Full Length Research Paper

Knowledge management (KM) and economic models

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This article attempts to assess the contribution of tacit and explicit knowledge in expert systems implementation. Its contribution in achieving rule-based expert systems of production is very important. Expert system developed was based on knowledge (tacit and explicit) of financial accounting, which ultimately led to the prediction of the health of the company. The results of the three economic models used to predict the health of a company are presented, as well as the generalization of the “n” economic models.

Key words: Cognitive dimension, explicit knowledge, tacit knowledge, Altman model, Conan-Holder model, expert system, assistant’s decision.

INTRODUCTION

Knowledge management (KM) supports three types of activities: generation, codification and utilization of knowledge (Davenport and Prusak, 1998). Organizations can achieve enormous benefits by implementing KM such as better customer service, productivity and staff morale (Davenport and Prusak, 1998; Alavi and Leidner, 1999; Jarrar, 2002).

Knowledge management concerns information processing used to obtain useful information, and the key elements in the decision-making process include data, information, knowledge and the process derived from individuals and organizations (Liebowitz, 2001).

According to Hassanali (2002), the success of a KM effort depends on many factors. The five categories of factors are highlighted as follows: Leadership, structure, culture, IT infrastructures, roles and responsibilities and measurement.

Succinctly put, KM is the process by which organizations generate value from their intellectual and knowledge-based assets. Most often, generating value from such assets involves codifying what employees, partners and customers know, and sharing that information among employees, departments and even with other companies in an effort to devise best practices (Levinson, 2003).

Tacit knowledge is that kind of knowledge that cannot be documented, but can only be transferred through training or gained from personal experience (Alwis and Hartmann, 2008).

The conception of a Japanese professor, Nonaka regarding the classification of knowledge (explicit and implicit) has generated in the last three decades, a small “revolution” within the management of business organizations. The classification proposed is extremely general, since it shares only two classes of knowledge. The impact of such approach is a major one in management and other related fields (creative thoughtfulness, stimulation of innovations, scientific research etc.). The classes of explicit and implicit knowledge and the classification proposed by Nonaka have not shown a significant interest as seen from the perspective of systems engineering. However, this research direction can lead towards new elements for creating expert systems on economic issues.

Explicit knowledge, as expressed by Nonaka et al. (1998), signifies those types of knowledge that are accumulated, processed and exploited by individuals and organizations using rational thinking mechanisms. They can be found in user books, utilization instructions, databases, rules and other hundreds of social or organizational principles that individuals apply day by day. But by nature, explicit and implicit knowledge can be...
taught and communicated between different individuals, as well as within an organizational frame.

Not all information is valuable. Therefore, it is up to individual companies to determine what information qualifies as intellectual and knowledge-based assets. In general, however, intellectual and knowledge-based assets fall into one of two categories: explicit or tacit (Levinson, 2003).

Having tacit knowledge codified organizations can use explicit knowledge any time they wish and keep intellectual asset inside company (Arifin, 2007).

The implicit knowledge, also expressed by Nonaka (Nonaka et al., 1998), is knowledge derived from the experience, intuition/ imagination of individuals that are solicited to solve issues within an organizational frame; each employee accomplishes and accepts the fact that organizational performance appeals to experience, intuition and creative imagination. It cannot be explained how this mechanism is applied in the real world (Alavi and Leidner 2001) because its functioning reflects aspects of non-rational thoughtfulness (previously this type of thinking was denoted as intuitive knowledge).

It is about complex economic issues that are solved by models applied to real economy, or about other fields of knowledge (chemistry, medicine, physics etc). It can be understood and accepted somehow automatically by the following ideas: we can see everything as a postulation; we can appeal and exploit permanently mix explicit and implicit knowledge in order to achieve a better performance within an organization.

Finally, an important remark for the interest of this study is that only individuals as well as business organizations (available for any type of organization) dispose of and exploit both categories of knowledge:

- of a majority, explicit knowledge being in possession of organizations takes the form of innovations, inventions, patents, license, factory brands, trade brands, origin names, production rules, management rules or consultancy principles etc;
- of a majority, the implicit knowledge being in possession of organizations takes the form of what is generically known as know-how or savoir faire respectively, the part of an invention patent, license or something similar to things that cannot be transmitted by diagrams, sketches, application instructions etc.

This part that is specific to the general knowledge owned by an organization can be transmitted, taken as rent or sales only when there is a direct contact between employees. Such a contact can be accomplished between employees that signify two entities, being able to be transmitted only by direct and immediate experience.

Within the process of knowledge transfer, more demonstrative simulators are used, based on explanations that are in parallel with natural and/or conventional, oral, written or gestures language. If the knowledge engineer proves his ability of reproducing what has been proven vocally in written or gestures language, it signifies that he fully assumes explicit knowledge; but if there is uncertainty, then he assumes implicit knowledge, that can be transferred (Apurva and Singh, 2011).

The implicit knowledge has two visualizing dimensions:

- The technical dimension: this includes the type of aptitudes and informal and indefinite abilities, often included within the “know-how” term. In this, the experts accomplish fast a multitude of expertise because of experience, but are confronted sometimes with issues of communication, technical and scientific principles, based on reasoning and personal thoughts that are very subjective. Intuition, senses and inspiration that result from the experience of each individual will be within such dimension (Stankic et al., 2012);

- The cognitive dimension, which consists of the expert's own point of view, perception, ideas, values, emotions and mental models, taken as “good”; therefore, they cannot be easily transferred. This dimension of implicit knowledge draws the way we see the world around us.

From the perspective of economic, financial and management issues, already solved in an acceptable way in the practice of business, by appealing to various types of methods and models of analyses (the combined, additive, balance sheet, Altman models etc), it is seen that all the theoretical creations are mainly based on processing explicit knowledge that is taken from various areas of the company's accountancy, including the accountant's information "marked" by the participation of implicit knowledge, even in a small percentage. On the other hand, the application and functioning of these models as well as the entire process of designing them and their previous creation have appealed to a certain volume and relative size of implicit knowledge. The previous argument is based on the nature and way the accountancy functioning of a company is organized, as well as the tree structure processing the accountancy information. This is done in order to reach a finished version, pertinent for decision process, that needs the intervention of some experts on accountancy issues.

Eze (2008) conducted an empirical study to investigate the factors affecting e-business deployment, and the results revealed that fit is one of the key factors affecting it.

Lin and Lee (2005) examined the impact of organizational learning factors (training available, technical expertise and knowledge level) and knowledge management processes (knowledge acquisition, application and sharing) on e-business systems adoption level.

Obviously, the entire work carried out by accountant experts in order to process and synthesize data from a
company’s balance sheet is implicitly based on using various types of implicit knowledge, which each employee disposes of. Based on empirical observations, experiments and direct contact within the business organizations area, the followings are considered: a) every time accountancy information is referred to, it is considered that almost 94% of the entire volume of processed knowledge, treated and synthesized for the top management are explicit knowledge; this is the reason it was chosen within our demarche as the designing of a traditional Expert Systems (ES) and not one based on fuzzy logics; b) similarly, in direct relationship with exploitation of accountancy information and other interventions of human experts, it is considered that almost 6% of the total volume of processed and treated knowledge signifies implicit knowledge, meaning that these meet simultaneously specific characteristics of this class.

Finally, other aspects regarding the nature of knowledge on which the economical-financial models are based and which have obvious explicit - implicit distinction can result in a tree structure description of those “n” economic models, with an ES conceived for solving such high complex issues.

**MATERIALS AND METHODS**

Looking at the explicit and implicit knowledge of the applications of economical models management (company’s accountancy offering a good image to the economical-financial situation) and taking into account the past and present situations, it can be used as a model for an entity in future. The expert system concept designed took into consideration three analyses models as follows.

**Determination of Altman model**

Below, the basic aspect of each model is illustrated, using Altman model (1968), specific to score function:

\[
Z = (1.2* X_1 + 1.4 * X_2 + 3.3 * X_3 + 0.6 * X_4 + 0.999 * X_5)
\]

where:

\[
X_1 = \text{work capital/total of assets};
X_2 = \text{reinvested profit/total of assets};
X_3 = \text{profit before rates of interest and taxes/total of assets};
X_4 = \text{market value of the stocks/accountancy value of the loans};
X_5 = \text{sales/total active}.
\]

The score function developed by Altman is based upon five variables, denoted by \( X_1 \) to \( X_5 \), which by sum and weight will result in a value of the score, able to define the company’s reliability; function of the accountancy system applied in various countries, where variables have been further defined and reformulated (in some papers, \( X_1 \) as a company’s flexibility, \( X_2 \) as the rate of assets self-financing etc).

The Altman model is one of the first models imposed within the international financial world, especially applied by commercial banks in the process of establishing a company’s reliability, about to be credited. When a commercial bank allots substantial funds for average and long term, the elementary rules of bank prudence will oblige the bank to analyze in detail the company’s past (for the least four years), to evaluate as correct as possible the management and position of the company in market, in order to estimate how the company will or not reach bankruptcy during those “n” years, indicating the duration for refunding the bank loan.

Further, the Altman model has known various adaptations, modifications and simplifications; today, commercial banks apply simplified variants of the theoretical principles on which this model is based. This is done in order to establish the reliability of a customer, as physical person that solicits a loan. Between other directions of applying the Altman model, it can be mentioned that:

- the investment funds, carried out currently on the main money stock markets, applying these model in order to estimate the future rate of exchange of stocks;
- other organizations or institutions that have different economic interests in terms of acquisitions, fusions, reorganizations, attracting competitors, able to finance those “finished” versions of the Altman model with high amounts, and estimating the potential bankruptcy risk of a company;
- similarly, more and more sophisticated models are used for other organizations, such as the rating agencies, by which a company’s situation can be analyzed, with potential bankruptcy estimated on time.

**Determination of Conan-Holder model**

The score function for the Conan-Holder model has the following form (Conan and Holder, 1979):

\[
Z = 0.24* X_1 + 0.22* X_2 + 0.16 X_3 - 0.87* X_4 - 0.11* X_5
\]

where:

\[
X_1 = \text{gross exceeding of exploitation/total debts};
X_2 = \text{permanent capital/total of assets};
X_3 = \text{(floating assets – stocks)/total of assets};
X_4 = \text{financial expenditures/turnover};
X_5 = \text{staff expenditures/added value}.
\]

Using the Conan-Holder model as field of application and interest in the financial and money stock world of various countries has not been very distant from the Altman model. Commercial banks, investment funds and other similar agencies have received with high interest this theoretical construction as economical-financial analysis of some companies.

**Determination of rating model**

The rating model specific to score functions, as defined in this paper, is based on the following algorithm:

\[
vR_{T1} + vR_{T2} + vR_{T3} + vR_{T4} + vR_{T5} + vR_{T6} + vR_{T7} + vR_{T8}
\]

\[
vR_{T1} - \text{rating of current liquidity} + vR_{T2} - \text{rating of claims recovering} + vR_{T3} - \text{rating of debts} + vR_{T4} - \text{rating of exploitation profit} + vR_{T5} - \text{rating of net profit} + vR_{T6} - \text{rating of solvency} + vR_{T7} - \text{rating of the turnover} + vR_{T8} - \text{rating of floating speed}
\]

A company’s rating illustrates the type of information about some
financial indicators of a company, for different time periods; for each indicator, a different score is established, which positions the component specific to company's accountancy. In sum, the general score given to the company at the evaluation time will be obtained.

It should be mentioned that the rating model is mostly applied by the commercial banks in order to establish companies' reliability, about to be credited in some intervals of time. In some countries, such as France, the central bank intervened, controlled and financed various studies in order to estimate companies' bankruptcy risk; which is the reason for which the so-called "scores method" was imposed on the field of commercial banks.

As previously mentioned, it is empirically considered that each of the three models analyzed have processed and exploited various types of knowledge, meaning:

- about 94% of the explicit knowledge given by company's accountancy information, no matter if the information is gross or finished, competes with the indicators' determination;
- about 2% of the implicit knowledge "set" in company's accountancy is induced gradually within the periodical operation process by accountant experts working together at tree structuring of information, up to the level of accountancy balance sheet;
- about 2% of the implicit knowledge is "brought" and "included" by experts within the internal mechanism of computing for each model, thus contributing to the designing and finishing of the way it functions timely;
- about 2% of the implicit knowledge is associated to the banking officer, or any other expert that is solicited to applying it, depending on the situation of the Altman, Conan-Holder or Rating model (depending on ability and qualification, the relevance of the information of the company's accountancy and transmission of benign model, up to the final score function).

Therefore, explicit-implicit sharing of knowledge is involved, when it refers to tree structuring type of accountancy information, from the analytical up to balance sheet points. There is explicit and implicit knowledge "set" within the functioning of the three models, as well as the ES functioning conceived in this research. It is important to mention that empirically quantifying the quantity and volume of implicit knowledge is induced into the accountancy information of the Altman model or other similar ones, depending on the situation.

As a matter of fact, ES functioning is a more methodological demarche for offering a unitary character of the current research. It is not about the quantity of implicit knowledge that mixes a given volume of explicit knowledge that would be relevant (the previous example: 6% as compared with 94% for a certain issue). On the contrary, the qualitative type and dimension of the implicit knowledge owned by the human expert induce the analyzed processes, leaving an essential dimension in order to solve the economic issues successfully. It is obvious that evaluation of "quality" that exists within a volume of implicit knowledge is an extremely difficult demarche, for any field of knowledge, including an economy. As a result, Altman model is illustrated based upon its functionality on explicit and implicit knowledge, all these following a tree structuring type of processing, up to the final result. Mixing between the two categories of knowledge is chaotic, and thus we cannot determine in other way than the intuitive, the final shape of the score function. In a graphical formulation (Figure 1), the sharing between explicit and implicit, regarding the knowledge database, upon which Altman functioning is based each time is applied for the real data, specific to a company's accountancy (application should include the last four years to the moment of evaluation).

In a similar way, the situation of tree structuring and sharing of knowledge (explicit and implicit) is emphasized based on Conan-Holder and Rating models. The differences that come within the other two models are absolutely minor and are determined by the typology of financial accountancy indicators that is retained and then processed within each model.

According to our opinion, it is not possible to make a higher expatiation regarding the volume and nature of implicit knowledge, included within the functioning of each Altman, Conan-Holder and Rating models. In Table 1, an example will be given showing some of the types of implicit knowledge, each of them expressing a shape subtly in the hierarchical aggregation of knowledge on which the three models are based. Essentially, it is exclusively about the accountancy information taken from the balance sheet, balance and other accountant documents.

**Conclusion type of knowledge**

Usually, the superior decision representative of a company evaluates the existing situation, disposes of some information and other elements that define the market and competitors, trying to formulate a number of "n" scenarios for the potential future of an organization. This means it draws up "n" scenarios for the company's progress to CAF.

The decision representative uses various models of economical-financial analyses, as well as different information instruments for data processing; it supports the human expert in adopting a strategic decision that will reflect further the way a company will develop in the future. Anyway, the company's top management (a bank currently establishing a company's reliability to which a ten years loan is given and is valid for a credit institution, investments funds etc.), usually issues three potential scenarios:

- a realistic (basic) scenario: this means having a better and real objective of the internal and external environment of the company; this scenario reflects in a realistic way, mathematically, the conclusion type of knowledge, that can be deducted from the company's accountancy. The conclusion type of knowledge is the moment of taking over the data of the analytical accounts in the synthetic accounts (a first general conclusion occurs), followed by the balance sheet synthetic accounts (the second general conclusion occurs); and then from the balance into the balance sheet (the third general conclusion occurs) and further into drawing up the documents necessary for describing the assembled situation of the company (the fourth synthetic and essential conclusion occurs);
- a pessimist scenario: this involves the deciding person being psychologically prepared and thinking of preventive measures, such as cash-flow favorable for the next months; and, this scenario takes into account the conclusion type of knowledge offered by the company's accountancy, also having in view some turbulences derived from macroeconomic, regional or global levels etc;
- an optimistic scenario: this appears as an extension of the basic scenario as a potential hypothesis, according to which some premises of the basic scenario will know a significant improvement, no matter the cause of this improvement (market, competition, level of incomes,
economic development times etc).

The aims of different economical-financial models, including the three models invoked here, include analyzing the company’s progress and being able to draw up the most realistic scenarios for the SSF of the years to come. Therefore, the superior decision maker of the company, either in the situation of appealing to the Altman model or in the situation of mixing the three models (processing the database will take place only by the support of an efficient information system) must be willing to visualize a volume of conclusion type of knowledge, more often preferably under a diagram form, since it is extremely suggestive and simple to be interpreted.

Generally, the simplified graphical form of scenarios that top management aims to achieve is illustrated in Figure 2 (the analysis is done at moment t₆, and the deciding person proposes to draw up the "n" variants for CAF in the next three years).

Obviously, at the end of applying each model of the economical-financial situation of a company (generally, talking about "n" economic models based on explicit and implicit knowledge, as suggested within the ES structure), the resulted synthetic conclusion will compulsorily include in its structure the two classes of Nonaka’s type of knowledge:

- a volume, structure and form of explicit knowledge, by which the company’s SSF is quantified almost mathematically;
- a volume, structure and form of implicit knowledge: these are sometimes part of the conclusion type of enouncement, that results after applying the model (though this thing rarely takes place); of a majority, the implicit knowledge will be used intensively when the top management interprets the enouncement, by which the final conclusion on applying the economic model is formulated.

Finally, if we wish to study thoroughly the conclusion type of knowledge that results at the final application of the "n" models of economic analysis, it is necessary to describe in detail the written form that such conclusions take over from (electronically or printed). It should be understood that a part not to be neglected in enouncing conclusions for such complex analysis is the verbal form that entails interpretations and divergent opinions of specialists that synthesize this conclusion in order to inform the top management. Predominantly, conclusion type of knowledge takes a written form, and its enouncement has more often three different typologies:

- an enouncement under the form of mathematical formulas, using variables or indicators precisely
quantifiable situation where such conclusions support each other in 100% of explicit knowledge; - an enouncement under the form of accountancy and other similar formulas (economical-financial), where empirically estimated conclusions are based on 98% of explicit knowledge and 2% of implicit knowledge; - an enouncement under descriptive, report or receipt form etc., where the final conclusion (or part of the general conclusion in a descriptive way) has almost equal mixed percentages of implicit and explicit knowledge; empirically, it can be said that such conclusions are based on 50% of explicit knowledge and 50% of implicit knowledge.

The ideas previously invoked are considered as relatively easy to understand, as illustrated in Figure 3.

CONCLUSION

With the aim of generalizing the idea suggested in Figure 1 (when talking about implicit and explicit knowledge of the Altman model) and describing the mechanisms of the functioning of any of the "n" economic models (Altman, Conan-Holder etc), the graphical description and succession of different graphs based on classifying any economic model are illustrated in Figure 4. Usually, such economic models start from the first information already existing in the analytical accounts of the company,
Figure 2. Graphs of knowledge representation within an economical model (valid for "n" models).

Table 1. Implicit knowledge of the accountancy information on which the Altman, Conan-Holder and Rating models are basing upon.

<table>
<thead>
<tr>
<th>Contexts that generate implicit knowledge in the accountancy information and Altman, Conan-Holder, Rating models</th>
<th>Types of implicit knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>- interpretation of some rules of filling the analytical accounts</td>
<td>- correspondences between components of different accounts</td>
</tr>
<tr>
<td>- interpretation of some rules of filling the synthetic accounts</td>
<td>- value of flows resulted o some accounts</td>
</tr>
<tr>
<td>- interpretation of some normative acts/rules on drawing up the accountancy balance sheet</td>
<td>- value of the commercial fund generated internally;</td>
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<td></td>
<td>- value of the acquired commercial fund;</td>
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<tr>
<td></td>
<td>- computing method of the commercial fund, resulted after a fusion.</td>
</tr>
<tr>
<td>- personal opinions and interpretations to the profit account and losses; capitalization of expenditures and registering of three groups (establishing, research and development expenditures, expenditures of rates of interest; by the alternative accountancy treatment allowed by IAS/IFRS, the accountant expert can chose between current and registered expenditures in the profit and losses account, or the class of unused assets within the balance sheet; similarly, the incomes registered in advance and presented into the balance sheet are susceptible of interpretations)</td>
<td>- some provisions are fiscally deductible when they refer to risks and general expenditures;</td>
</tr>
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<td></td>
<td>- other provisions are not fiscally deductible when referring to litigations being in progress;</td>
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<td></td>
<td>- interpretation of some expenditures of forfeit type, penalties etc, as derived from the interpretation of general law;</td>
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<td></td>
<td>- the transfer of incomes of “advance incomes”, included within “current incomes” class;</td>
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<td></td>
<td>- the regime and applied methods of redemption;</td>
</tr>
<tr>
<td>- personal opinions and interpretations to managers reporting; interpretation by bank or other partners of the company, of some rumors that come on the money stock market</td>
<td>- the value of some financial instruments derived as results of some different accountancy treatments;</td>
</tr>
<tr>
<td></td>
<td>- the market value of the company, by the quantification methods of intangible assets.</td>
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</table>
reaching to a type of knowledge that is relatively finished, called "secondary knowledge" (the left side of the figure). Then, the form of the two essential accountancy documents is tree structured, meaning the balance and accountancy balance sheet. Further, depending on the complexity and nature of the economic model taken, the human expert defines $X_n$ as cause variables, which by sum and weight will lead us to the final result of the model, the score function.

If it is referred to any of the “n” economic models, which can be included within an ES structure in order to estimate the bankruptcy risk, then there exists $M_1, M_2, \ldots M_n$ (as generic models which the designer can report to).

One can study a number of variables that should be defined depending on each model specific expressions defined differently from one model to another and depending on the production rules which the inference mathematical model will be based on.

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