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RESEARCH PROJECT SUMMARY: DEVELOPMENT OF INNOVATIVE BUSINESS RISK ESTIMATION MODELS TO SUPPORT «CRITICAL» OPERATIONAL BUSINESS DECISIONS

All known business intelligence systems that are available in the Greek and International market focus more on the comparative interpretation and evaluation of corporate financial data of a business unit. These data can be presented in the form of indices, tables, graphs, dash boards, chronological series and etc. Prediction, if exists, is an estimation based mainly on historical data (e.g. using statistical methods based on techniques like time series analysis).

This presentation helps to get a better picture of a business unit to focus on the causes of potential problems and to more accurately predict future trends but does not give us ways (tools) to focus on the uncertainty (and model it) which lay the various risks faced by each business / production unit.

The purpose of this project is to design methods and / or tools that will support a business unit to make the appropriate decisions for its mid or long term planning, timely, and to most accurately assess the various risks it will encounter in order o implement with success its business and financial policy. The difficulty of the task is due to its underlying uncertainty, and that factors that affect a risk are many and different per type of risk. Examples of different types of risks are the following:

- Market Risk (Market Risk)
- Credit Risk (Credit Risk)
- Liquidity Risk (Liquidity Risk)
- Operational Risk (Operational Risk)

Project Summary:

TWIN NET has significant experience, of more than 20 years, and know-how, in the analysis and implementation of integrated enterprise information systems (ERPs) with a specialty in the implementation of decision support systems and data analysis.

After an extensive literature study (see. P1.1 & P1.2) and based on the above considerable expertise of our company, we defined the main project work as follows:

1. We reduced the representation of all the risks that are likely to come across a business unit to the Business holistic Cash Flow. The positive cash flows of a business unit can be likened to the smooth blood circulation within an organization. Companies are failing not because they have not profits for one year, but because they lack liquidity.

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2. This way we reduced a multi-dimensional problem, regarding the nature and sources of a risk, to a one dimension problem as of the consequences of those risks (consequences that are reflected in the Company's holistic Cash Flow).

3. The holistic Cash Flow is a set of events distributed over time (in the x-axis) whose value (in the y-axis) is the expected in or out flow cash value of the company. To compute the Holistic cash flow of a company we have to take into account all possible sources of cash inflows and outflows (for example, invoices, orders, forecasts etc).

4. We correlated the risk (or risks) with the uncertainty as to when the specific inflow or outflow event will take place. Thus in each expected inflow or outflow event, the user can define one or more risks and formulate them with different (probabilistic) distributions or different parameters of a (probabilistic) distribution. We can also define the level of dependence between one or more events by specifying a correlation (<= 1) between them.

5. This formulation is done in the following ways:

a. By calculating a probability distribution which is based on historical data of similar nature (e.g. for the same Customer). The calculation is based on the forecast models developed and presented in deliverables P1.1 & P1.2.

b. By assigning (ad-hoc) a probability distribution at each point (event) of the generated holistic cash flow. The user is able to select a distribution among a proposed library set. The default distribution proposed by the system, in this case, is the distribution PERT GEV (generalized extreme value distribution) which is suitable to model rare and extreme values events (P1.1).

c. Furthermore we faced the problem of how to model the two uncertain values of a Cash Flow event (namely, the time the event occurs and the actual value. We modeled that by «dividing» equally the event's expected value (in the y-axis) to n-sub values where each one may have its own probabilistic distribution function regarding its time occurrence (x-axis).

6. The user can define risk scenarios by changing the types or the parameters of these distributions.

7. Verification: After modeling the problem as before, we proceed to its solution. We came up with two alternatives:

a. Based on the values theory and calculating the output data with extreme values and a confidence interval of these values.

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b. By applying the techniques of Monte Carlo Simulation which produce a proposed distribution of the holistic Cash Flow output events. Depending on the (distribution) parameters to be used and the number of (execution) times we can approach more accurately (and more time-consuming) the final result.

8. The above was implemented as prototype software (in Oracle Forms & Oracle DB). The prediction algorithms and algorithms of Monte Carlo Simulation were implemented in Matlab. As a GUI presentation and Decision Support S/W, we used the state-of-the-art BI tool Qlikview (of Qliktech.com).

9. Decision Support: The user can see the results of the execution of the process both graphically and in a table format. Negative cash flow events (or cash flow events which can become negative with a certain probability) are indications of risks. Using different execution parameters we can "experiment" with alternative scenarios that will help us improve our decision making process.

10. The above were successfully designed and implemented as a pilot system. To evaluate our system we used real corporate input data (more than three years long).

Project Innovation:

The originality and innovation of our work is summarized as follows:

a. In modeling the holistic enterprise risk as a set of different probability distributions of events forming the holistic Cash Flow of a company.

b. In the design and implementation of methods for the estimation of (the above) probabilistic distributions and their correlation with one or more risks.

c. Of how to model the two uncertain values of a Cash Flow event (namely, the time the event occurs and the actual value. We modeled that by «dividing» equally the event's expected value (in the y-axis) to n-sub values where each one may have its own probabilistic distribution function regarding its time occurrence (x-axis).

d. On the capability (of the system), to model and execute multiple scenarios (of the above).

e. On the calculation of total risk (or the final distribution of the holistic cash-flow) with two alternative scenarios: Extreme Values and Monte Carlo Simulation.

While most cash-flow calculation applications (available on the market) are based on deterministic calculations (without the possibility of defining the uncertainty and therefore risk), most of the risk management applications do not treat analytically the total Cash Flow of a company (i.e. as a set of discrete events) but overall, having

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therefore a significantly lower accuracy regarding possible risks and supporting managerial decisions.

The best known, commercial s/w product, for risk analysis and assessment system is @RISK (of the British Company www.palisade.com). We purchased and evaluated this product as part of this project. The main differences between @RISK and our system are three:

a. @RISK mainly assesses the risks associated with a certain event rather than a set of discrete events (such as a Cash Flow)

b. The calculation or estimation of events is left (manually) to the user, and the system does not contain any built-in business logic (embedded business logic).

c. Even in the discrete event case, we cannot handle simultaneously the uncertainty in two variables e.g. time of occurrence and in payment value.

In our system we reduced the entire problem of the holistic business risk to the probabilistic estimation of the holistic Cash Flow of a company. At the same time we modeled the uncertainty regarding the expected Cash Flow value of a discrete event, by «dividing» equally the event's expected value (in the y-axis) to n-sub values where each one may have its own probabilistic distribution function regarding its time occurrence (x-axis).