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OPTIMIZATION OF MULTI-CRITERIA DECISIONS THROUGH CONQUEST - AN INTEGRATED SOFTWARE APPLICATION APPLIED IN ECONOMICS

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Abstract: This paper present the mechanism created by us to help manager in process of taking decision based on different factors. Some of these factors can be define by the user, without any help from accounting department, because conQuest is an integrated software application, applied in economics, developed by the authors of this paper during the last 7 years. This paper is based on the concept of integration of two primary tool: one used for extracting data from applications database, and the other used for analyzing these data. We present a real example in which we can take a multi-criteria decision in less than 20 seconds, analyzing 74912 records from application database.

1. INTRODUCTION:

In this paper we will present a business intelligence tool which can help manager, in taking decision based on different factors. conQuest is an integrated client server application for accounting, stock management, production, payments and so on. One of our tasks consists of helping manager in taking decision, based on the existing data from the database, which was entered by the users. The manager can define his own factors which will be considered in the process of taking decision.

To do this tool we have to create the mechanism of writing and evaluation of expression, and the mechanism of decision support.

We have to develop some functions which can be used to calculate different factors. These functions can calculate the period of time which was spent by a worker with a tool to do a task, or can calculate the costs of a process, the amount consumed by a specified entity from products and so on.

2. SECTION:

Microsoft Excel permits the evaluation of different kind of expression which contains subtractions, additions and other operations and functions. These functions are categorized in financial, mathematical, and statistical and so on. Because advanced users are very familiar with excel like expression building, we created similar functions for text processing, mathematical calculations, and most importantly functions that can extract data from a database, evaluate the results and display them. Also, we offered the possibility to create custom indexes and functions based on predefined ones. This tool is localized in the accounting, stock management and management module.

We have created a new set of functions for retrieving data from database:

SumValConsEntGrupe(Entity[,AccountingGroup[,Warehouse[,StartMonth[,StartYear[,EndMonth[,EndYear[,Entity2]]]]]]])

- The function is used to retrieve the value consumed by a specified entity (vehicle, land field, building etc.) from products that belong to a specified accounting group

SumValConsEntProdus(Entity[,Product[,Warehouse[,StartMonth[,StartYear[,EndMonth[,EndYear[,Entity2]]]]]]])

- The function is used to retrieve the value consumed by a specified entity from a specified product

SumCantConsEntGrupe(Entity[,AccountingGroup[,Warehouse[,StartMonth[,StartYear[,EndMonth[,EndYear[,Entity2]]]]]]])

- The function is used to retrieve the amount consumed by a specified entity from products that belong to a specified accounting group

SumCanConsEntProdus(Entity[,Product[,Warehouse[,StartMonth[,StartYear[,EndMonth[,EndYear[,Entity2]]]]]]])

- The function is used to retrieve the amount consumed by a specified entity from a certain product

RapValConsEntGrupe(Entity[,AccountingGroup1[,AccountingGroup2[,Warehouse[,StartMonth[,StartYear[,EndMonth[,EndYear[,Entity2]]]]]]])

- The function is used to retrieve the ratio of the value consumed by a specified entity from products that belong to AccountingGroup1 compared to the value consumed by the same entity from products that belong to AccountingGroup2;
- Its result is different from $\frac{SumValConsEntGrupe(,AccountingGroup1,)}{SumValConsEntGrupe(,AccountingGroup2,)}$ because it compares only those consumptions that take place on the same document from the specified groups.

RapValConsEntProdus(Entity[,Product1[,Product2[,Warehouse[,StartMonth[,StartYear[,EndMonth[,EndYear[,Entity2]]]]]]])

- The function is used to retrieve the ratio of the value consumed by a specified entity from Product1 compared to the value consumed by the same entity from Product2;

RapCantConsEntGrupe(Entity[,AccountingGroup1[,AccountingGroup2[,Warehouse[,StartMonth[,StartYear[,EndMonth[,EndYear[,Entity2]]]]]]])

- The function is used to retrieve the ratio of the amount consumed by a specified entity (vehicle, land field, building etc.) from products that belong to AccountingGroup1 compared to the amount consumed by the same entity from products that belong to AccountingGroup2;

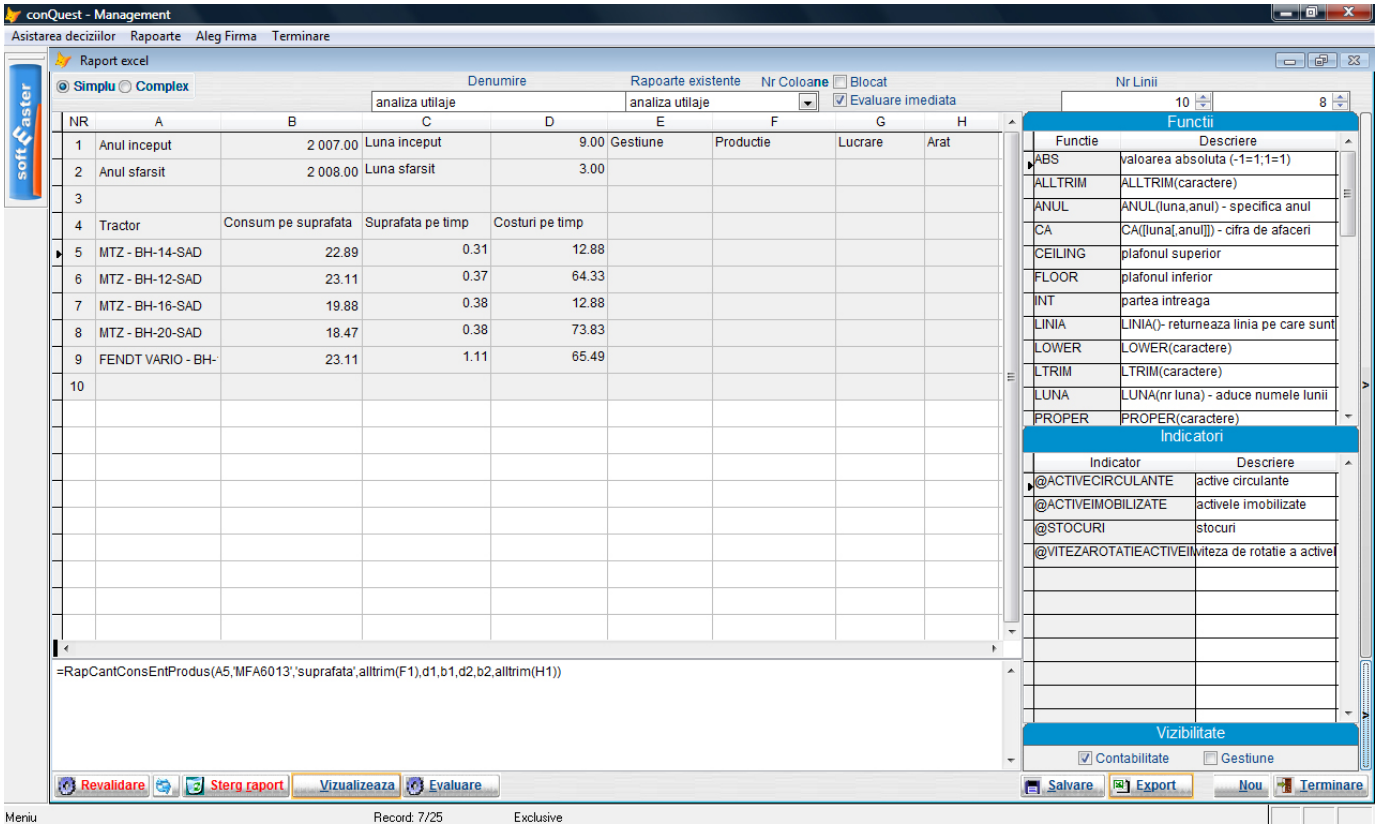
RapValConsEntProdus(Entity[,Product1[,Product2[,Warehouse[,StartMonth[,StartYear[,EndMonth[,EndYear[,Entity2]]]]]]])

- The function is used to retrieve the ratio of the value consumed by a specified entity from Product1 compared to the value consumed by the same entity from Product2;

RapCantConsEntProdus(Entity[,Product1[,Product2[,Warehouse[,StartMonth[,StartYear[,EndMonth[,EndYear[,Entity2]]]]]]])

- The function is used to retrieve the ratio of the amount consumed by a specified entity from Product1 compared to the amount consumed by the same entity from Product2;

We also can use mathematical functions like:ABS(),INT(),ROUND()…
The first tool which is used for extracting data from the database looks like: (Fig. 1)



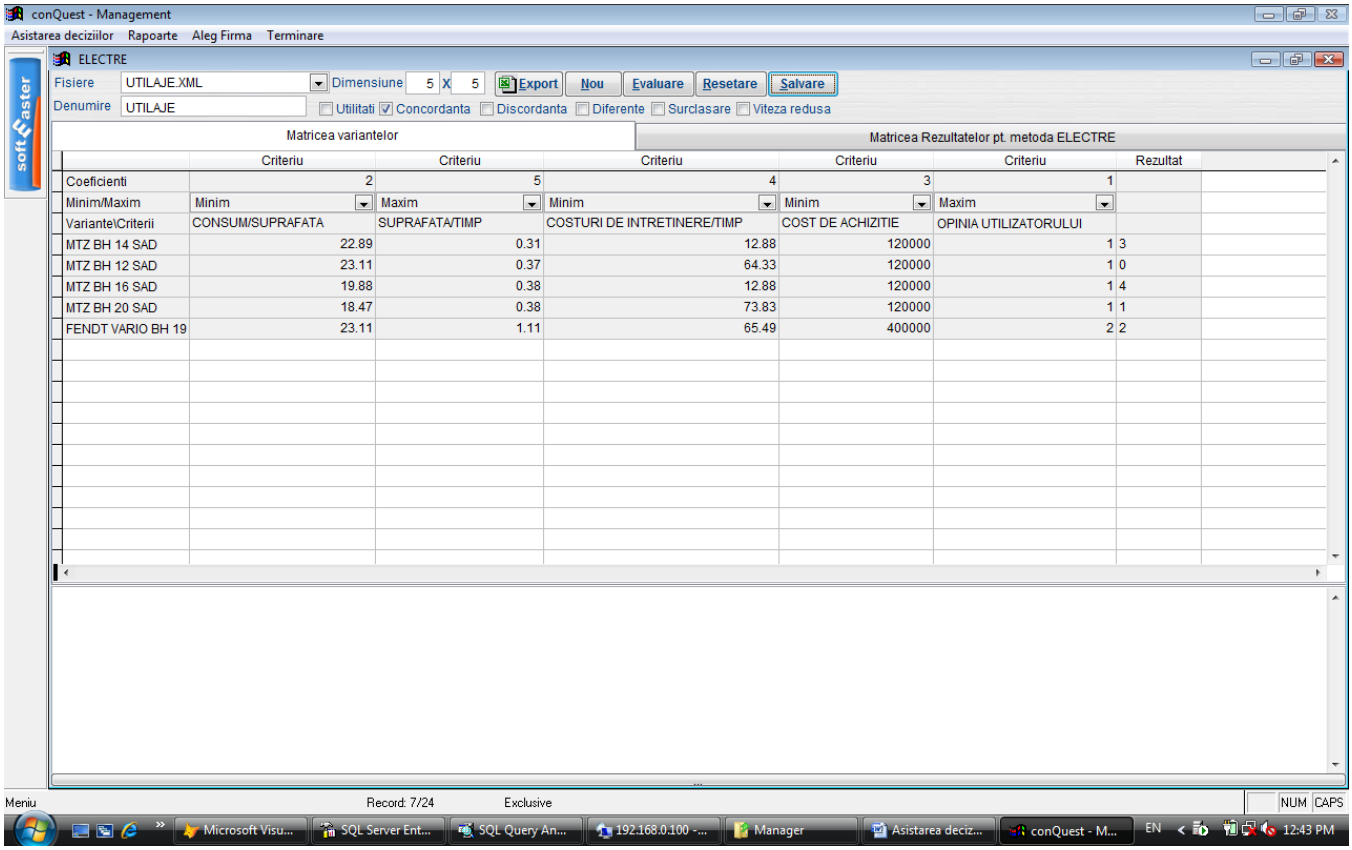
In theory and in practice, the decision represents the central point in management as it is found in all management – related activities and functions. To decide means to choose from many variants of action the one which is considered to be the most proper for attaining certain objectives, and to take into consideration several criteria while performing this activity.

Considering the knowledge of the environment by the decisional factor and the variables that influence the potential results, decisions are divided into the following categories: the ones taken in circumstances of certainty, the ones taken in circumstances of uncertainty and risk.

In the process of rationalizing decisions, in circumstances of certainty, methods such as the Global Utility Method, the ELECTRE Method and so on.

The first step in tackling the methods of decision optimization in the case of decisions taken in circumstances of certainty is the realization of the utility matrix starting from the economic consequences matrix (criteria (minimum / maximum), variants, importance values).

The second step was the creation of an interface used for the process of taking decisions. (Fig. 2)



With the help of this interface, the user will have the possibility to establish the number of criteria, the importance value associated with them, whether a certain criterion is minimum or maximum, and also the number of variants and the corresponding economic consequences. All these data can be saved in an XML file, which can then be used for remaking the calculations.

By pressing the Assessment button, the utility matrix, the concordance and discordance values, the subsequent matrix resulted from comparing these values and the display of results are all automatically calculated.

First Step

Utilities matrix calculations

Column: 1

Minimal value: 18.4700

Maximal value: 23.1100

U11= 1 - (22.8900 - 18.4700)/(23.1100 - 18.4700)

U21= 1 - (23.1100 - 18.4700)/(23.1100 - 18.4700)

U31= 1 - (19.8800 - 18.4700)/(23.1100 - 18.4700)

U41= 1 - (18.4700 - 18.4700)/(23.1100 - 18.4700)

U51= 1 - (23.1100 - 18.4700)/(23.1100 - 18.4700)

Column: 2

Minimal value: 0.3100

Maximal value a: 1.1100

U12=(0.3100 - 0.3100)/(1.1100 - 0.3100)

U22=(0.3700 - 0.3100)/(1.1100 - 0.3100)

U32=(0.3800 - 0.3100)/(1.1100 - 0.3100)
U42=(0.3800 - 0.3100)/(1.1100 - 0.3100)
U52=(1.1100 - 0.3100)/(1.1100 - 0.3100)
Column: 3
Minimal value: 12.8800
Maximal value: 73.8300
U13= 1 - (12.8800 - 12.8800)/(73.8300 - 12.8800)
U23= 1 - (64.3300 - 12.8800)/(73.8300 - 12.8800)
U33= 1 - (12.8800 - 12.8800)/(73.8300 - 12.8800)
U43= 1 - (73.8300 - 12.8800)/(73.8300 - 12.8800)
U53= 1 - (65.4900 - 12.8800)/(73.8300 - 12.8800)
Column: 4
Minimal value: 120000.0000
Maximal value: 120000.0000
U14= 1 - (120000.0000 - 120000.0000)/(120000.0000 - 120000.0000)
U24= 1 - (120000.0000 - 120000.0000)/(120000.0000 - 120000.0000)
U34= 1 - (120000.0000 - 120000.0000)/(120000.0000 - 120000.0000)
U44= 1 - (120000.0000 - 120000.0000)/(120000.0000 - 120000.0000)
U54= 1 - (120000.0000 - 120000.0000)/(120000.0000 - 120000.0000)
Column: 5
Minimal value: 1.0000
Maximal value: 2.0000
U15=(1.0000 - 1.0000)/(2.0000 - 1.0000)
U25=(1.0000 - 1.0000)/(2.0000 - 1.0000)
U35=(1.0000 - 1.0000)/(2.0000 - 1.0000)
U45=(1.0000 - 1.0000)/(2.0000 - 1.0000)
U55=(2.0000 - 1.0000)/(2.0000 - 1.0000)
****

The Second Step
Calculation of concordance coefficients

Concordance coefficient C[1,2] = (2.0000 + 4.0000 + 3.0000 + 1.0000)/ 15.0000
Concordance coefficient C[2,1] = 1- (2.0000 + 4.0000 + 3.0000 + 1.0000)/ 15.0000
Concordance coefficient C[1,3] = (4.0000 + 3.0000 + 1.0000)/ 15.0000
Concordance coefficient C[3,1] = 1- (4.0000 + 3.0000 + 1.0000)/ 15.0000
Concordance coefficient C[1,4] = (4.0000 + 3.0000 + 1.0000)/ 15.0000
Concordance coefficient *C[4,1] = 1- (4.0000 + 3.0000 + 1.0000)/ 15.0000*
Concordance coefficient C[1,5] = (2.0000 + 4.0000 + 3.0000)/ 15.0000
Concordance coefficient C[5,1] = 1- (2.0000 + 4.0000 + 3.0000)/ 15.0000
Concordance coefficient C[2,3] = (3.0000 + 1.0000)/ 15.0000
Concordance coefficient C[3,2] = 1- (3.0000 + 1.0000)/ 15.0000
Concordance coefficient C[2,4] = (4.0000 + 3.0000 + 1.0000)/ 15.0000
Concordance coefficient C[4,2] = 1- (4.0000 + 3.0000 + 1.0000)/ 15.0000
Concordance coefficient C[2,5] = (2.0000 + 4.0000 + 3.0000)/ 15.0000
Concordance coefficient C[5,2] = 1- (2.0000 + 4.0000 + 3.0000)/ 15.0000

Concordance coefficient C[3,4] = (5.0000 + 4.0000 + 3.0000 + 1.0000)/ 15.0000
Concordance coefficient C[4,3] = 1- (5.0000 + 4.0000 + 3.0000 + 1.0000)/ 15.0000
Concordance coefficient C[3,5] = (2.0000 + 4.0000 + 3.0000)/ 15.0000
Concordance coefficient C[5,3] = 1- (2.0000 + 4.0000 + 3.0000)/ 15.0000
Concordance coefficient C[4,5] = (2.0000 + 3.0000)/ 15.0000
Concordance coefficient C[5,4] = 1- (2.0000 + 3.0000)/ 15.0000
****

The Third Step
Calculation of discordance coefficients
Maximum ecarts: 1

Discordance coefficient D[1,2]= (MAX(|0.0000-0.0750| ,|0.0000-0.0000| ,|0.0000-0.0000|))/ 1.0000
Discordance coefficient D[1,3]= (MAX(|0.0474-0.6961| ,|0.0000-0.0875| ,|1.0000-1.0000| ,|0.0000-0.0000| ,|0.0000-0.0000|))/ 1.0000
Discordance coefficient D[1,4]= (MAX(|0.0474-1.0000| ,|0.0000-0.0875| ,|0.0000-0.0000| ,|0.0000-0.0000|))/ 1.0000
Discordance coefficient D[1,5]= (MAX(|0.0000-1.0000| ,|0.0000-0.0000| ,|0.0000-1.0000|))/ 1.0000
Discordance coefficient D[2,1]= (MAX(|0.0000-0.0474| ,|0.1559-1.0000| ,|0.0000-0.0000| ,|0.0000-0.0000|))/ 1.0000
Discordance coefficient D[2,3]= (MAX(|0.0000-0.6961| ,|0.0750-0.0875| ,|0.1559-1.0000| ,|0.0000-0.0000| ,|0.0000-0.0000|))/ 1.0000
Discordance coefficient D[2,4]= (MAX(|0.0000-1.0000| ,|0.0750-0.0875| ,|0.0000-0.0000| ,|0.0000-0.0000|))/ 1.0000
Discordance coefficient D[2,5]= (MAX(|0.0000-0.0000| ,|0.0750-1.0000| ,|0.0000-0.0000| ,|0.0000-1.0000|))/ 1.0000
Discordance coefficient D[3,1]= (MAX(|1.0000-1.0000| ,|0.0000-0.0000| ,|0.0000-0.0000|))/ 1.0000
Discordance coefficient D[3,2]= (MAX(|0.0000-0.0000| ,|0.0000-0.0000|))/ 1.0000
Discordance coefficient D[3,4]= (MAX(|0.6961-1.0000| ,|0.0875-0.0875| ,|0.0000-0.0000| ,|0.0000-0.0000|))/ 1.0000
Discordance coefficient D[3,5]= (MAX(|0.0875-1.0000| ,|0.0000-0.0000| ,|0.0000-1.0000|))/ 1.0000
Discordance coefficient D[4,1]= (MAX(|0.0000-1.0000| ,|0.0000-0.0000| ,|0.0000-0.0000|))/ 1.0000
Discordance coefficient D[4,2]= (MAX(|0.0000-0.1559| ,|0.0000-0.0000| ,|0.0000-0.0000|))/ 1.0000
Discordance coefficient D[4,3]= (MAX(|0.0875-0.0875| ,|0.0000-1.0000| ,|0.0000-0.0000| ,|0.0000-0.0000|))/ 1.0000
Discordance coefficient D[4,5]= (MAX(|0.0875-1.0000| ,|0.0000-0.1368| ,|0.0000-0.0000| ,|0.0000-1.0000|))/ 1.0000
Discordance coefficient D[5,1]= (MAX(|0.0000-0.0474| ,|0.1368-1.0000| ,|0.0000-0.0000|))/ 1.0000

Discordance coefficient D[5,2]= (MAX(|0.0000-0.0000| ,|0.1368-0.1559| ,|0.0000-0.0000|))/ 1.0000
Discordance coefficient D[5,3]= (MAX(|0.0000-0.6961| ,|0.1368-1.0000| ,|0.0000-0.0000|))/ 1.0000
Discordance coefficient D[5,4]= (MAX(|0.0000-1.0000| ,|0.0000-0.0000|))/ 1.0000
****

The Fourth Step
Calculation of differences between concordance and discordance coefficient

Difference C12-D12 = 0.5917
Difference C13-D13 = -0.1154
Difference C14-D14 = -0.4193
Difference C15-D15 = -0.4000
Difference C21-D21 = -0.5108
Difference C23-D23 = -0.5774
Difference C24-D24 = -0.4667
Difference C25-D25 = -0.4000
Difference C31-D31 = 0.4667
Difference C32-D32 = 0.7333
Difference C34-D34 = 0.5628
Difference C35-D35 = -0.4000
Difference C41-D41 = -0.5333
Difference C42-D42 = 0.3108
Difference C43-D43 = -0.8667
Difference C45-D45 = -0.6667
Difference C51-D51 = -0.4632
Difference C52-D52 = 0.3809
Difference C53-D53 = -0.4632
Difference C54-D54 = -0.3333
****

The Fifth Step
Calculation of under classification matrix

Verifying Dif[1,2] > DIF[2,1] Yes
Verifying Dif[1,3] > DIF[3,1] No
Verifying Dif[1,4] > DIF[4,1] Yes
Verifying Dif[1,5] > DIF[5,1] Yes
Verifying Dif[2,1] > DIF[1,2] No
Verifying Dif[2,3] > DIF[3,2] No
Verifying Dif[2,4] > DIF[4,2] No
Verifying Dif[2,5] > DIF[5,2] No
Verifying Dif[3,1] > DIF[1,3] Yes
Verifying Dif[3,2] > DIF[2,3] Yes
Verifying Dif[3,4] > DIF[4,3] Yes
Verifying Dif[3,5] > DIF[5,3] Yes
Verifying Dif[4,1] > DIF[1,4] No

Verifying Dif[4,2] > DIF[2,4] Yes
Verifying Dif[4,3] > DIF[3,4] No
Verifying Dif[4,5] > DIF[5,4] No
Verifying Dif[5,1] > DIF[1,5] No
Verifying Dif[5,2] > DIF[2,5] Yes
Verifying Dif[5,3] > DIF[3,5] No
Verifying Dif[5,4] > DIF[4,5] Yes
****

The Sixth Step
Displaying the results in which MTZ BH 16 SAD was the best choice.

Conclusions:

This tool which was created by using the Electre method for optimization multi-criteria decisions which can help manager to take the best decision based on the data from databases.

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