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An Expert System for Enterprise Risk Assessment

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Abstract. Risk assessment in the enterprise is a pillar in achieving objectives and mission following, and proper treatment contribute to enterprise development. Risk assessment determines future decisions, identify new alternatives or opportunities within the organization. This paper presents the implications of semi-quantitative assessment of risk in the enterprise, and the developement of a risk assessment expert system. The cycle of risk assessment involves a semi-quantitative analysis of risk. The developed expert system displays the result of the risk assessment, the evaluation conclusion and possible methods of prevention and control. With this tool, managers at different levels of the enterprises can better define their strategies, policies and tactics.

Keywords: Enterprise Risk, Risk Assessment, Expert System, Risk, Business, Decision

1. Introduction

Risk is an inherent component which occurs in the enterprise's activities at all levels, and it is based on several factors. Because of significant potential impact of these risk factors on business results and the inability to be fully controlled by the business, risk analysis is an important dimension of strategic management of the enterprise which supposes the completion of the whole cycle of risk assessment.

Risk assessment determines future decisions, identify new alternatives or opportunities within the organization. Understanding the disadvantages of all the factors is very important. This increases the probability of success and reduces losses in the enterprise.

2. The Implication of the Enterprise Risk Assessment

Risks are the events that, if they occur, will cause unwanted change in the cost, schedule, or technical performance of an engineering system. Thus, the occurrence of risk is an event that has negative consequences to an engineering system project; the risk is a probabilistic event [1].

The process by which the risk is monitored and managed is the risk management. The process of risk management summarizes the activities related to risk identification, assessment, treatment, communication and control [2].

Risk management process is based, as any management system the four-steps (PDCA [3]: Plan, Do, Check, Act; and then modified in PDSA [4]: Plan, Do, Study, Act), that is continuously repeated until the risks have an acceptable level:

- Planning;
- Risk Identification;
- Risk Assessment;
- Mitigation and tracking.

Of the above phases, risk assessment or analyses can be considered the most important because after identifying risks, their analysis leads to future decisions that can be taken in the analyzed company.

Considering that the risk management process is a continuous and cyclic process, the risk management lifecycle can be represented as follows (Figure 1) [2]:

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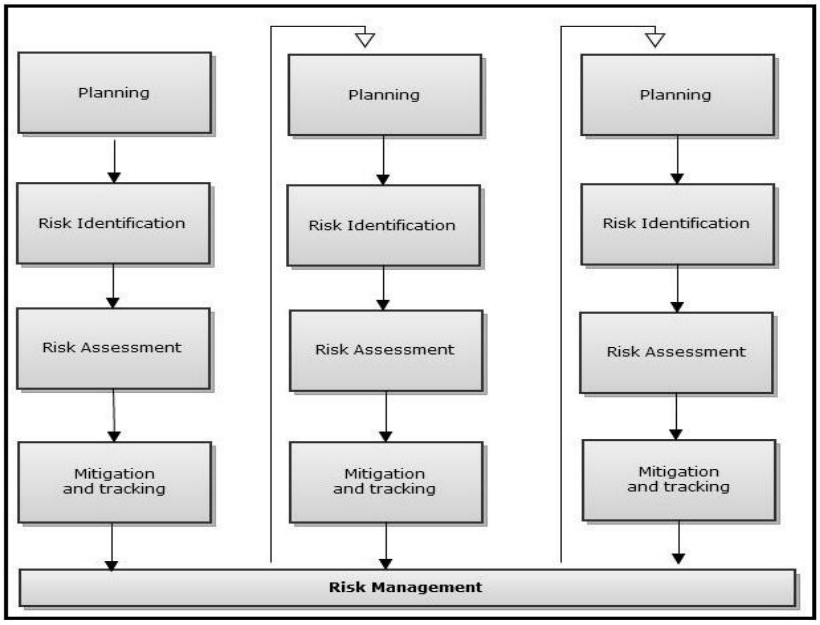

Fig. 1: The basic process of risk management

The authors propose a risk assessment cycle in the enterprise, based on the steps of a management system, by risk modeling and treatment according to the data (features) of the industrial environment (Figure 2). Risk assessment is done by using *semi-quantitative* methods. Semi-quantitative assessment calls for a qualitative risk assessment (selection of high / medium risk of developing and / or impact) which is then evaluated quantitatively (by giving scores). The method avoids the accumulation of errors that can occur in the qualitative method and the complexity of data that are necessary in the quantitative evaluation [5].

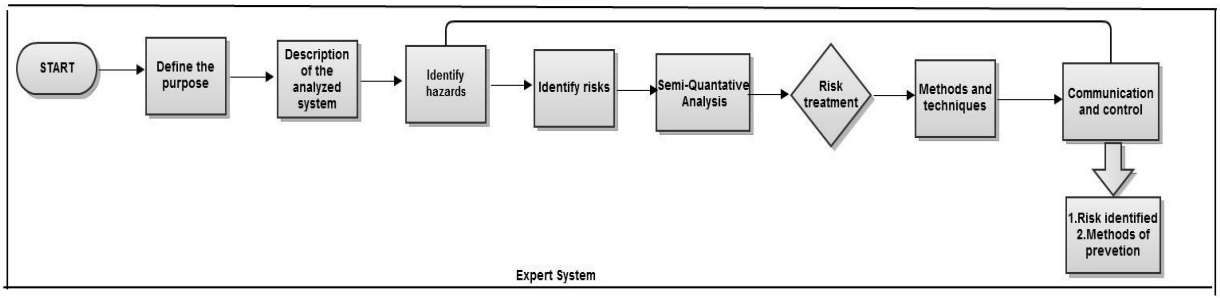

Fig. 2: Risk Assessment cycle diagram

Based on these considerations, the authors have developed an expert system for risk assessment in the enterprise which will be described in the following paragraph.

3. The VP-Expert Expert System Generator

The VP-Expert expert system generator was developed by Brian Sawyer, it is distributed by the firm Paperback Software International, and it is a complex tool for the development of expert systems.

In the realization of system for the technologcal risk assessment in the enterprise, the authors have used VP-Expert version 2.1 - Educational Version.

The developed system evaluates the technologcal risk within the four responsibilities of sustainability (environmental, social, economic and technological) [6].

Based on these considerations, technological risk assessment and the measures taken as a result of these permanent analyzes lead in terms of the enterprise to:

- creation of adaptive technologies that lead to sustainable development;
- increase flexibility of production systems;

- increasing competitiveness in the industrial environment;
- improving the social image (Corporate Social Responsibility);
- protect the environment through various practices implemented at the enterprise level (solar energy, reusable / recyclable waste, optimal energy consumption, etc.);
- use of preventive measures to reduce costs;
- infrastructure development with low financial effort.

The steps for developing the proposed approach are:

a) To identify hazards in the company authors exemplified a hazard for each type of responsibility (social, economic, environmental and technological) (eg Table 1). This list may be extended depending on the specific activities of the activity sectors. Correct identification of hazards in the enterprise requires active involvement of all employees in the process of collecting the information.

Table 1: Examples of hazards in the responsibilities: social, economic, environmental and technological.

No.	Hazard	Yes	No
1	Old facilities and equipment?		
2	Use of preventive measures to reduce costs?		
3	Treatment of recyclable waste?		
4	Trainings for employees?		

b) After identifying the hazards of the enterprise the probability-impact table is filled with these risk indicators identified, Table 2, for example, risk indices with 13 and 2 have high severity and risk 8.9 and 10 with zero impact or risk 11 and 14 zero issues per year represents no risk for the enterprise but they should be specified for a clear identification (VHI-very high, HI-high, MED-medium, LO-low, VLO-very low);

Table 2: Model of semi-quantitative analysis for risk assessment

I M P A C T	VHI						3
	HI		4				
	MED					1	
	LO						
	VLO						
	NIL			2			
		NIL	VLO	LO	MED	HI	VHI
		EVENTS/YEAR					

c) The hazards in Table 2 are associated with severity scores (6 - very high-death, 0-inexsistent), and finally we calculate the severity of the risks identified (d) as follows:

Table 3: The Calculation of severity

Risk Index	Probability	Probability Score	Impact	Impact Score	Severity Score
3	VHI	5	VHI	6	5+6=11
1	HI	4	MED	3	4+3=7
4	VLO	1	HI	5	1+5=6

The highest degree of severity is set to 12 (unacceptable risk) and the lowest severity reaches zero (acceptable risk).

Using VP-Expert expert systems generator and the general list for identifying hazards we have created the knowledge base RISK.KBS.

RISK.KBS knowledge base rules are:

Rules for the award of points for identified hazards (specified in FIND clauses);

- Rules for calculating the impact and probability for the hazards identified in the company;

- Rules for assessing and calculating the score of severity.

To achieve risk assessment expert system the authors used as methods of knowledge representation the production rules. The direction for the application of the rules is forward chaining with reset (the nodes of the current road are stored in the factual base, and from the rules applicable to each node are those that have already been activated – in the search tree, the current path is the path connecting the root to the factual base state where we are. The first rules evaluate the probability and severity of a hazard and also the risk from hazards caused by the obtained placement, followed by exploring in depth before the rules (Figure 3).

After querying the knowledge base RISK.KBS for an activity domain, it displays the outcome of the risk assessment, the conclusion and possible methods of prevention and control (Figure 4).

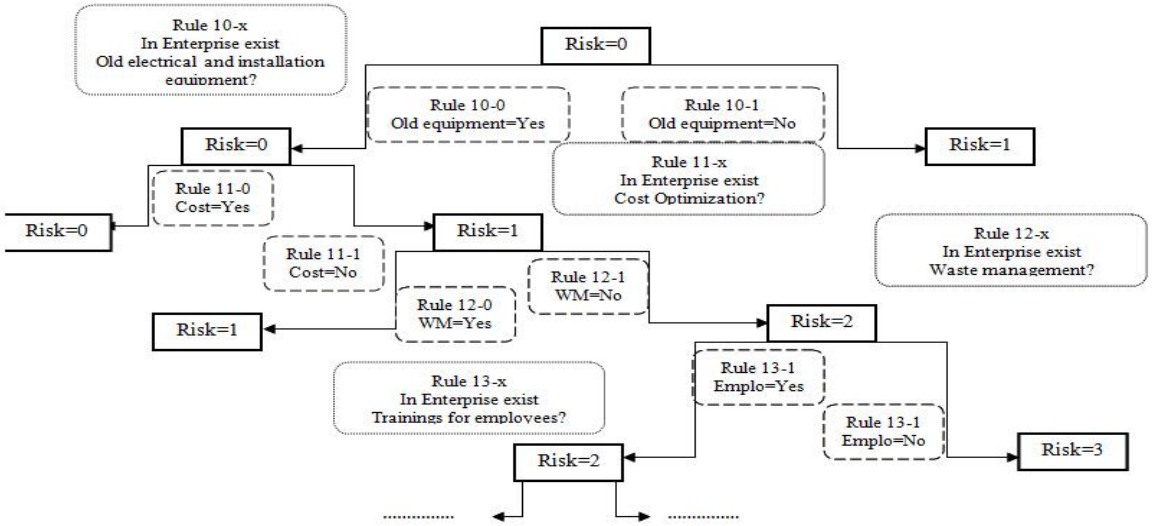

Fig. 3: The arborescence with production rules

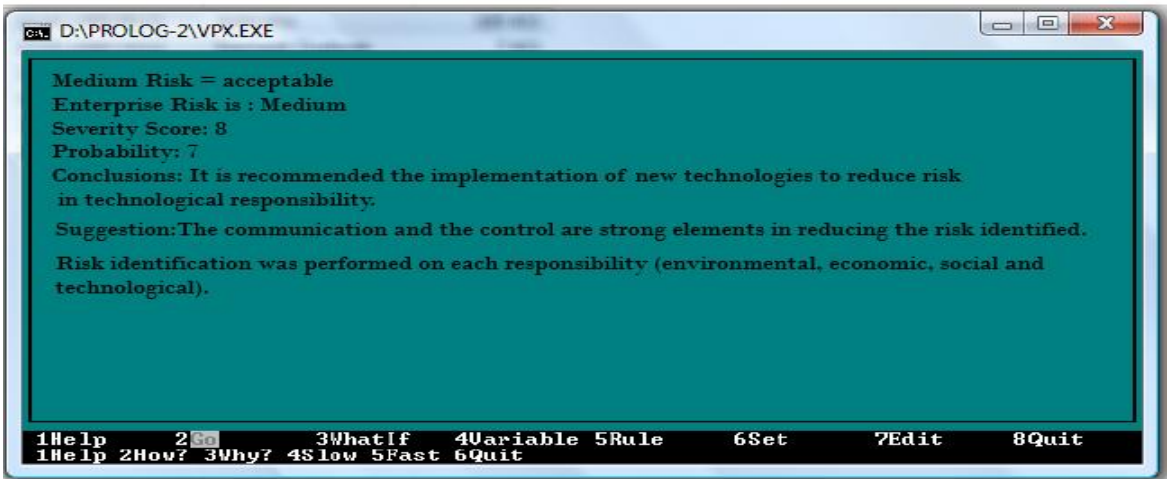

Fig. 4: Knowledge RISK.KBS query result (Runtime module)

Usually, if the risk is assessed as unacceptable (high) the treatment actions are urgent. If the risk is assessed as acceptable (medium / low) the action plan to reduce it is recommended or you need to ensure that it will remain the same (if assessed as low risk).

Prevention and protection measures to be developed within the organization are different and are dependent on the enterprise risk manager. Periodically the enterprise needs to be reassessed after implementation of measures and to compare this result with that (or those) obtained at the first review to verify the effectiveness of prevention and control measures implemented [7].

4. Conclusion

Risk assessment is an important step in achieving the objectives of companies. All element of the risk management cycle are important, but the risk assessment is the headstone for all other elements.

The integration in an expert system of the defining elements of the risk assessment cycle leads to an optimization of decisions within the enterprise and its sustainable development.

The development of sustainable enterprises is the result of a continuous risk assessment and its treatment according to the identified severity. Communication and control are important actions in the development, optimization and stabilisation of the company.

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