A Model of Decision Support System in Economy

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Abstract: It is crucial to design and implement decision support systems to assist the manager because of the diversity and the large amount of data stocked in an organization. The concept of decision support system (DSS) defines any information technology focused on supporting the decision process. For a manager, informatics and the using of information technologies always meant formalizing the routine activities, those laws of existence and manifestation that can be described. The "casualty" fact is transformed into a "standardized" fact, elaborating behavioral conducts possible to use depending of the specificity of the situation occurred. The importance of interpreting is vital, from the information dimension to the strategic one. Information technologies are applied, separately and together, in management and decision modeling. They offer modeling instruments being able to automate the processes. The use of the decision and the context of decision making are two key aspects that characterize the utility of the decision models. In the decision making process are used data, information and knowledge corroborated with the manifestation of reasoning stated by the intelligence and experience of the decisional factor. Artificial intelligence proved its applicability in management using specific technologies such as expert systems (capable of offering the expertise in a specific knowledge domain) and decision support systems (a system that brings together the intellectual resources of a person with computer capabilities in order to improve the quality of the decisions). In this paper we present a model of decision support system implemented in tourism.

Key-Words: information technology, axiomatization, production rules, decision support systems, DSS

1 Introduction

In a competitive economy the success of a firm depends decisively by the quality of the decisions taken by firm's managers. Modern companies use knowledge-driven applications in order to respond quickly to continuously changing market conditions and customer needs. Since the information systems' recent development, decision taking implies a large volume of information and a complex analytical and synthesis process. This capacity of gathering, processing and analyzing information used in the decision process is above the human capacity so the use of new information technologies to support the decisional process is necessary. Economic sciences have known an obvious evolution in the last century; beginning to use axiomatic methods, applying mathematical instruments as a decision-making tool. So the process of economic axiomatization in the knowledge era should be based on new concepts as: knowledge society, knowledge management, organizational learning and memory. Axiomatization is a process that generates new knowledge using a set of knowledge that is considered to be true. So the main concept of axiomatization is knowledge. If the organization is knowledge-focused, the probability of defining and determining new knowledge through the axiomatic method is bigger, knowledge that helps the manager choose the right decision. In this paper I proposed a model of a decision support system based on production rules derived from axioms, in order to support the manager of a hotel to make the right decisions in this competitive era that we live in.

One of the main elements in building a knowledge based system is the representation of knowledge, the quality of the cognitive system being essential to a good functioning of a decision support system. Goldstein and Papert underlined that the fundamental problem in artificial intelligence is not discovering some efficient techniques, but defining some methods to represent large amounts of knowledge, so that the knowledge can be easily used [Zaharia, 2003]. Most of the researchers in the field of artificial intelligence think that WHAT has to be represented it's known; so what the programmer has to do is to think of HOW the information can be coded [Tacu, 1998].

In this paper I present a way of using axioms in economics, more precisely building a formalized axiomatic system. Then I will transform the axioms into production rules, using the knowledge provided by the expert (the manager, in this case) and some historical data that predict a trend – the values being also determined by the expert. Then, I built the application implementing those production rules.

2 Problem formulation

Steps have been made in order to transcend the natural language and achieve a symbolic axiomatic language. I used some undeniable achievements but I think that the main direction in the reconstruction of the economic theory is by using the logical and semiotic tools. In some papers I found arguments sustaining this initiative [Băileşteanu 2004, 2005].

I noticed time and effort are wasted when the information is not at hand, and managers could use a little help in making decisions based on what-if predictions. I wanted to design an application to help them joggle the variables and see the results almost immediately. I consider that to be one of the biggest advantages that my model brings. I chose a hotel situated in the western part of Romania, in a beautiful resort called Băile Felix. The manager wanted to invest and was open to new ideas and implementing an information system that could help him deal with economic indicators and predict what could happen in the future. Of course the system doesn't take into consideration some indicators like inflation, but I consider it is a good starting point. Therefore, I want to expand it in the future, so I could apply it to the entire complex of hotels in Băile Felix.

3 Our proposal – a model of decision support system

Information and knowledge technologies are two essential tools for modeling and developing of interactive solutions. Therefore, I focused on identifying their use in decision modeling. I created an intelligent system of decision making, who's first characteristic is intelligent informing. Hybrid support systems are systems resulted by integrating decision support systems (DSS) with other tools and technologies in order to maximize efficiency of the decision process in an organization. My proposal is a hybrid system, a combination of a decision support system **model** oriented – flexible systems that use spreadsheets, used in **What-If** analysis) and decision support systems **knowledge** oriented – software modules based on artificial intelligence.

3.1 The formalized axiomatic system

In order to study economic facts and processes, they should be in an organized and logical structure.

An axiomatic system is a system of propositions based on the distinctions between axioms (primary propositions) and theorems (derived propositions). The transition from the primary terms to derived ones assumes the existence of definition and deduction rules. When the interpretation of the symbols is not used, the system is called a formalized axiomatic system. An axiom is an obvious proposition that requires no demonstration. Theorems are propositions obtained from axioms or other proposition obtained using inference rules. Through deduction I understand applying inference rules for a finite number of times to axioms or propositions initially considered true.

The organization that I studied can be modeled using semantic trees. I used a left-decomposed semantic tree, as can be seen in figure no. 1.

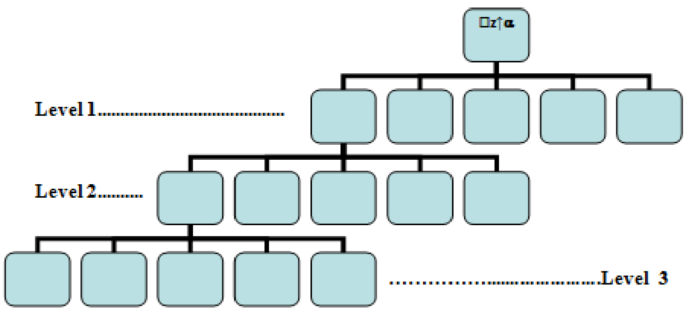

Fig. 1. A left decomposed semantic tree

Here, the symbol □ represents "must", ↑ represents growth, and α the growth coefficient.

Two basic observations can be outlined: if the number of alternatives is reduced, the complexity of the system is also reduced, but the interpretation is easier; the right part of the semantic tree can be also interpreted, so the generality of the system is not reduced.

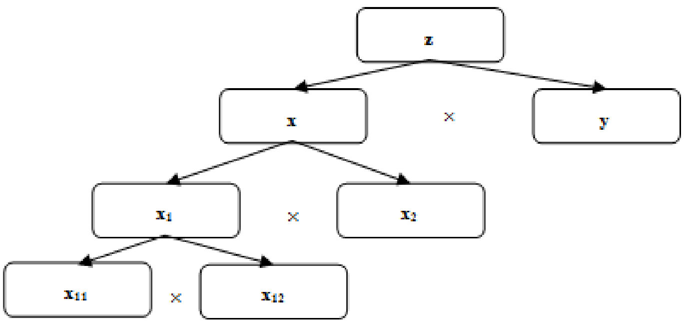

Fig. 2. Product system

We chose to represent a product system – figure no. 2 $\times(\times(\times(x_{11},x_{12},x_1),x_2,x),y,z)$ where z is a very well determined target: $z = f(x_{11}, x_{12}, x_2, y)$.

Using the formalized symbols we decompose all the possible growth alternatives depicted in the following figure:

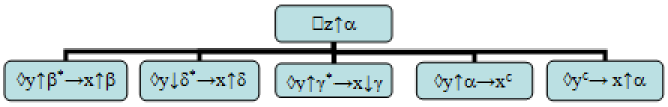

Fig. 3 The first level of the semantic tree

Figure no. 3 can be translated into relation (1):

$$\square z\uparrow\alpha \rightarrow \Diamond ((y\uparrow\beta^*\rightarrow x\uparrow\beta) \vee (y\downarrow\delta^*\rightarrow x\uparrow\delta) \vee (y\uparrow\gamma^*\rightarrow x\downarrow\gamma) \vee (y\uparrow\alpha\rightarrow x^c) \vee (y^c \rightarrow x\uparrow\alpha)) \quad (1)$$

where $\alpha>1$, $\beta>1$, $\beta^*=\frac{\alpha}{\beta}$, $\beta^*>1$, $\delta>1$, $\delta^*=\frac{\alpha}{\delta}$, $\delta^*<1$, $\gamma<1$, $\gamma\neq0$, $\gamma^*=\frac{\alpha}{\gamma}$, $\gamma^*>1$ and $\Diamond$ represents possibility, $\downarrow$ means decrease, $\vee$ stands for logical "or" (multiple choices), and the latin letters are the change coefficients for each variable.

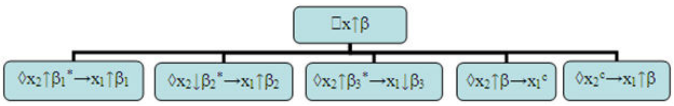

Fig. 4. Second level of the semantic tree (left node)

Figure no. 4 can be translated into relation (2):

$$\square x\uparrow\beta\rightarrow\Diamond((x_2\uparrow\beta_1^*\rightarrow x_1\uparrow\beta_1)\vee(x_2\downarrow\beta_2^*\rightarrow x_1\uparrow\beta_2)\vee(x_2\uparrow\beta_3^*\rightarrow x_1\downarrow\beta_3) \vee (x_2\uparrow\beta\rightarrow x_1^c) \vee (x_2^c \rightarrow x_1\uparrow\beta)) \quad (2)$$

where $\alpha>1$, $\beta>1$, $\frac{\alpha}{\beta}>1$, $\beta_1>1$, $\beta_2>1$, $\beta_3\neq0$, $\beta_3<1$, $\beta_1^*=\frac{\beta}{\beta_1}$, $\beta_1^*>1$, $\beta_2^*=\frac{\beta}{\beta_2}$, $\beta_2^*<1$, $\beta_3^*=\frac{\beta}{\beta_3}$, $\beta_3^*>1$

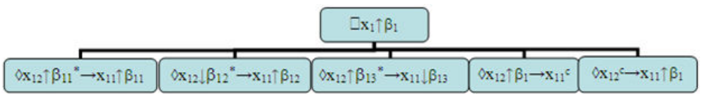

Fig.5. Third level of the semantic tree (left node)

Figure no. 5 can be translated into relation (3):

$$\square x_1\uparrow\beta_1 \rightarrow \Diamond((x_{12}\uparrow\beta_{11}^*\rightarrow x_{11}\uparrow\beta_{11}) \vee x_{12}\downarrow\beta_{12}^*\rightarrow x_{11}\uparrow\beta_{12}) \vee (x_{12}\uparrow\beta_{13}^* \rightarrow x_{11}\downarrow\beta_{13}) \vee (x_{12}\uparrow\beta_1 \rightarrow x_{11}^c) \vee (x_{12}^c \rightarrow x_{11}\uparrow\beta_1) \quad (3)$$

where $\alpha>1$, $\beta_1>1$, $\beta_{11}>1$, $\beta_{11}^*=\frac{\beta_1}{\beta_{11}}$, $\beta_{11}^*>1$, $\beta_{12}>1$, $\beta_{12}^*=\frac{\beta_1}{\beta_{12}}$, $\beta_{12}^*<1$, $\beta_{13}<1$, $\beta_{13}\neq0$, $\beta_{13}^*=\frac{\beta_1}{\beta_{13}}$, $\beta_{13}^*>1$

We can obtain the following intermediate relations:

$$\square z\uparrow\alpha \rightarrow \Diamond ((y\uparrow\beta^*\rightarrow x\uparrow\beta) \vee (y\downarrow\delta^*\rightarrow x\uparrow\delta) \vee (y\uparrow\gamma^*\rightarrow x\downarrow\gamma) \vee (y\uparrow\alpha\rightarrow x^c) \vee (y^c \rightarrow x\uparrow\alpha))$$

$$\square x\uparrow\beta \rightarrow \Diamond ((x_2\uparrow\beta_1^*\rightarrow x_1\uparrow\beta_1) \vee (x_2\downarrow\beta_2^*\rightarrow x_1\uparrow\beta_2) \vee (x_2\uparrow\beta_3^*\rightarrow x_1\downarrow\beta_3) \vee (x_2\uparrow\beta\rightarrow x_1^c) \vee (x_2^c \rightarrow x_1\uparrow\beta))$$

$$\therefore \square z\uparrow\alpha \rightarrow \Diamond ((x_1\uparrow\beta_1 \,\&\, x_2\uparrow\beta_1^* \,\&\, y\uparrow\beta^*) \vee (x_1\uparrow\beta_2 \,\&\, x_2\downarrow\beta_2^* \,\&\, y\uparrow\beta^*) \vee (x_1\downarrow\beta_3 \,\&\, x_2\uparrow\beta_3^* \,\&\, y\uparrow\beta^*) \vee (x_1^c \,\&\, x_2\uparrow\beta \,\&\, y\uparrow\beta^*) \vee (x_1\uparrow\beta \,\&\, x_2^c \,\&\, y\uparrow\beta^*) \vee (y\downarrow\delta^*\rightarrow x\uparrow\delta) \vee (y\uparrow\gamma^*\rightarrow x\downarrow\gamma) \vee (y\uparrow\alpha\rightarrow x^c) \vee (y^c \rightarrow x\uparrow\alpha))$$

$$\square x_1\uparrow\beta_1 \rightarrow \Diamond ((x_{12}\uparrow\beta_{11}^*\rightarrow x_{11}\uparrow\beta_{11}) \vee (x_{12}\downarrow\beta_{12}^*\rightarrow x_{11}\uparrow\beta_{12}) \vee \vee (x_{12}\uparrow\beta_{13}^* \rightarrow x_{11}\downarrow\beta_{13}) \vee (x_{12}\uparrow\beta_1 \rightarrow x_{11}^c) \vee (x_{12}^c \rightarrow x_{11}\uparrow\beta_1))$$

$$\therefore \square z\uparrow\alpha \rightarrow \Diamond (((x_{11}\uparrow\beta_{11} \,\&\, x_{12}\uparrow\beta_{11}^* \,\&\, x_2\uparrow\beta_1^* \,\&\, y\uparrow\beta^*) \vee (x_{11}\uparrow\beta_{12} \,\&\, x_{12}\downarrow\beta_{12}^* \,\&\, x_2\uparrow\beta_1^* \,\&\, y\uparrow\beta^*) \vee (x_{11}\downarrow\beta_{13} \,\&\, x_{12}\uparrow\beta_{13}^* \,\&\, x_2\uparrow\beta_1^* \,\&\, y\uparrow\beta^*) \vee (x_{11}^c \,\&\, x_{12}\uparrow\beta_1 \,\&\, x_2\uparrow\beta_1^* \,\&\, y\uparrow\beta^*) \vee (x_{11}\uparrow\beta_1 \,\&\, x_{12}^c \,\&\, x_2\uparrow\beta_1^* \,\&\, y\uparrow\beta^*) \vee (x_1\uparrow\beta_2 \,\&\, x_2\downarrow\beta_2^* \,\&\, y\uparrow\beta^*) \vee (x_1\downarrow\beta_3 \,\&\, x_2\uparrow\beta_3^* \,\&\, y\uparrow\beta^*) \vee (x_1^c \,\&\, x_2\uparrow\beta \,\&\, y\uparrow\beta^*) \vee (x_1\uparrow\beta \,\&\, x_2^c \,\&\, y\uparrow\beta^*) \vee (y\downarrow\delta^*\rightarrow x\uparrow\delta) \vee (y\uparrow\gamma^*\rightarrow x\downarrow\gamma) \vee (y\uparrow\alpha\rightarrow x^c) \vee (y^c \rightarrow x\uparrow\alpha)) \quad (4)$$

where $\alpha>1$, $\beta>1$, $\beta^*=\frac{\alpha}{\beta}$, $\beta^*>1$, $\delta>1$, $\delta^*=\frac{\alpha}{\delta}$, $\delta^*<1$, $\gamma<1$, $\gamma\neq0$, $\gamma^*=\frac{\alpha}{\gamma}$, $\gamma^*>1$, $\beta_1>1$, $\beta_2>1$, $\beta_3\neq0$, $\beta_3<1$, $\beta_1^*=\frac{\beta}{\beta_1}$, $\beta_1^*>1$, $\beta_2^*=\frac{\beta}{\beta_2}$, $\beta_2^*<1$, $\beta_3^*=\frac{\beta}{\beta_3}$, $\beta_3^*>1$, $\beta_{11}>1$, $\beta_{11}^*=\frac{\beta_1}{\beta_{11}}$, $\beta_{11}^*>1$, $\beta_{12}>1$, $\beta_{12}^*=\frac{\beta_1}{\beta_{12}}$, $\beta_{12}^*<1$, $\beta_{13}<1$, $\beta_{13}\neq0$, $\beta_{13}^*=\frac{\beta_1}{\beta_{13}}$, $\beta_{13}^*>1$, $\therefore$ symbolizes inference and & symbolizes logical "and".

From the relation (4) we can obtain the following relations:

A1. $\square z\uparrow\alpha \rightarrow \lozenge\, (x_{11}\uparrow\beta_{11} \,\&\, x_{12}\uparrow\beta_{11}^{*} \,\&\, x_{2}\uparrow\beta_{1}^{*} \,\&\, y\uparrow\beta^{*})$

where $\alpha>1,\ \beta>1,\ \beta^{*}=\frac{\alpha}{\beta},\ \beta^{*}>1,\ \beta_1>1,\ \beta_1^{*}=\frac{\beta}{\beta_1},\ \beta_1^{*}>1,$

$\beta_{11}>1,\ \beta_{11}^{*}=\frac{\beta_1}{\beta_{11}},\ \beta_{11}^{*}>1$

A2. $\square z\uparrow\alpha \rightarrow \lozenge\, (x_{11}\uparrow\beta_{12} \,\&\, x_{12}\downarrow\beta_{12}^{*} \,\&\, x_{2}\uparrow\beta_{1}^{*} \,\&\, y\uparrow\beta^{*})$

where $\alpha>1,\ \beta>1,\ \beta^{*}=\frac{\alpha}{\beta},\ \beta^{*}>1,\ \beta_1>1,\ \beta_1^{*}=\frac{\beta}{\beta_1},\ \beta_1^{*}>1,$

$\beta_{12}>1,\ \beta_{12}^{*}=\frac{\beta_1}{\beta_{12}},\ \beta_{12}^{*}<1$

A3. $\square z\uparrow\alpha \rightarrow \lozenge\, (x_{11}\downarrow\beta_{13} \,\&\, x_{12}\uparrow\beta_{13}^{*} \,\&\, x_{2}\uparrow\beta_{1}^{*} \,\&\, y\uparrow\beta^{*})$

where $\alpha>1,\ \beta>1,\ \beta^{*}=\frac{\alpha}{\beta},\ \beta^{*}>1,\ \beta_1>1,\ \beta_1^{*}=\frac{\beta}{\beta_1},\ \beta_1^{*}>1,$

$\beta_{13}<1,\ \beta_{13}\neq 0,\ \beta_{13}^{*}=\frac{\beta_1}{\beta_{13}},\ \beta_{13}^{*}>1$

A4. $\square z\uparrow\alpha \rightarrow \lozenge\, (x_{11}^{c} \,\&\, x_{12}\uparrow\beta_{1} \,\&\, x_{2}\uparrow\beta_{1}^{*} \,\&\, y\uparrow\beta^{*})$

where $\alpha>1,\ \beta>1,\ \beta^{*}=\frac{\alpha}{\beta},\ \beta^{*}>1,\ \beta_1>1,\ \beta_1^{*}=\frac{\beta}{\beta_1},\ \beta_1^{*}>1$

A5. $\square z\uparrow\alpha \rightarrow \lozenge\, (x_{11}\uparrow\beta_{1} \,\&\, x_{12}^{c} \,\&\, x_{2}\uparrow\beta_{1}^{*} \,\&\, y\uparrow\beta^{*})$

where $\alpha>1,\ \beta>1,\ \beta^{*}=\frac{\alpha}{\beta},\ \beta^{*}>1,\ \beta_1>1,\ \beta_1^{*}=\frac{\beta}{\beta_1},\ \beta_1^{*}>1$

In the same manner can be obtained a total number of 105 theorems, which can be grouped into one meta-theorem that contains all the possible cases for the growth of z in the case of product of the variables.

We can also obtain a table of restrictions which is very useful when constructing the decision support system for this particular case.

P1			Variables				Restrictions
			x_{11}	x_{12}	x_2	y	
P1.1	P1.1.1	P1.1.1.1	$\uparrow\beta_{11}$	$\uparrow\beta_{11}^{*}$	$\uparrow\beta_1^{*}$	$\uparrow\beta^{*}$	$\alpha>1,\ \beta>1,\ \frac{\alpha}{\beta}>1,\ \beta_1>1,\ \frac{\beta}{\beta_1}>1,\ \beta_{11}>1,\ \frac{\beta_1}{\beta_{11}}>1,\ \beta_{11}^{*}=\frac{\beta_1}{\beta_{11}},\ \beta_1^{*}=\frac{\beta}{\beta_1},\ \beta^{*}=\frac{\alpha}{\beta}$
		P1.1.1.2	$\uparrow\beta_{12}$	$\downarrow\frac{\beta_1}{\beta_{12}}$	$\uparrow\frac{\beta}{\beta_1}$	$\uparrow\frac{\alpha}{\beta}$	$\alpha>1,\ \beta>1,\ \frac{\alpha}{\beta}>1,\ \beta_1>1,\ \frac{\beta}{\beta_1}>1,\ \beta_{12}>1,\ \frac{\beta_1}{\beta_{12}}<1$
		P1.1.1.3	$\downarrow\beta_{13}$	$\uparrow\frac{\beta_1}{\beta_{13}}$	$\uparrow\frac{\beta}{\beta_1}$	$\uparrow\frac{\alpha}{\beta}$	$\alpha>1,\ \beta>1,\ \frac{\alpha}{\beta}>1,\ \beta_1>1,\ \frac{\beta}{\beta_1}>1,\ \beta_{13}<1,\ \beta_1\neq 0,\ \beta_{13}\neq 0,\ \frac{\beta_1}{\beta_{13}}>1$
		P1.1.1.4	-	$\uparrow\beta_1$	$\uparrow\frac{\beta}{\beta_1}$	$\uparrow\frac{\alpha}{\beta}$	$\alpha>1,\ \beta>1,\ \beta_1>1,\ \frac{\beta}{\beta_1}>1$
		P1.1.1.5	$\uparrow\beta_1$	-	$\uparrow\frac{\beta}{\beta_1}$	$\uparrow\frac{\alpha}{\beta}$	$\alpha>1,\ \beta>1,\ \frac{\alpha}{\beta}>1,\ \beta_1>1$
	P1.1.2	P1.1.2.1	$\uparrow\beta_{21}$	$\uparrow\frac{\beta_2}{\beta_{21}}$	$\uparrow\frac{\beta}{\beta_2}$	$\uparrow\frac{\alpha}{\beta}$	$\alpha>1,\ \beta>1,\ \frac{\alpha}{\beta}>1,\ \beta_2>1,\ \frac{\beta}{\beta_2}<1,\ \beta_{21}>1,\ \frac{\beta_2}{\beta_{21}}>1$
		P1.1.2.2	$\uparrow\beta_{22}$	$\downarrow\frac{\beta_2}{\beta_{22}}$	$\uparrow\frac{\beta}{\beta_2}$	$\uparrow\frac{\alpha}{\beta}$	$\alpha>1,\ \beta>1,\ \frac{\alpha}{\beta}>1,\ \beta_2>1,\ \frac{\beta}{\beta_2}<1,\ \beta_{22}>1,\ \frac{\beta_2}{\beta_{22}}<1$

Fig. 6. Part of the restrictions table

This axiomatic system can be also applied in a particular case in economics, specifically to the calculus of turnover. If we consider z=turnover (CA), x= average tariff (TM) , y= number of effective tourist days (ZT), x_1=touring capacity in function (CF), x_2= occupation grade (GO), x_{11}=operate grade (GF), x_{12}=touring built capacity (CT).

3.2 The variables used in the model

We decided to test and use the DSS in order to increase the productivity of a hotel. In order to do that, we studied the specific variables and predicted what would happen if we could change some coefficients.

The decision modeling system built uses the intelligence of a decisions support system of an invariant nature. To build a generally valid system (a formalized one) it is necessary to create an interconnected system of indicators, the advantage being that if the value of one indicator is changing, all the other values of the indicators depending on it will also automatically be changed.

The system sets the targets for three basic variables: the income resulted from hotel activities, restaurant and treatment (Vrht); the expenditure for 1000 lei income (C/1000v); the total assets (Atotale). For those base variables we used the semantic tree presented in 3.1. in order to obtain the axioms which were translated into production rules, then into subroutines. The other variables change their value depending on these base variables.

The relationship between the all the variables can be seen in figure no. 7.

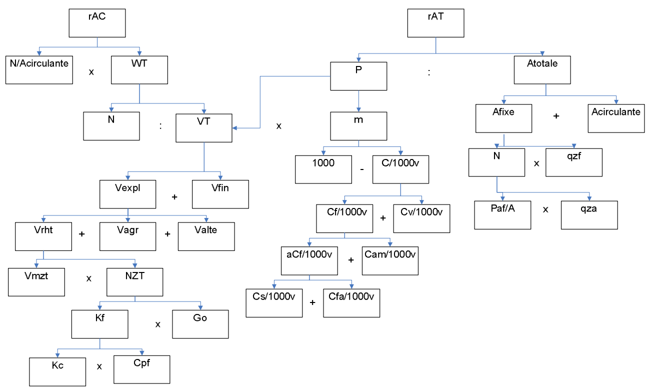

Fig. 7. The system of variables

where: Vrht = income resulting from hotel, restaurant and treatment, NZT = number of tourist days, Vmzt = average income on a tourist day, Kf = using capacity, Go = occupying level, Kc = touristic built capacity, Cpf =

putting to function coefficient, Cf/1000v = fixed expenditures for 1000 lei income, Cv/1000v = variable expenditures for 1000 lei income, aCf/1000v = fixed expenditures 1000 lei income, other than amortization, Cam/1000v = amortization expenditure for 1000 lei income, Cs/1000v = wages expenditures for 1000 lei income, Cfa/1000v = other expenditures for 1000 lei income, Afixe =fixed assets, Acirculante = circulating assets, N =average personnel number, qzf = Af/N = degree of endowment with fixed assets Af/N, paf/A = Af/Atotale = weight of fixed assets in total assets, qza = A/N = degree of endowment with total assets, Vagr = income from leisure, Valte = income from other activities, Vexpl = operating income, Vfin = financial income, VT = total income, WT = work productivity, rAC = circulating assets capitalization, P = profit, m= P/Vtotale = weighted profit, rAT = P/Atotale = total assets capitalization.

One important feature is that any intervention on a variable will be reflected on a change of values of the variables influenced by it – the system behaves in a dynamical way.

As a rationing method we used deduction (started from the bottom level, if we change the value of building capacity, how that change affects all the variables until it reaches circulating asset capitalization) and induction (eg. – setting a target for total asset capitalization, the system will determine the values for all the other variables in order to sustain that target.

3.3 The DSS

The model was created based on decision trees. We divided this complex system into several trees and built rules for each type of tree, based on the operators between the variables. For each of the three sub-modules, the application permits choosing between the following alternatives: we can set the target or we can see the history of the variables (the last three years) and follow the expert opinion. Both user's choice or the expert opinion can be corrected at any chosen moment, based on some external information.

A big advantage is the formalization of the system. That means that instead of income we can use any other variable or indicator, but the operators between the variable must remain the same.

I implemented these concepts in Microsoft Excel 2007, using Visual Basic Application – a powerful tool that uses procedures in order to control Excel's objects behavior.

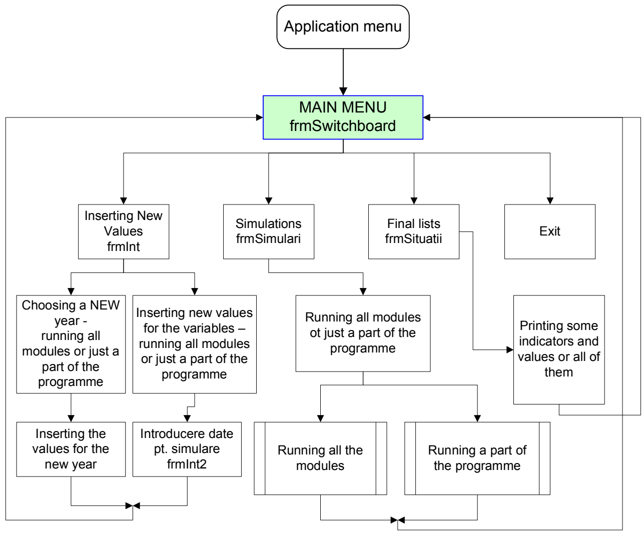

Fig. 8. The application map

The main advantage of the application is that the user can change the value of each variable, regardless the moment or the position in the main system of indicators. The results are automatically re-calculated and updated right away.

The application contains 9 sheets and 25 user forms, the interface being a visual one. The DSS is divided into four modules that permit: gathering data, simulations, printing the results and exit. Figure no. 8 presents the application map.

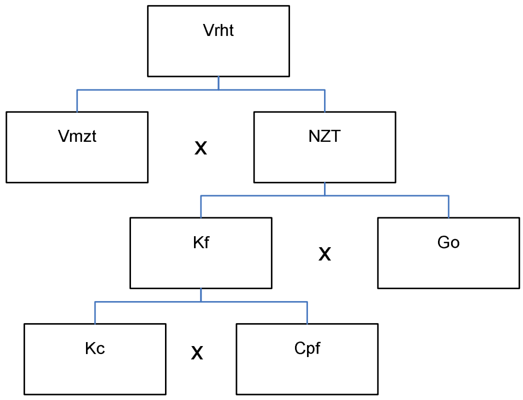

Fig. 9. The semantic tree used on Income module

We will present one of the modules, the one called Income, that is depicted in fig. no. 9.

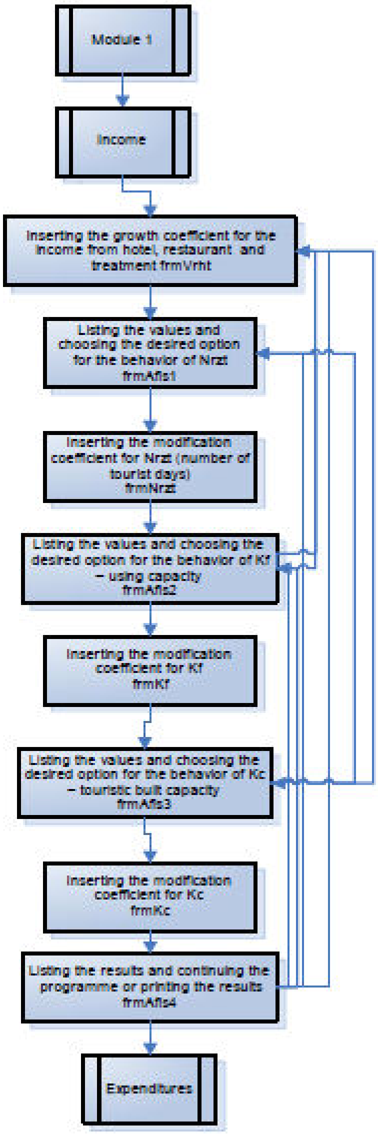

Fig. 10. Operations from the Income module

Indicators from fig. no. 9 can be translated into equation (4).

$$\begin{cases} Vrht = NZT * Vmzt \\ NZT = Kf * Go * (365/12) \\ Kf = Kc * Cpf \end{cases} \quad (4)$$

The Income module's operations are presented in fig. no. 10. First, we insert the growth coefficient for the Income resulting from hotel, restaurant and treatment, then we display the results and choose the modifying coefficient for number of tourist days, and so on, until we reach the last node of the semantic tree.

In a more detailed approach, I can display the first step of the process in fig. no. 11 – inserting the values of the actual indicators and choosing to input the growth coefficient or expect the expert opinion based on the history from the last three years.

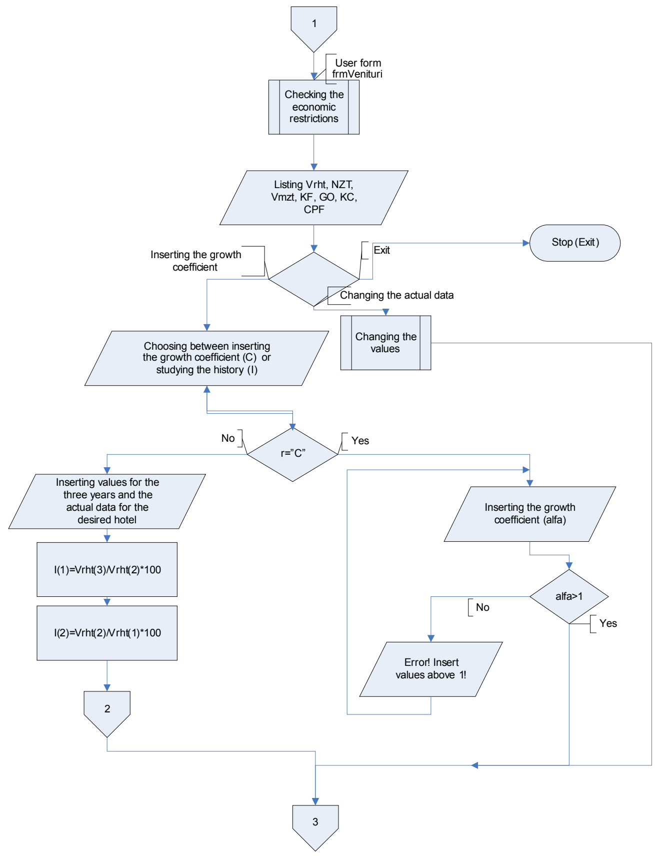

Fig. 11. The operations on the first level

I can underline some important facts regarding the Income module:

- data validations – the initial data must verify the relations (in our case, the economic relations) between the variables;
- we need to have all the necessary data in order to display the expert opinion;
- acquiring actual data on which the simulation will apply, verifying the validity of the data – the relations between variables;
- choosing a growth coefficient for the income from hotel activities, restaurant and treatment (>1) – figure no. 12;
- choosing coefficients for each of the variables that depends on the income, and the validation of the value; depending of the case choose by the user, the expert opinion should be verified;

- the user can follow the expert opinion or can insert a value based on his own opinion;
- displaying the initial values of the indicators, the coefficients to change and new calculated values;
- if the user doesn't have sufficient information, he demands supplementary data from the system;
- displaying the expert opinion based on the history of that specific indicator – figure no. 13;

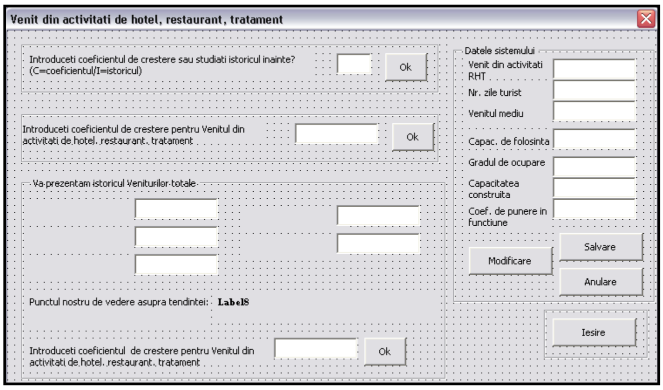

Fig. 12. frmVenituri form in design mode – choosing the growth coefficient for the income

- based on the history and some hypothesis introduced in the system by the expert, the application provides three scenarios: an optimistic one, a pessimistic one and the most probable one, suggesting the user his option;

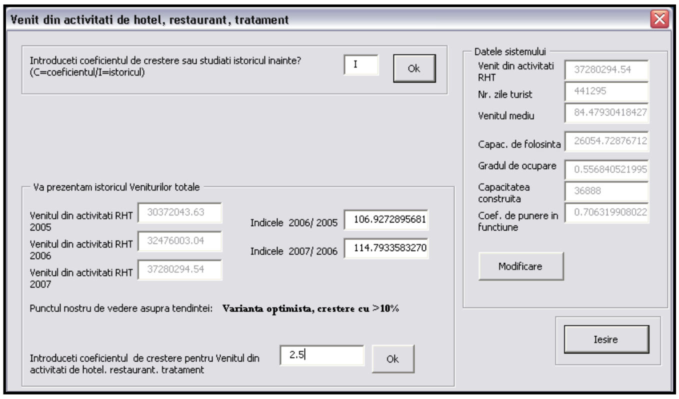

Fig. 13. The history for the Income variable

I will present the code for the OK button from the Fig. no. 13, where the user can choose between inserting the value I (History) – therefore the history indicators are calculated and the expert opinion is displayed, or C (coefficient) – accepting a coefficient independent of the expert opinion.

```
Private Sub cmdOk1_Click()
If UCase$(txtRasp.Value) = "C" Then
   Frame2.Visible = True
   Frame4.Visible = False
   txtAlfa.SetFocus
   Else
   Frame4.Visible = True
   Frame2.Visible = False
   Label1.Caption = "Venitul din activitati RHT " &
          Str(Sheets(foaie).Cells(1, 2).Value)
   Label2.Caption = "Venitul din activitati RHT " &
         Str(Sheets(foaie).Cells(1, 3).Value)
   Label3.Caption = "Venitul din activitati RHT " &
         Str(Sheets(foaie).Cells(1, 4).Value)
   Label5.Caption = "Indicele " &
         Str(Sheets(foaie).Cells(1, 3).Value) & "/" &
         Str(Sheets(foaie).Cells(1, 2).Value)
   Label6.Caption = "Indicele " &
         Str(Sheets(foaie).Cells(1, 4).Value) & "/" &
         Str(Sheets(foaie).Cells(1, 3).Value)
   txtVt1.Value = Sheets(foaie).Cells(2, 2)
   txtVt2.Value = Sheets(foaie).Cells(2, 3)
   txtVt3.Value = Sheets(foaie).Cells(2, 4)
   txtVt1.Enabled = False
   txtVt2.Enabled = False
   txtVt3.Enabled = False
   txtIvt1 = (Val(txtVt2.Value) / Val(txtVt1.Value)) * 100
   txtIvt2 = (Val(txtVt3.Value) / Val(txtVt2.Value)) * 100
   If (Val(txtIvt1.Value) > 100) And (Val(txtIvt2.Value) > 100) Then
      Label8.Caption = "Varianta optimista, crestere cu >10%"
      Else
      If (Val(txtIvt1.Value) < 100) And (Val(txtIvt2.Value) > 100) Or (Val(txtIvt1.Value) > 100) And (Val(txtIvt2.Value) < 100) Then
         Label8.Caption = "Varianta moderata, crestere cu 5-8%"
      Else
         Label8.Caption = "Varianta pesimista, crestere cu maxim 2-5%"
      End If
   End If
   txtRasp2.SetFocus
End If
End Sub
```

- the validation of the coefficient based on the expert opinion;
- the possibility of choosing any other coefficient of change for each variable, if the simulation results are not satisfactory – figure no. 14;
- displaying/printing of the information resulting after applying the algorithm.

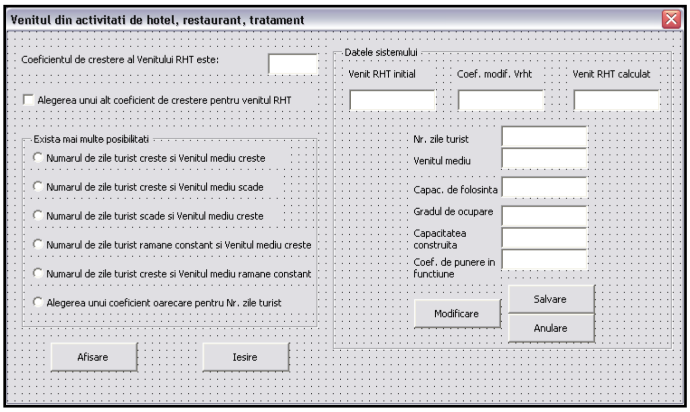

Fig. 14. All the possible alternative for this particular case

For each variable we also have a history, like in the Income case: eg. a raise in the income from hotel activities, restaurant and treatment can be sustained only by either number of tourist days, average income on a tourist day or both.

In the next figure we can see the final form of this module, the one that displays all the values and permits modifying the initial values or going back on each step of the way, to change any values that we want.

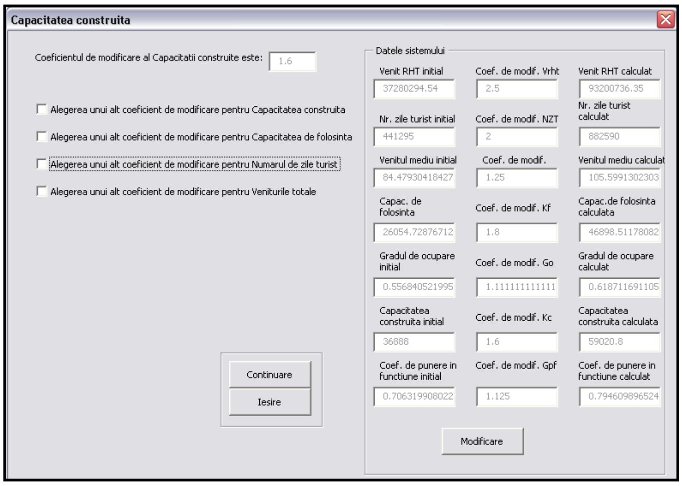

Fig. 15. Displaying the calculated values

If one of the five options of changing the number of tourist days was picked, the system uses the rules built based on axioms and provides the user with an interval in which the value should be placed, so that the specific case selected is verified. If this indication is not followed, the input is denied.

	Tinte							Coeficienti						
	Vrht*	NZT*	Vmzt*	Kf*	Go*	Kc*	Cpf*	CVrht	CNZT	CVmzt	CKf	CGo	CKc	CCpf
1	93.200.736,35	882.590,00	105,60	46.898,51	0,62	59.020,80	0,79	2,5	2	1,25	1,8	1,11	1,6	1,125
2	93.200.736,35	882.590,00	105,60	46.898,51	0,62	70.087,20	0,67	2,5	2	1,25	1,8	1,11	1,9	0,95
3	93.200.736,35	882.590,00	105,60	46.898,51	0,62	29.510,40	1,59	2,5	2	1,25	1,8	1,11	0,8	2,25
4	93.200.736,35	882.590,00	105,60	46.898,51	0,62	36.888,00	1,27	2,5	2	1,25	1,8	1,11	1	1,80
5	93.200.736,35	882.590,00	105,60	46.898,51	0,62	66.398,40	0,71	2,5	2	1,25	1,8	1,11	1,8	1,00
6	93.200.736,35	882.590,00	105,60	54.714,93	0,53	73.776,00	0,74	2,5	2	1,25	2,1	0,95	2	1,05
7	93.200.736,35	882.590,00	105,60	54.714,93	0,53	81.153,60	0,67	2,5	2	1,25	2,1	0,95	2,2	0,95
8	93.200.736,35	882.590,00	105,60	54.714,93	0,53	33.199,20	1,65	2,5	2	1,25	2,1	0,95	0,9	2,33
9	93.200.736,35	882.590,00	105,60	54.714,93	0,53	36.888,00	1,48	2,5	2	1,25	2,1	0,95	1	2,10
10	93.200.736,35	882.590,00	105,60	54.714,93	0,53	77.464,80	0,71	2,5	2	1,25	2,1	0,95	2,1	1,00
11	93.200.736,35	882.590,00	105,60	23.449,26	1,24	35.043,60	0,67	2,5	2	1,25	0,9	2,22	0,95	0,95
12	93.200.736,35	882.590,00	105,60	23.449,26	1,24	29.510,40	0,79	2,5	2	1,25	0,9	2,22	0,8	1,13
13	93.200.736,35	882.590,00	105,60	23.449,26	1,24	40.576,80	0,58	2,5	2	1,25	0,9	2,22	1,1	0,82
14	93.200.736,35	882.590,00	105,60	23.449,26	1,24	36.888,00	0,64	2,5	2	1,25	0,9	2,22	1	0,90
15	93.200.736,35	882.590,00	105,60	23.449,26	1,24	33.199,20	0,71	2,5	2	1,25	0,9	2,22	0,9	1,00
16	93.200.736,35	882.590,00	105,60	26.054,73	1,11	44.265,60	0,59	2,5	2	1,25	1	2,00	1,2	0,83
17	93.200.736,35	882.590,00	105,60	26.054,73	1,11	29.510,40	0,88	2,5	2	1,25	1	2,00	0,8	1,25
18	93.200.736,35	882.590,00	105,60	26.054,73	1,11	36.888,00	0,71	2,5	2	1,25	1	2,00	1	1,00
19	93.200.736,35	882.590,00	105,60	52.109,46	0,56	36.888,00	1,41	2,5	2	1,25	2	1,00	1	2,00
20	93.200.736,35	882.590,00	105,60	52.109,46	0,56	36.888,00	1,41	2,5	2	1,25	2	1,00	1	2,00
21	93.200.736,35	882.590,00	105,60	52.109,46	0,56	36.888,00	1,41	2,5	2	1,25	2	1,00	1	2,00
22	93.200.736,35	882.590,00	105,60	52.109,46	0,56	36.888,00	1,41	2,5	2	1,25	2	1,00	1	2,00
23	93.200.736,35	882.590,00	105,60	52.109,46	0,56	36.888,00	1,41	2,5	2	1,25	2	1,00	1	2,00
24	93.200.736,35	1.191.496,50	78,22	67.742,29	0,58	88.531,20	0,77	2,5	2,7	0,93	2,6	1,04	2,4	1,08
25	93.200.736,35	1.191.496,50	78,22	67.742,29	0,58	99.597,60	0,68	2,5	2,7	0,93	2,6	1,04	2,7	0,96
26	93.200.736,35	1.191.496,50	78,22	67.742,29	0,58	33.199,20	2,04	2,5	2,7	0,93	2,6	1,04	0,9	2,89

Fig. 16. Results for different targets for the Income module

For the Income module I tested the programme on each of the 105 possibilities, presenting in fig. no. 16 some of them.

Finally – taking into account the organization specificity and the management point of view we chose six possible alternatives presented in Fig. no. 17.

					[illegible]					
	UM	2005	2006	2007	V1	V2	V3	V4	V5	V6
Venit din activitati hoteliere, restaurant, tratament (Vrht)	Lei	30.372.043,63	32.476.003,04	37.280.294,54	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Numar zile turist (Nzt)	Zile turist	458.652,00	447.957,00	441.295,00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Venit mediu pe zi turist (Vmzt)	Lei	66,22	72,50	84,48	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Capacitatea de folosinţă (Kf)	x	30.242,89	27.645,67	26.054,73	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Gradul de ocupare % (Go)	%	49,86%	53,27%	55,68%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Capacitatea construita (Kc)	x	37.656,00	37.656,00	36.888,00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Coeficientul de punere in functiune % (Cpf)	%	80,31%	73,42%	70,63%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cheltuieli la 1000 lei (C/1000v)	Lei	804,87	817,20	828,79	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cheltuieli fixe la 1000 lei (Cf/1000v)	Lei	549,86	561,90	551,36	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cheltuieli variabile la 1000 lei (Cv/1000v)	Lei	255,01	255,30	277,42	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Alte Cheltuieli fixe la 1000 lei (aCf/1000v)	Lei	482,14	498,12	469,82	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cheltuieli cu amortizarea la 1000 lei (Cam/1000v)	Lei	67,72	63,78	81,54	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cheltuieli cu salarii la 1000 lei (Cs/1000v)	Lei	308,26	324,60	319,00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cheltuieli fixe rămase la 1000 lei (Cfa/1000v)	Lei	173,89	173,52	150,82	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Active totale (AT)	Lei	92.929.393,00	177.156.309,00	181.457.027,00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Active fixe (Af)	Lei	77.198.070,00	152.456.601,00	169.480.220,00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Active circulante (Ac)	Lei	15.731.322,00	24.699.708,00	11.976.807,00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Grad de inzestrare cu active fixe (qzf)	Lei	92.452,78	192.010,83	200.568,31	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Numar mediu personal (N)	Nr	835	794	845	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ponderea activelor fixe in activul total (pafA)	%	83,07%	86,06%	93,40%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Grad de inzestrare cu active totale (qza)	x	111.292,69	223.118,78	214.742,04	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Venituri din activitati de agrement (Vagr)	Lei	2.024.365,87	2.523.431,73	3.306.312,77	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Venituri din alte activitati (Valte)	Lei	3.616.581,99	4.668.620,98	4.291.235,25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Venituri din exploatare (Vexp)	Lei	36.012.991,49	39.668.055,75	44.877.842,56	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Venituri financiare (Vfin)	Lei	322.342,38	624.735,08	3.040.274,90	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Venituri totale (VT)	Lei	36.335.333,87	40.292.790,83	47.918.117,46	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Productivitatea muncii (WT)	Lei/salariat	43.515,37	50.746,59	56.707,83	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rentabilitatea activelor circulante (rAC)	Lei profit/lei active	2,31	1,63	4,00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Marja de profit (m)	%	19,51%	18,28%	17,12%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Profit (P)	Lei	7.090.116,97	7.365.471,80	8.204.226,21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rentabilitatea activelor totale (rAT)	Lei profit/lei active	0,08	0,04	0,05	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					Pesimist	Pesimist	Pesimist	Cel mai probabil	Cel mai probabil	Optimist

Fig. 17. Possible alternatives – predictions for 2011

My application is one universally valid regardless of the considered variables. The only condition is that the relation between variables to be one of sum, product, diference or division. The user can make any predictions for growth or decrease coefficients associated to the variables.

Sometimes we can come across a situation in which variable expenditure for 1000 lei income to be negative, occupying level to be more than 100%, etc. Therefore, before making a selection of the alternatives to be considered, we have to apply the validity test, that includes among other rules: income, number of tourist days can't be negative, occupying level has to be more than zero and less or equal to 100, etc.

If from these resulted alternatives this situation occur, we consider them, from an economical point of view, nonfesible, and consequently we do not take them into consideration.

4 Conclusions

Information systems studies are at the confluence of many domains – information technologies, management, accounting, designing, analysis, organizational culture, constituting a real challenge for those who wish to grasp it.

In the future economy, a knowledge-based economy, decision support systems (DDS) are very rigorous and precise, if the hypothesis is well grounded. An important direction of research is simulation of specialist thinking based on a Knowledge Based Systems (KBS). The evolution of DDS and KBS depends on the evolution of knowledge representation. Even though the researches in economic knowledge representation are in progress, the cases in which the theory is put into practice are very rare, and of limited complexity. An evolved KBS must incorporate knowledge pieces capable of explaining the economic phenomenon in all it's complexity. In the near future not only the problem of rational, conscious knowledge will be a problem, but the one of unconscious knowledge based on intuition and imagination. All of these will be a support for the development of economic axiomatic systems.

Modern organizations worldwide are slowly discovering that controlling knowledge is a major component for strategic growth and creating a competitive organization.

Managers usually use formal information systems for tasks like: planning, organizing, coordinating activities and inter-personal communications, building networks inside the organization and establishing or executing daily personal tasks. Therefore, these systems are not used in purposes that reflect their motivation, but they are destined to solve multiple tasks. The designers of information systems must create systems that can process more general information. Using a formal model, generalizing the system, we offered a framework for applying our application in any field that fulfills some requirements.

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References:

[1] Băileşteanu, Gh., Logică economică – Editura Mirton, Timişoara, 2004;

[2] Băileşteanu, Gh., Semiotica economică – Editura Mirton, Timişoara, 2005;

[3] Băileşteanu Gh., Mogoşanu (Târnăveanu) D. – Knowledge representation - a premise for decision axiomatization, Scientific bulletin of the West University of Timisoara, Faculty of Economical Sciences, Series: Management theory and practice, IIIrd year, 2006, no.3;

[4] Brândaş C. – Sisteme suport de decizie pentru managementul performant. Concepere, proiectare şi implementare, Editura Brumar, Timişoara, 2007

[5] Filip F. – Sisteme suport pentru decizii, Editura Tehnică, Bucureşti, 2007;

[6] Firu L. – Diagnosticul şi strategia de dezvoltare a turismului balnear în România, Editura Mirton, Timişoara, 2006;

[7] Ghilic-Micu, B., Stoica, M., Mircea, M., *How to Succed in Business Intelligence Initiative: A Case Study for Acquisitions in Romanian Public Institutions*, WSEAS Transactons on Business and Economics, ISSN 1109-9526, Issue 6, Volume 5, June 2008

[8] M. Martensson, A critical review of knowledge management as a management tool. *Journal of Knowledge Management*, Vol.4, No.3, 2000, pp.204-216;

[9] Muntean, M., Muntean, C., *Collaborative Environments – A Framework for Business Intelligence*, WSEAS Transactions on Business and Economics, ISSN 1109-9526, Issue 8, Volume 3, August 2006;

[10] Mihaela I. Muntean, Diana A. Târnăveanu – Information Technology & Organizational Knowledge Management, 13th WSEAS International Conference on COMPUTERS (CSCC '09), Rodos, Greece, July 23-25, 2009, p. 335-339;

[11] Mihaela I. Muntean, Diana Târnăveanu – Some Considerations About Collaborative Systems Supporting Knowledge Management in Organizations, WSEAS TRANSACTIONS on COMPUTERS, Issue 8, Volume 8, August 2009, p. 1378-1387;

[12] Mogoşanu (Târnăveanu) D**.**, Dănăiaţă D. – Electronic Knowledge Networks, *International Workshop in Collaborative Systems*, Annals of the Tiberiu POPOVICIU – Seminar of Functional Equations, Approximation and Convexity, vol.IV, Mediamira Science Publisher, Cluj-Napoca, 2006;

[13] Massimo Paolucci, Roberto Revetria, Flavio Tonelli – An Agent-based System for Sales and Operations Planning in Manufacturing Supply Chains, WSEAS TRANSACTIONS on BUSINESS and ECONOMICS, Issue 3, Volume 5, March 2008;

[14] Tacu P. Alexandru, Vancea R., Holan Ş., Burciu A. – *Inteligenţa artificială. Teorie şi aplicaţii în economie,* Editura Economică, 1998, pag. 209

[15] Târnăveanu Diana – Axiomatization – a fundament for Decision Support System in Tourism, The 3rd WSEAS International Conference on CULTURAL HERITAGE and TOURISM (CUHT '10), Corfu, Greece, July 23-25, 2010, p. 78-83;

[16] Târnăveanu Diana – Knowledge and axiomatization, Ed. Mirton, Timişoara, 2007;
[17] Turban E., Aronson J., Liang T.P. Sharda R. – Decision Support and Business Intelligence Systems, Eighth edition, Pearson Prentice Hall , New Jersey, 2007;
[18] N. Vlahovic, Discovering Tacit Knowledge in Business Decision Making. WSEAS TRANSACTIONS on BUSINESS and ECONOMICS, Vol.4, No.5, 2008, pp.58-63;
[19] M.C. Voicu - Algorithms used to obtain aggregated value sets from relational databases, 9th WSEAS International Conference on MATHEMATICS & COMPUTERS IN BUSINESS &ECONOMICS (MCBE '08), Bucharest, Romania, June 24-26, 2008, p.209-221;
[20] Voicu Mirela-Catrinel, Bânciu Andreea, Dragota Mihai, Turcu Raul - Study on Residential Assemblies. Database and Algorithms - The Proceedings of the 10th WSEAS Int. Conf. on MATHEMATICS AND COMPUTERS IN BUSINESS AND ECONOMICS (MCBE '09), Prague, Czech Republic, March 23-25, 2009, p. 159-164;
[21] Zaharia M. Cârstea C, Sălăgean L – *Inteligența artificială şi sistemele expert în asistarea deciziilor economice*, Editura Economică, Bucureşti, 2003, pag. 59-60;
[22] Wei-Wen Wu – Discovering KM Features of High-Performance Companies, WSEAS TRANSACTIONS on BUSINESS and ECONOMICS, Issue 10, Volume 5, October 2008, p.481-486.