), but this will not increase the capability to manage different projects (it only has more strings to its bow, but not a different weapon).

Knowledge as a generative entity is typical of open contexts, where the diffusion of knowledge implies the combination of processes that create new knowledge which will increase both in quantitative and qualitative terms, i.e. product/service/process/organizational innovation.

### 3.1 The contextual value of knowledge

As previously stated, the value of knowledge is strongly connected to the context in which this knowledge is generated, diffused and used. In other words, the same knowledge can have different values depending on the context. The context has therefore a key role in determining the value of knowledge. To the extent that the context exerts a crucial role, knowledge cannot be easily separated from its original context; knowledge is strictly linked to a process, which is closely related to values, culture and social and economic conditions of the business environment in which knowledge itself is embedded. Other resources can be easily removed from their context and therefore are reproducible.

The context-dependence is inversely proportional to the level of knowledge codification: the more knowledge is codified and embedded in a product, the less it is dependent on the context of origin. The value of knowledge in relation to the context is very similar to the concept of “fitness landscape” introduced by the American biologist Stuart Kauffman (1993). Knowledge, understood as a complex adaptive system, moves in adaptable “landscapes”, or rubber bands (fitness landscape) that change in a co-evolutionary logic, for the joint action of knowledge itself, other systems and exogenous factors. Craighead and Nemeroff (2004) suggest that the constructivist theory of knowledge presupposes a relationship of interaction between knowledge and the real world. The activity of knowing is viewed as a river that traces its way through the constraints that the landscape poses. The river does not discover how the landscape is shaped, but through trial and error will adapt its course. The path that the river takes is determined on the one hand in part by the constraints of the landscape and on the other by the constraints implicit in the “logic” of water, which prevents the river from flowing out. From the constructivist point of view, knowledge is not about what may or may not exist, but concentrates on what has proven useful (such as the pragmatic point of view). Instead of using the concept of truth, the part of knowledge, which reflects the reality, constructivists use the concept of “functional fit” (functional adaptation) assuming that their knowledge befits the world of their experience. Synthesizing the value of knowledge is a quantity that we do not know at all. Knowledge can be considered a Kantian noumenon, not knowable in itself. The value attributed to knowledge depends on the context and the metric adopted, so is a subjective representation. When new knowledge emerges from the learning process, an irreversible change of the situation happens. Knowledge is a constantly changing resource in the act of propagation, therefore the cognitive experience plays an important role in the process of generating



knowledge throughout the personal preconceptions, capabilities, feelings, emotions and beliefs of the actors involved.

### 3.2 Duality of knowledge carriers

Knowledge can be defined as an entity embedded in an object and/or in a process. In other words, the knowledge carrier can be an object, a process or both. The duality of knowledge carriers is a metaphor based on the physical studies of light, which has a dual nature and is at the same time a particle and a wave. Knowledge has a “particle” nature when it can easily be detached from the original context (knowledge embeddable in an object), while the “wave” nature is expressed when the context strongly influences knowledge (knowledge embedded in a process). As the photoelectric effect reveals the corpuscular nature of light, so does the transferability of knowledge into contexts different from the original one (thanks to the incorporation into products) reveal the nature of the “particle” of knowledge. Similarly, the phenomena associated with the undulatory nature of light – attenuation, reflection, refraction, diffraction, dispersion, interference, Doppler effect – could find matches in a “wave” of knowledge. In this case, it is embedded in a process closely related to the values, the culture and the structural characteristics of the original context. Figure 3 shows examples of how knowledge is incorporated in products and practices based on:

- knowledge nature: conservative and multiplicative/generative;
- contextual value of knowledge: independent or dependent; and
- knowledge carrier: object or process.

As represented in Figure 3, knowledge is an entity incorporated:

- in an object (quadrants 1 and 4), the value of which is independent from the context of the generation and application; and
- in a process (quadrants 2 and 3), the value of which is dependent on the context of the generation and application.

As regards examples:

- Quadrant 1: Patents or industrial secrets are examples of objects incorporating knowledge which, if not protected, could be used by others as replicable because independent from the context of application.
- Quadrant 2: Consultancy techniques and practices are transmitted from senior to junior members and knowledge is poorly codified in manuals so apprentices learn through processes of “narrative” and imitation. The context is basically closed and knowledge depends on the context itself. Similar considerations can also be extended to industry and the services sector.
- Quadrant 3: Techniques and practices – even when not protected – cannot be replicated in other contexts tout court, as the processes co-evolve with the context in which they are applied and if that knowledge is separated from that context, different knowledge will be generated because all characterizing relationships, linkages and interconnections are lost. Lean production practices have been exported outside Japan, but they will work differently in Italy and in Europe, in relation to the different cultural and social systems.

- Quadrant 4: Non-proprietary or open-source software is perhaps the first example of complete independence from the application context as, for example, the knowledge needed to develop Linux is the same worldwide.

#### 4. The metaphor of the energy of knowledge

We propose the metaphor of the energy of knowledge assuming that the conservative nature of the knowledge makes it act as energy, which is a conservative quantity for the well-known law of the conservation of energy. The metaphor uses the concept of potential and kinetic energy: if energy is only potential, it has a potential value not yet effective and if the potential energy (knowledge) becomes kinetic energy (products and/or services), then it has a value, which is a function of the speed acquired.

Aristotle elaborated the concepts of potentiality and actuality. Potentiality is any possibility of entities to change and therefore to assume a certain shape. The act is the motion or the realization of the change, the existing result after the change. For example, a chick is a potential rooster, whereas the rooster is the chick in act. The act for Aristotle is superior to the potential, as it is the effect, the full sense, the fulfillment of the potentiality. Using this distinction, the potential energy is kinetic energy in potentiality, whereas the kinetic energy is potential energy in act. Similarly, knowledge is a set of products and services in potentiality, while products and services are knowledge in act. In other words, knowledge is potential value, while value is knowledge in act.

In their first theoretical work, Bratianu and Andriessen (2008) considered knowledge as a metaphor for energy. They considered explicit knowledge similar to kinetic energy, associated to the decision-making process and to action as a dynamic form of knowledge and tacit knowledge similar to potential energy. More recently, Bratianu (2010) tried to overcome limitations of the metaphors related to the law of conservation and linearity proposing a different set of four metaphors from thermodynamics. Moreover, Bratianu (2013), instead of using the old dyad of explicit and tacit knowledge, proposed a new dyad containing cognitive and emotional knowledge and their reciprocal transformation.

Our metaphor is based on the law of energy conservation and on the use of kinetic and potential energy but we do not believe in the direct link kinetic energy-explicit knowledge and potential energy-tacit knowledge, as both explicit and tacit knowledge have potentiality and actuality. Moreover, we consider our metaphor generally valid only on “knowledge as a conservative entity” case but, as we discussed, knowledge is an entity with a threefold nature.

The classic example of transformation of potential energy into kinetic energy is a body of mass ( $m$ ) which, when it is stationary at a height ( $h$ ), possesses a potential energy equal to  $mgh$  (with  $g$  being the acceleration of gravity). Whereas, when it descends along an inclined plane at velocity ( $v$ ), its potential energy turns into kinetic energy equal to  $(\frac{1}{2})mv^2$ . This metaphor can be represented by a ball positioned at any given height  $h$  and while rolling along the inclined plane its potential energy is transformed into kinetic energy (Figure 4).

The potential energy of the ball symbolizes knowledge: setting the ball at height  $h$  requires an investment equal to a value of  $mgh$ ; the kinetic energy gained by the ball reaching the end of the inclined plane symbolizes the set of products and services sold in the market to a value of  $(\frac{1}{2}) mv^2$ . The angle of the inclined plane ( $\alpha$ ) is the business model implemented by the company: the more the floor is tilted, the more the business model is effective, as it generates higher speed, which subsequently generates greater kinetic energy and thus greater value.

The potential energy ( $mgh$ ) is the knowledge that has been accumulated by a company (i.e. patents, organizational routines, tacit knowledge of people, etc.), while the kinetic energy ( $\frac{1}{2} mv^2$ ) is the set of products and services that the company is able to develop and to sell in the market, namely, it represents the knowledge in act, the effect, the fulfillment of the potentiality. Potential energy is necessary but not sufficient: owning considerable energy potential but not being able to turn it into kinetic energy, implies the company will not generate economic value. For example, owning a patent does not generate any value if this in turn is not used to create and sell products or services. Knowledge becomes a competitive factor for a company only if it is not accompanied by the ability to transform this potential into products and services for market success. At the same time, potential energy cannot be achieved without first creating kinetic energy, that is to say, without creating a heritage of knowledge. Therefore, investing in knowledge, potential energy, it is essential to create a necessary energy gap.

Investments in knowledge allow companies to explore new business possibilities and develop new products and services bringing the ball at a height and creating the foundations for subsequent exploitation. If investments in research and development, training, technology are reduced, then the conditions for the subsequent exploitation of such knowledge become weaker and ineffective.

Knowledge assumes a real value only when it is converted into products and/or services sold in a competitive market, i.e. when the intangible becomes tangible. Developing and protecting new knowledge is necessary but not sufficient to compete and succeed in business. What is fundamental is the ability to transform it. It is much easier to turn money into good research than to transform good research into money.

Coming back to the metaphor of the energy of knowledge, the reduction of investing in knowledge in the short term can lead to better economic results, but what happens in the long term?

#### 4.1 Generating value versus extracting value: a real case

The answer to the question about the opportunity of creating value versus extracting value comes from the historical experience gained in a Multinational Corporation from the '90s onward when corporations made important choices concerning investments or disinvestments in tangible and intangible assets.

Since the late nineties, the Group adopted the value creation index as a key indicator to measure and evaluate the performance of a company and management. This index links operating income and asset efficiency to the cost of capital invested and it was used to assess the profitability for each region, business area and product line. The value created is defined as operating income excluding elements that can affect comparability, minus the weighted average cost of capital on net assets, excluding items that may affect comparability. The Group value creation index is a summary measure for operating profit excluding the cost of capital. This index was introduced by CEOs in charge from 1997 to 2002 – and was officially presented in the 2000 Annual Report.

The Group value creation index led to strong pressure to reduce fixed costs and capacity utilization to achieve the profits that met shareholders' requests. During the CEO's five years at the top of the group, driven by the desire to improve the economic and financial results, he took drastic restructuring measures: shutting down 25 of the 150 plants, 50 of the 300 stores and the reducing staff from 105,950 to 87,139 units. These actions improved operating and financial results and above all boosted the value creation index.

Did the CEO generate or extract value? Many authors argue that indicators such as economic value added (EVA) or the value creation index promote economic and financial results in the short term and adversely affect the ability of a company to stay profitable in the long period. Several managers were skeptical about this evaluation method, especially those working in manufacturing and logistics. The value creation index is a good concept on paper, but it is potentially dangerous in practice. In fact, the index tends to promote the liquidation of assets to improve short-term results. The use of value creation indicators has some negative effects because reaching high values of the ratio implies minimizing investments, circulating capital, real estate, etc. In fact, the effect it had was the reduction of the company's competitive capabilities in the medium and long term.

## 4.2 Discussion

Since 2000, the topic of value creation has become very popular and indicators such as EVA have spread rapidly (Tortella and Brusco, 2003). The tendency of analysts to evaluate a company almost exclusively on its financial results is strongly linked to the belief that the primary objective of the firm is to maximize the return on capital and shareholders' satisfaction. The great importance given to this index results in a reduction of investment in fixed assets and a great attention to cost control, which if carried to excess runs the risk of driving the company away from its primary activities of the value chain and from organizational capabilities. Restructuring policies, therefore, need to distinguish between actions aimed at reducing costs while still maintaining the ability to generate high value over time, from actions that reduce costs, but penalize the long-term ability of the company to continuously generate value.

When restructuring, value extraction – as opposed to value generation – based on lower costs and better short-term results for shareholders (e.g. dividends) leads to the decline of the company in the long term. In the case described, the CEO extracted value to improve the value creation index through a reduction in investment, which had impoverished the corporate capability to generate value in the medium to long term.

Interpreting the case with the knowledge energy metaphor, the CEO has reduced the amount of potential energy – cyclically converted into kinetic energy associated to the value obtained – and consequently reduced the ability of the firm to obtain higher value cyclically.

Dividend policy covers the decision on how much firms should reinvest and how much to return to the owners, rather than just dividends. For instance, as regards dividend policy, Damodaran (2001) suggests a framework in which managers should ask themselves how much cash is available for paying dividend and how good are a firm's capital expenditure proposals. As a matter of fact, investors and stockholders expect firms with good business perspectives to reinvest cash in the company and pay a higher return later, while firms with poor business perspectives should return cash to investors as soon as possible. Generally, firms that pay too much in dividends or distribute too many profits to shareholders lose value because they cannot take value-creating projects which they should.

The trade-off between short- and long-term results is the eternal managerial dilemma of the listed companies. No industrial strategy can be successful if merely managed with a policy of quarterly results, even if stock analysts use the quarterly results to judge companies. The complexity lies in finding a good balance, but managers should resist the temptation to follow only “the fourth quarter” strategy, which aims at creating only good short-term financial performance. An investment in knowledge can rarely be profitable within three months. Knowledge is the source of the value and can be maintained and regenerated only through continuous investments. Several years later the value extraction hits a null value of the company (potential energy) which will cease to act (kinetic energy) for triggering both the value generated and value extracted.

## **5. Conclusions**

Knowledge is rebel. Its plural, conservative, multiplicative or generative nature, its contextual value and product-process incorporating carriers make up its determinants. These peculiarities of knowledge, resource reckoned by many authors as a distinctive element that can provide competitive advantage for a company, makes it a strategic asset different from the classical ones (land, labor and capital).

The intersection of three fundamental concepts introduced in our paper – the plural nature of knowledge, the value of knowledge in relation to the context and the duality of knowledge carriers – allows achieving a classification of products and activities that incorporate knowledge and which are fundamental elements of a company's business model. Every company – consciously or unconsciously – shapes a unique and path-dependent business model based also on a unique model of KM. Understanding the limitations and potential of their own knowledge strategy model and its management and evaluation is an essential key for the development of an organization's competitive advantage.

The metaphor of knowledge energy clearly depicts the managerial dilemma of balancing a company's resources for both the creation of “potential energy” and its transformation into “kinetic energy”. Knowledge may be worth nothing, which may well explain the metaphor of the potential

energy, but it may also be worth anything. The inclination of the plane, which gives more (or less) kinetic energy to the ball, is itself a good metaphor of a company's business model: the same level of investment in knowledge, the same potential energy, can boost more (or less) profitability depending on the effectiveness of the business model used. So, organizational learning becomes central in balancing the process as, even if not immediately, sooner or later knowledge can generate value. Conversely, the extraction of value from organizations – resizing investment in the development of knowledge – sooner or later will empty the organization of its own possibility to generate new value and, consequently, gain competitive advantages from innovation.

Our conceptual framework wants to be a call for knowledge managers and epistemologists because it casts doubt over normative, objectivist and universalist claims and calls for further research into the plural nature of knowledge. Managers should adopt different observation perspectives to understand and identify knowledge-based competitive advantages of their corporates and try to exploit the peculiarities of this rebel resource. The paper proposes an initial attempt to explain the meaning of the transformation of knowledge using a physics metaphor. Similarly, it might also be interesting and useful to try to associate other knowledge peculiarities to physical phenomena. For example, how might the wave nature of light find correspondence – attenuation, reflection, refraction, diffraction, dispersion, interference, Doppler effect – in a “wave” of knowledge? A future metaphor could analyze the incorporation of knowledge using the complementarity principle enunciated by Niels Bohr in 1927 in physics, according to which the double aspect, corpuscular and undulatory phenomena, that occurs at the atomic and subatomic level cannot be observed simultaneously during the same experiment. Therefore, two theories can mutually interfere, but also mutually interact, in some way, alternating in the explanation of the same phenomenon.

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**Corresponding author**

Fabio Nonino can be contacted at: [fabio.nonino@uniroma1.it](mailto:fabio.nonino@uniroma1.it)