

Accounting Decisions' Modeling with Intelligent Technologies

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Abstract: - This paper surveys a selection of recent research results which use laboratory methods to contribute to our understanding of the accounting decisions' characteristics and of the accounting decision-making process.

During accounting decision modeling process, we observed that there are some qualitative factors which constraint the accounting decision-making and that these factors should be modeled by using the so called knowledge technologies.

We present an example which treats the accounting decisions concerning fixed assets' management. We discussed the economic decisions, the accounting decisions, the knowledge required to make the accounting decisions related to fixed assets and the related models.

The necessarily interactive role of theory development, laboratory experimentation and field observation is discussed. The importance of the present study consists in: the enunciation of the accounting decisions' characteristics, the enunciation of the accounting decision-making process and in the revealing the conclusions detached from the different modeling techniques.

Key-Words: - accounting decision, accounting decision-making model, accounting knowledge, intelligent modeling

1 Introduction

The decisions' modeling constitutes a major concern of specialists in different areas, with the purpose of augmenting the quality of decision making. The first approach encountered in decision modeling was the mathematical approach. Thus, through the use of economic-mathematical models, depending on utility, the decisional problem becomes one of maximization of decisional making utility. Precisely in the moment in which the researches in economic-mathematical modeling domain were reaching a climax, the decision theory acknowledges a new referential point marked by Herbert Simon. The decisional process is no longer considered one of utility maximization and possible to be modeled in an economic-mathematical way; the decision-maker actions in conditions of limited rationality and it is not perfectly informed; the decisions are classified in structured and unstructured. For structured problems, adequate are the economic-mathematical models for which informational models can be built that are using the algorithms of economic-mathematical models, for the unstructured ones, informational models are built that use AI techniques that are meant to capture the knowledge of decisional problem solving.

Knowledge is accumulated through experience. It can not be said that an accountant becomes a CFO after only less than a year experience. The questions to be asked are, though:

- what kind of knowledge must an accountant possess?
- are there any assumptions that sustain accounting-decisions knowledge modeling using intelligent technologies?

It seems that an accountant must know:

- to offer a bit of financial information starting from the data about economic transaction;
- how to interpret and analyze this information;
- how to certificate and validate it.

All these activities undertook by an accountant are specific for accounting knowledge management within a firm.

In their preoccupation to deliver a faithful image in order to support the decisional factors, the accountants are applying reasoning (the so-called professional reasoning in conformity with International Financial Reporting Standards); make decisions in order to use one treatment or another for accomplishing valid information.

The present article deals, in order, with the following aspects: the review of intern and

international literature regarding accounting decision making and the modeling of accounting decisional process; presentation of accounting decisions and tasks; the importance of decision making cognition and of quantitative and qualitative factors in decision making; the exemplification of quantitative/qualitative modeling of decision making and modeling with intelligent technologies of decision-making process. The article finishes with conclusions grasped from the activity of accounting modeling and the importance of those for decision theory.

2 Problem Formulation

The core deficiencies in assuring a generality degree to the computer-based decision model derive from:

- The technologies integration proves to be difficult to accomplish;
- Knowledge modeling is a difficult process due to the specificity of decisional problems.

The intelligent computer-based models developed for decisional problems pose the danger to be too specific. The problems capable of applicability on artificial intelligence techniques are of small dimension and depend of the specificity degree of the domain. The main objective of this paper relies in the proposal of an original method to develop an intelligent model as general as possible, for the accounting decision.

3 Purpose of the study

The core objective of the study undertaken in this paper is constituted by the acquirement of answers to the questions formulated in the introductory part. The study is based on the modeling of the accounting decision and formulation of accounting decision characteristics and of the steps of the accounting decisional process.

The present article establishes the following working hypotheses:

- the accountant effectuates reasoning and takes accounting decisions;
- the accountants reasoning is predominantly symbolic;
- the intelligent systems technology is an instrument for modelling the accounting knowledge;
- the reasoning of the most valuable experts from the accounting domain can be captured by means of technologies of (intelligent) knowledge.

The project proposes the approach of the following directions:

- identification of accounting decisional moments;
- concluding on modeling for the accounting decision.

4 Review of the literature

I consider that the national plan is a less developed than the international plan for the intelligent systems in accounting application, perhaps for the research financing reasons manifested in Romania. The international plan is developed due to the interest that financial consulting firms manifest in using this technologies and a developed infrastructure research.

On national level, the researchers and financiers are concerned in this field of study. The researchers' participations with papers on national conferences prove it.

The intelligent instruments and the artificial intelligence methods are, in some way, a little analyzed on the national level, especially the modeling of knowledge (expertise) that an accountant possessed in a problem domain.

On international level, the research groups are organized in study teams which include firms interested in the application of the tools and techniques developed in the research studies.

The actual informational systems for data processing are oriented on transactions (more accurate, on justificatory document). It is sufficient that an accountant to be able to operate a justificatory document and the solution of recording in accounting is offered by the computer-based application.

Often, in the process of accounting knowledge, the accountants need intelligent solutions through which they can verify and implement accounting reasoning produced by the most valuable experts in the field. The elicitation of the knowledge from experts can be a rather expensive and laborious. And, as the proverb has it: why to reinvent the wheel?, we come to the conclusion that firm experience in using the expert systems and the instruments of acquisition and representation of knowledge can tell us many about the advantages of using such instruments.

The four major firms of accounting consulting are using or have used AI techniques and expert systems in decision making and in solving accounting problems: Deloitte, Ernst&Young, KPMG and PricewaterhouseCoopers. The main

domains in which the applicability of such techniques is proved are: taxes, financial planning, audit and the accounting consulting services.

In Europe, researchers are interested in intelligent systems technology, in hybrid systems and the technologies of knowledge. The ESPRIT Program was, probably, the biggest source of financing for expert systems projects. Many companies are using the expert system technology as a strategic advantage or in order to enhance the value of their business.

The knowledge possessed by accountants contains pieces of knowledge (concepts and attributes) inter-bounded through relations. The teaurization of these pieces of knowledge is very useful for the processes of knowledge management and the process of value creation through informational plus.

If we look at the computer-based accounting applications market we observe that intelligent technologies aren't the tool for supporting decision-making process. Today it is considered that accounting expertise is very expensive and not available for elicitation, so the computer-based tools used are the automatic numeric-data processing tools.

The international accounting firms developed intelligent applications, but their experience in developing these products isn't available for public use. A software developer can't come on the market with an intelligent application for accounting domain without capturing previously the accountants' expertise.

The small firms, which need computer-based application for accounting often appeal delivered software products for price-results reason. The large firms need delivered software products, partially developed within the firm. The implementation process of such solution is sometimes very long and difficult because of the incompatibilities that appear between real business' needs and the software product's characteristics. On the process of the informational business flows' automation the information is lost and sometimes knowledge. But this fact is unknown for the both sides.

In our opinion, in Romania, the computer-based developers for the accounting domain aren't familiarized with the intelligent technologies using benefits and the firms don't know any experience possessed by intelligent solutions developers.

In our opinion, ontology of accounting domain must include taxonomies of concepts and the relations between them. International Standards for Financial Reporting are taxonomy of accounting knowledge specialized in production of financial

information. The edification of such an ontology demands time and resources, but the benefits of reusing it would be considerable.

Accounting represents a complex of knowledge processes from the processing of primary data to the authentication of financial information offered to the user. Accounting ceases to be a precise science, because the pertinent data' acquisition imposes the performing of reasoning for each case alone.

Researches in the domain of accounting decisions are not numerous, albeit multiple studies regarding the role of accounting and of the information provided by it in the decisional process does exists.

5 Questions and hypotheses

The result of making accounting decisions is objectified in information at the level of the whole informational system and influences the credibility of the information presented in financial reports. According to this information, the financial capital providers will influence the capital financing politics.

Now, the question that must be remembered in our demarche: is useful the accounting information in accounting decisions making? It is known that in order to fundament the accounting decision, a processing of primary data issued by the system of transactions and economic events is accomplished, followed by an analysis, a reasoning and a selection of the information resulted that are in direct connection to the preordinated objectives. Our opinion is that accounting information is essential in all accounting decisions linked to enterprise's transaction (decision to produce or to buy, the quantification of budgets, evaluation of competences, evaluation of manager's performances, etc.).

The hypothesis enunciated next is:

Accounting decisions making implies application of knowledge from the accounting domain upon data regarding economic transactions in order to produce financial-accounting information necessary for economic decisional - and/or accounting - decisions at an enterprise level.

The second question to be asked is: is the accounting decision an economic one? The accounting decision is an economic one in the extent in which takes place in an enterprise and has connections with the economic life of the firm. But accounting decisions have a special connection with activity transaction, accounting being known as a science of business transaction. The going concern is a principle for accounting and an objective for

management, and this means that while for management the going concern presumes the commitment to some risks, for accounting it means the acceptance of those risks and making accounting decisions that will enable credible and pertinent information.

The second hypothesis of the present study is:

Accounting decisions are necessary in orienting all the participants at the economic life of the enterprise, but they are not sufficient in order to assure the continuity of the activity.

The third question that lies in front of us is: is the accounting decision an operational decision, an investments or a financing decision? The cycles of economic activity of the enterprise are divided in: investment cycle, operational cycle and financing cycle. In these cycles accounting decisions are taken, in order to provide pertinent information to internal and external users. In conclusion, accounting decision is specific to all the three cycles of activity of the enterprise. Accounting decisional models are used in decisional models from the three activity cycles as generic knowledge tasks.

The third hypothesis formulated is the following one:

The knowledge of accounting decisions making must be taken into consideration in the elaboration of economic decisional models as reusable generic knowledge tasks.

What does this mean for information users? The user of financial-accounting information that works mostly in a highly informational environment needs a computer-based system that offers the conditions for the fulfillment of user's informational and knowledge necessities. In the case of accounting, we can formulate with complete certainty the truth according to which, at the base of accounting decision making lay the information and accounting knowledge. The present computer-based systems are oriented upon transactions taken down in justificatory documents. In these conditions, it is sufficient an accountant to introduce data in a justificatory document which is displayed on the screen, and the solution for recording in accountability to be automatically offered by the software product used. The present computer-based solutions do not offer facilities for accounting reasoning and does not map this reasoning.

The fourth hypothesis that is formulated by us is the following one:

The integration of functionalities offered by intelligent technologies and that offered by traditional technologies is possible.

In the next sections of our paper we try to demonstrate these hypotheses starting from the

observations obtained from the modeling of accounting decisions.

6 Methods and procedures

The study presented in this paper begins with the presentation and classification of accounting decisions. The study finishes with the presentation of conclusions and the importance of the study carried on.

The accounting decisions modeling with computer-based tools was accomplished based on the documentation at Centre for research ECO-INFOSOC: Modeling and informatization of economic processes from Academy for Economic Sciences Bucharest, Romania; this documentation was allowed through the contract for research CEEEX — Projects of mobility of researchers in which the author of the present study has occupied the position of director.

7 Instrumentation

The researches in the domain of accounting decisions are not numerous; albeit many studies exist regarding the role of accounting and the information provided by this one in the economic decisional process. Economic decisions are addressed to the optimal functionality of the firm, on long and short term.

The accounting decision is any decision whose core objective is to influence (the form, or the substance) of the outputs from the accounting system of a firm in an identifiable manner.

In a published paper [10], we have classified the accounting decisions based on their affiliation to the managerial or financial accounting. One can observe that economic decisions are influenced by accounting decisions. The enacting of economic decisions leads to the necessity of new accounting decisions. Also, the enacting of accounting decisions may influence the enacting of other accounting decisions.

The accounting decision field of study is an interdisciplinary one. The decisional environment is represented by firm's transaction, the decision makers are the accountants and the managers, and the decisional alternatives are of an accounting nature. Thus, we can infer that the interdisciplinary domains are: accounting, management, firm transaction.

Every decision is made based on a rigorous study of the problem to be solved; the study being accomplished based on the information gathered

about the problem in hand, the effects of adopting an alternative or another upon the presentation of the respective element in the balance sheet, as well as the effects upon profit and loss account. All these information are accounting information extracted from the financial-accounting system.

The accounting decision for enterprise transaction is represented by the rational choice from a set of possible alternatives represented by accounting methods and treatments with the objective of efficiently controlling an enterprise.

The accounting management resides in business administration, compliance to regulations with accounting character, so as, through enterprise's decisions and actions, the fundamental objective of a true and fair value.

The accounting decisions for assets, debts and capitals are made by the CFO together with the other accountants from the financial-economic department, which, based on information from the financial accounting, on the economic environment, on regulations and standards existent in the domain and on the analysis accomplished based on the information at hand, offer the adequate solutions. To be bared in mind that all these decisions does not submit themselves to the approval of general manager, these must be adopted or approved by the CFO, and the information resulted from adopting such decisions enters in the informational circuit of the firm, being materialized in an output at the accounting system level and input for assets, debts or capitals owned – level. The justificatory documents afferent to the information represented by these accounting decisions are the decisions of CFO and the resolutions or the so-called notifications or announcements.

The management accounting decisions are made by the CFO, seconded by the executive control accountants which, based on the information regarding costs or activities, offer solutions for controlling the costs, evaluation of performances, and for budgeting and planning of the activity.

Accounting, in its applicative aspects, is a process for information production and requires very much expertise (know-how), the accountant specialists being know-how holders.

Thus, we can talk about the following accounting knowledge processes:

- The process of financial information production;
- The financial performances evaluation process;
- The evaluation process through audit of financial information.

The process of financial information production: Presently, it is known that the process of financial information production presumes the application of techniques, reasoning and accounting politics according to users' information needs and has as primary objective the true and fair value representation of financial position and performance of the enterprise. It is a process of transforming the data delivered by economic events and transactions in financial information and treasures the knowledge from the accounting domain.

Under functional aspect, the process of financial information production can be represented with the function (1):

$$f(N, d) \tag{1}$$

where:

N = the users' needs for financial information;

D = numerical data pending of economic transactions that take place at the level of a producer of financial information, that is, the enterprise.

The transformation of these numerical data in information takes place through application of accounting reasoning, depending on user's necessities. The performance in a business represents all that determines the build-up of the business. So, a new question imposes itself: which are the elements that determine the build-up of the business?

- The best possible value of the financial indicators of performance and the best possible accomplishment of revenues and expenditures budgets, established for the accomplishment of the strategic plans;
- The best possible relation with the customers;
- The best organizing and controlling of internal processes (innovative, production operational and post-sale services);
- The best possible founded relation of the research-development function.

The economic analysis is an instrument for evaluating the internal performances. The economic analysis studies the phenomena from the economic point of view, respectively from the perspective of consumption of resources and of results obtained. Also, there must be taken into consideration the structural-functional relations and that of cause-and-effect relations.

The financial analysis implies from the part of its effecter, along with solid knowledge of accounting, control and financial analysis, some subtlety: "to make the figures speak" [5]. Financial analysis has as a purpose the establishment of strong and weak points of an economic entity, through the diagnostic

of performance state at the closure of a financial exercise. The financial information published by enterprises depends of the relevance of financial markets. The appraisal of financial markets has determined the definition of larger obligations in matter of financial information in Anglo-Saxon countries.

The evaluation process through financial audit: The financial auditors, as specialists with superior theoretical training, with authority and competence, are named experts. The expertise activity implies professionals with theoretical and practical knowledge which, as a result of the contracts received from third persons, are investigating the financial reports.

The processes of accounting knowledge enounced before are using three tasks of accounting knowledge: classification, evaluation and recognition.

The advantages of building a conceptual model of knowledge in modeling of accounting decision derives, especially, from the high degree of reuse of knowledge models and modeling of the behavior of the system capable of making decisions (knowledge determines the action of the system).

Between knowledge and the expertise specific to the accounting domain and the necessity of building knowledge models exists a direct bond: the more the knowledge of solving accounting problems manifests as a condition, the more the necessity of building knowledge models manifests. Conversely, the models of accounting knowledge once built contribute to the sharing of the modeled knowledge and to the management of accounting knowledge at enterprise's level.

Our goal in this subchapter is to underline the importance of reusing accounting tasks defined in a library in building the various knowledge-based systems. The evaluation task can be used in knowledge-based systems for accounting decision making, such as: the evaluation of asset undervaluation, the evaluation of selecting a specific method for recording stock consumption, the evaluation at the fair value of financial instruments, the evaluation of situations that can result in provisions- or contingent debts recording, the evaluation of completion of conditions by a financial instrument to be considered an element of asset or equity owned and generally the evaluation of accounting reports in which the professional reasoning manifests itself.

Decision modeling is a research direction bordering with mathematics and informatics and is preoccupied with foundation of managerial decision in efficiency conditions for producer, with the help

of a number of flexible economic-mathematic models and with the opportunity of using simulation technique.

The analysis of decisions through modeling starts on one hand from the assumption of accepting the human limits of information processing and, on the other hand, from the consideration of the necessity of incorporation of judgments and intuitions, of the result of imagination and creativeness of the decision makers.

Important to remember is the fact that simulation is especially valuable for problems that cannot be approached through mathematical, analytical or of optimization methods. Albeit simulation and optimization are quantitative methods based on mathematical models, the fundamental difference between these two approaching lies in the role of decision variables.

In the case of optimization, the values of decision variables are output data of the model. These values are obtained with a formula or an optimization algorithm, so as to maximize or minimize the value of an objective function which is expressing the performance criterion of the model.

In case of simulation, the values of decision variables are input data of the model. Through simulation, based on the mathematical models, the performance criterion for specific value of decisional variables is evaluated. In the end, one will choose the alternative that leads to the best value of performance criterion.

In case of modeling with intelligent technologies, the values of decision variables are input data of the model. Through the incorporation of expertise and decisional factors reasoning in knowledge base, the best way to action is evaluated. By means of using intelligent technologies, one can assure the intelligence of business processes. Intelligence is the ability of something (a system, artifact or being) to evaluate the possibility of reaching a goal and of using this evaluation in the achievement of the goal (Pierce's semiotic definition of intelligence).

Economic-mathematical modeling of decision can be applied only in the conditions in which the result expected by the decisional factor can be monetary quantified and accomplishes an optimization. Modeling the decision through intelligent technologies is applied in the circumstances in which the decisional factor lacks the knowledge regarding the acting ways and the reasoning about the implementation of the best decision and incorporates, through the computer-based model developed, the knowledge from the domain. The decision modeling through computer-based technologies has a larger area of coverage.

Thus, computer-based technologies can be used for developing an informational solution based on an economic-mathematical model through the implementation of this model into a programming language, and for developing an intelligent informational solution which incorporates knowledge from a specific domain of action.

8 Conclusion

The necessity of making accounting decisions leads to the confusion of considering those as being repetitive or of routine. Accounting decisions are not of routine, because they are unstructured. Accounting decisions are not repetitive, because many of them do not repeat themselves in normal activity cycles of the enterprise and have a characteristic of appearance reduced to the level of whole enterprise's activity duration. In turn, they are necessary, which means that once the enterprise is confronted with an accounting decisional problem; this must be solved frequently in the shortest time possible. From here we can infer the importance of accountant decision makers' abilities and the necessity of those in the financial-accounting activity of the enterprise. Frequently, the insufficient experience and lack of knowledge in the domain lead to fallacious accounting decisions which influence the economic decisional process and the credibility of the financial information disclosed.

Knowledge of making accounting decisions is strictly specific to these activities and, in most cases, a tacit one. During the hours of teaching within the discipline of "Expert Systems for Management", we have perceived that, on the example of accounting decision modelling, students from "Economic Informatics" specialization were captivated and interested by the subject of presenting the knowledge necessary to accounting decision making, while the students from "Accounting and Control Informatics" specialization envisaged this knowledge as implicit, without presenting a novelty characteristic for them. Their question was frequently: what accountant would not know such aspects? Or, more palpable: a person that does not know these aspects is not an accountant! However enthusiastic and expansive would be considered these students, we must admit that "nobody knows everything" and that, frequently, persons endowed with little creativity and lack of experience make wrong decisions because they do not master sufficient knowledge in the accounting domain.

Characteristics of accounting decisions:

- they use knowledge and constitutes tasks of accounting knowledge necessary in making economic decisions;
- the importance of qualitative factors and of heuristics in making accounting decisions is a notable one, which demonstrates the assumption of modeling accounting decisions with the help of knowledge technologies;
- the accounting decisional problems are not of optimization; they offer the knowledge of acting in the broader context of making accounting decisions and constitutes tasks of intensive knowledge;
- accounting decisions present an important characteristic, of necessity, in contrast with economic decisions.

The steps of accounting decision-making process:

- accessing knowledge from the domain;
- certifying the completion of accounting decisional conditions;
- selection or choice of a course for action;
- implementation.

Decisional conditions:

- assuring the accomplishment of true image objective;
- the cost/benefit ratio in obtaining financial information.

Conclusions issued from the activity of computer-based modeling of accounting decisions:

- on theoretical plan, the results obtained constitute a priority in Romanian;
- the only failure is constituted by the impossibility of integrating the computer-based modules other way than in JAVA, due to the specific limits of integration for the platforms belonging to developing instruments. We believe that, albeit informatics and the technologies specific to this area are adequate to any activity domain, with real benefits to the society in which we live, the limits imposed at the integration requires recognized common standards for the producers of software; so, we appreciate that the research direction regarding the elaboration of standards presents a particular importance in the context of implementing computer-based solutions specific to knowledge society.
- any technology must be tested and accepted by the user. For now, the degree of acceptability by the user of some technologies is sufficiently weak (we

believe that this is because of the fact that producers are oriented onto the market formed by final consumers). We know enough examples in which a cell phone user does not benefit of all the advantages offered by the respective technology, because he/she does not need them, or because he/she does not know them. Maybe because software producers will turn more to the real needs of the knowledge society and they will be able to offer one day a common platform for work which will allow the integration of various models from various domain of science.

The study of the phases of methodology for developing the intelligent systems used to the implementation of intelligent solution brings to the attention the following conclusions:

- the nature of the problem possible to be solved with the help of this technology must be well identified and studied in an analysis domain which regards a special problem, specific to the enterprise;
- the identified problem must be adaptable to this technology, which implies that expertise in this domain to be rare and expensive and to be formalized by symbolic reasoning and using of heuristics;
- parallel building of an ontology of the domain under study simplifies the activities regarding the knowledge acquisition and optimizes communication relations between the knowledge engineers and experts from the field;
- the refinement of knowledge base must be a ceaseless process, until the implementation of final solution, by test cases emanated from the enterprise;
- documentation and instruction of the users of the implemented intelligent solution must be well accomplished, and where is possible, even through sustained training, because these users do not know the technology and are afraid of the danger of replacing them by this technology;

Conclusions detached from the analysis and designing phase:

- the costs of developing the systems can be greater than the costs initially envisaged, due to the unexpected obstructions that can appear in developing the intelligent solution;
- the greatest benefits are expected to be from the optimization of decisional process, optimization of reporting to management

and elimination of routine operations and repetitive controls;

Conclusions detached from the rapid prototyping phase:

- formalizing the knowledge acquired through rules of production is more difficult than that obtained with the help of trees;
- the necessary knowledge in knowledge representation phase must necessarily be anteriorly conceptualized. The knowledge pieces and their use in reasoning must be delimited before the knowledge representation;
- the failures recorded by now in the implementation of this technology and presented in the specialty literature must have been the result of a fallacious definition of the problem to be solved;
- it is also possible to record failures when people which participate to the formalization of knowledge do not use the deductive reasoning in problem solving and are trying to use an approach of bottom-up type, specific to conventional systems for automate processing of data, so popularized in enterprises;
- the technology of intelligent systems offers the possibility of neutralizing the negative effects of eventually wrong made mathematical optimizations, by means of capture of heuristics that use qualitative factors;
- use of optimizations and simulations proves to be unreliable in cases of estimation that are connected to intelligence (as a phase of decisional process). Sometimes, the simple adding of an ϵ within a mathematical equation does not makes them more trustworthy than the intelligent technology. Both modelling techniques exhibit their own benefits and advantages that must be correlated with users interests.

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