

Frontiers for the Codification of Knowledge

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Abstract

Although knowledge management techniques have been discussed and developed substantially during the last years, moderate success has been reported what measurable business results are concerned. We show how human information exchange can be mapped to investment processes of modern portfolio theory. We argue, that the presented theory is the major reason for the rather limited success of computer based techniques used for codifying knowledge. The theory should be taken into account during the implementation of knowledge management programs.

Motivation

During the 80th several researchers [Feigenbaum et al, 1988; Newell, 1990] tried to capture knowledge in so called expert systems. Even for process control applications expert system techniques have been developed and applied successfully in limited domains [Barachini et al., 1988; Gupta et al.,1988]. Later on they have been enhanced by different techniques as e.g. simulated annealing, genetic algorithms and neural networks to make them more robust to unpredictable events. These techniques have one thing in common - they offer search mechanisms to identify chunks of knowledge for specific situations. There is no doubt that there has been substantial progress in computer science, yet the question how exactly knowledge is produced out of information in our brains remains unsolved.

There is much ongoing research in the area of knowledge management. William R. King et al. [King et al., 2002] show in their study, that an important strategic knowledge management issue in industry is the motivation for people to participate in knowledge exchange circles. We have recently conducted a similar study in German speaking countries (Germany, Swiss, Austria) among 1500 IT companies. Our statistical survey shows that motivation is even the most important point – even more important than management support. Thus, knowledge management is not only an IT challenge but it is mainly the question of how to motivate people to share valuable information so that intellectual capital of a company can be leveraged. Bontis [Bontis et al., 2002], Edvinsson and Malone [Edvinsson et al., 1997] and Sveiby [Sveiby, 1997] see intellectual capital as the “stock” of knowledge that exists in an organization at a particular point in time. Managing this stock remains a challenge since there is the need to socialize and codify tacit knowledge. Codification of knowledge was always a tedious task and knowledge acquisition was only successful when people were willing to cooperate. Willingness to cooperation is strongly dependent on the trust level [Huener et al., 1998] in an organization.

On the other hand, there is absolutely no empirical evidence [Sveiby et al., 2002] that more collaboration is creating more value than competition. Nevertheless, researchers [Davenport et al., 2002] are starting to identify new incentives and rewarding schemas for knowledge sharing. However, one has to accept that knowledge always was the cornerstone for mankind

to survive. This is particularly true for our society. Individuals don't offer information (knowledge) for free. Thus, in our subsequently presented theory we argue that exchange of knowledge can be regarded similar to business transactions. The establishment of a successful knowledge-sharing culture must especially consider trading aspects of modern portfolio theory and is not only dependent on trust, attitude, leadership and group support.

Different Perspectives of Knowledge

The different forms of knowledge are increasingly recognized as crucial assets in many organizations. However, managers do have different pictures in mind when we talk about knowledge management initiatives. Some of them stress the organizational point of view, some of them prefer IT tools and some of them concentrate on psychological aspects. Few consider the holistic picture, consisting of 3 overlapping disciplines [see table-1]. In this respect Nonaka and Takeuchi [Nonaka et al., 1995] define knowledge management as managing the stock of knowledge in an organization as it flows over time.

Economic Science	Sociology	Computer Science
Human Resource Management	System Theory	Network Technologies
Organizational Learning	Systemic Organization	Information Management
Organizational Development		Artificial Intelligence

Table-1 : important overlapping disciplines in knowledge management

Bonifacio [Bonifacio et al, 2002] characterizes knowledge management as the process of creating, codifying and disseminating *knowledge*. They claim that *knowledge* can be disseminated. But this approach would presume that an objective epistemology is existing so that all contextual, subjective and social aspects of knowledge can be eliminated in favor of an objective and general codification. An interesting idea, but as soon as humans grasp information from databases of any kind they start to interpret this information. It is obvious that different knowledge is produced out of the same piece of information in different brains no matter how information is codified. Consequently, *information* only can be disseminated – not knowledge. This view is also strongly supported by some researchers belonging to the autopoietic epistemology school [Varela et al., 1992]. According to this school knowledge is a private personal thing, it is intuitive and strongly linked to user's values and believes. Explicit knowledge is data and information which enable other people create *their own knowledge* via a “*structural coupling*” process as explained by Joia [Joia, 1999].

Other researchers prefer to extend information with additional context. The more context we store with a chunk of information the better we can transfer knowledge they claim. Indeed, methods as e.g. *story telling* or *micro articles* show in certain situations better results in knowledge transfer than pure databases. But in no way we can guarantee the transferability of knowledge itself.

Proof-1 : **iff** a turing engine [Turing, 1936] exists so that the input consisting of any arbitrary complex information chunk including the context is accepted **and** the output alphabet of the turing engine, representing the interpretation of the input alphabet is produced in finite time **and** the output alphabet is identical to a human interpretation **than and only than** we can

transfer knowledge. This means that knowledge transfer can only be performed if a machine passes the turing test, which has not yet been proven.

Therefore in knowledge management circles it is well known that codification must be balanced with collaboration in order for knowledge management to succeed. Researchers developed methods to evaluate intellectual capital, but until recently not enough attention has been paid to the fact that during the collaboration process information might be dynamically evaluated. Before we talk about information brokerage, we finally face two very different definitions for knowledge management.

Firstly knowledge management can be regarded as an organizational task which is exclusively performed on individual level in our brains. All the rest is human resource management, information management or another kind of management.

Secondly knowledge management is the prompt establishment and timely limited management of communities and resources in order to pursue well defined objectives. The latter definition [Barachini, 2002] follows Edvinsson's, Sveiby's and Nonaka's ideas and links management of intellectual stocks to business results. This approach assumes that knowledge can be evaluated with different available score card methods. Several companies are already publishing their intangible assets on a regular basis once a year.

Our research is only marginally affected by these definitions since the presented information brokerage theory deals with the motivation for information exchange.

The Information Brokerage View

Cultures have been characterized by researchers differently. Culture depicts the way members of a society relate to each other. One of the best known definitions by Hofstede [Hofstede, 2001] identifies four dimensions of national culture : Power Distance, Uncertainty Avoidance, Individualism and Masculinity. Information management is not treated as separate dimension although there are differences in between societies. Martinson's [Martinsons, 1991] studies show that e.g. in the Chinese business culture, information is often treated as an individual, rather than an organizational resource.

According to *proof-1* we can only socialize information but not knowledge as such. We can talk to someone, we can paraphrase but we are not sure whether the *structuring coupling process* produces identical knowledge in the partners brain. In this respect we follow the theory of Varela and Joja. Moreover, we assert that during the information exchange process humans intuitively assess the value of information. Independent from cultural roots people act like brokers of investment companies.

We define two types of information exchange. Type-1 is the immediate exchange of information in both directions. Thus sender and receiver give information away. This type of duplex information exchange can be mapped to over-the-counter businesses of banks. The difference to the well known over-the-counter (OCT) business is, that there are no intermediaries as e.g. dealers and brokers involved because the so called "information market" is generated implicitly in our brains.

Type-2 is more complicated because information flow is first of all unidirectional. This is the case when we either earn money due to our profession as e.g. a teacher or when we offer

information to individuals in the hope to get even more valuable information back some day in future. Type-2 of information exchange can be mapped to options.

In the investment world [Sharpe et al, 1995], an option is a type of contract between two people where one person, the writer, grants the other person, the buyer, the right to buy a specific asset at a specific price within a specific time period. Alternatively, the contract may grant the other person the right to sell a specific asset. The variety of contracts containing an option feature is enormous.

Type-2 of information exchange can be mapped to the most prominent type of option contracts – the call option for stocks. It gives the buyer the right to buy a specific number of shares of a specific company from the option writer at a specific purchase price at any time¹ up to an including specific date. Figure-1 and Figure-2 show the P&L graphs² of a buyer and a seller. The buyer of a call option will have to pay the writer a premium in order to get the writer to sign the contract. The fair value of an option can be evaluated by the binomial option pricing model or by the more modern method from Black-Scholes [Sharpe et al, 1995] :

$$\text{Fair value} = N(d1) * P_s - E * N(d2) / e^{RT}$$

$$\text{Where : } d1 = (\ln(P_s/E) + (R + 0.5\sigma^2)T) / \sigma * \text{sqr}T, d2 = d1 - \sigma * \text{sqr}T$$

P_s = Current market price of underlying stock

E = Exercise price of option

R = Compound risk free rate of return

T = Time remaining before expiration

σ = Risk of the underlying stock

sqr = square root

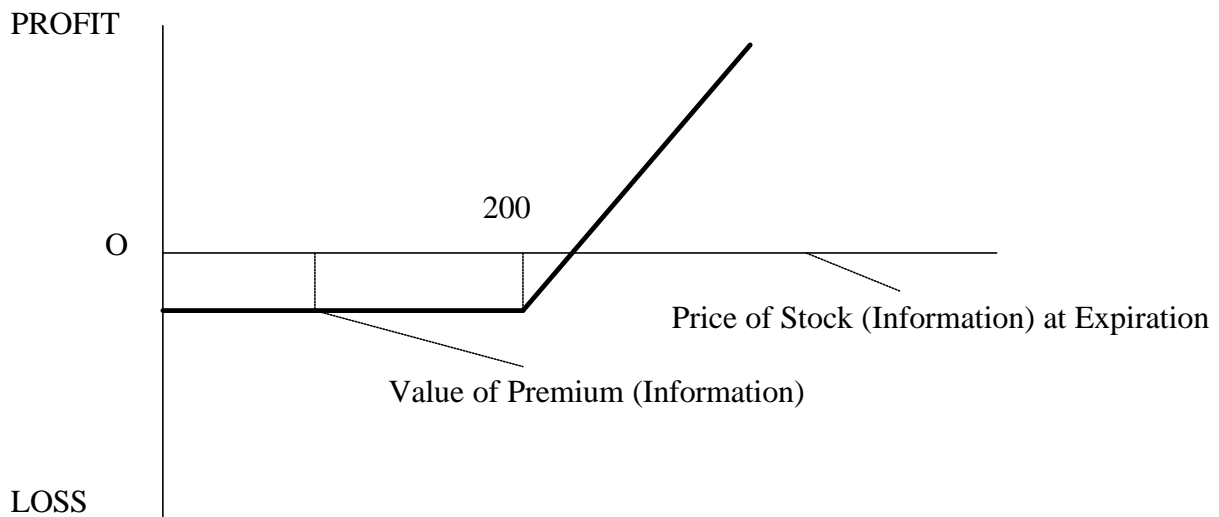


Figure-1 : P&L Graph for “Buy a Call”

Figure-1 relates the value of a call option with an exercise price of 200 to the price of the underlying stock of expiration. If the stock price is below 200, the option will be worthless when it expires. In this case the writer will gain (see Figure-2) the premium. If the price is

¹ For US options only

² Profit and Loss

above 200, the option can be exercised for 200 to obtain a security with a greater value, resulting in a net gain to the option buyer that will equal the difference between the securities market price and the 200 exercise price. However, in practice the things are even more complicated due to margin requirements, commission payments and other market making activities.

Typ-2 of information exchange means that one person (the buyer) gives information away and hopes to get even more valuable information in the future (see Figure-1). The information offered to the writer has some value – the premium. The buyer hopes getting back another type of information which is at least as valuable as the premium. Thus, the underlying is not stocks but it consists again of information.

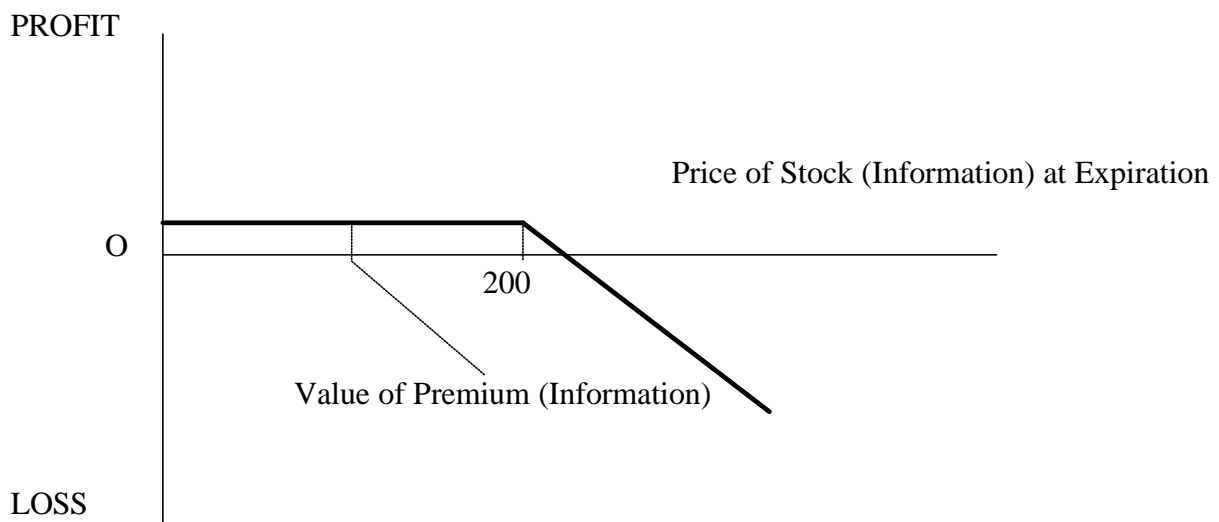


Figure-2 : P&L Graph for “Write a Call”

Hence, the difficulty is how to evaluate a fair price for a piece of information which is unknown. The Black-Scholes formula is based on statistics, the exercise price is known, the risk of the underlying common stock can be evaluated and the option has a well defined expiration date³. In the case of information brokerage we even don't know the value of the underlying because it is an unknown piece of information which might be offered from the writer sometime in the future. In the Black-Scholes formula the current market price of the underlying stock can be evaluated. No objective evaluation can be performed for information generated by humans since one type of information is evaluated differently from brain to brain. Thus, each of us uses its own evaluation function. This function might be similar from brain to brain but due to different context knowledge the same piece of information is evaluated differently on individual basis. Therefore statistics as in the Black-Scholes formula cannot be applied immediately since the values of P_s , E , R and σ represent individual functions. The parameter T is indeterminable since we don't know when and even if we will receive valuable information in the future. Thus, a fair price for information cannot be

³ this is true for European options – US options can be exercised arbitrarily

calculated. Nevertheless, we argue that the P&L statement of a call option can be used as a thought model when we talk about information exchange⁴ between humans.

Summary

There are two reasons for the limited success of computer based techniques for codifying knowledge. Firstly it is not knowledge but information which is stored and secondly this information is not offered for free. The information exchange process between humans can be mapped to investment processes of modern portfolio theory. However, the presented theory is only a thought model because identical information is assessed differently on individual basis. This individual evaluation process calculating the fair price is determined by instinct, intuition and ratio. The proof of the theory and the deeper investigation of this process remains a challenge for neurology, computer science, sociology and economic science.

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⁴ Type-2 information exchange

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