

Implications of Technology on Integrated Approaches to Risk Assessment in Sustainable Enterprises

Lucian-Ionel Cioca¹, Larisa Ivascu^{2 +}, Monica Izvercian²

¹“Lucian Blaga” University of Sibiu, Romania

²Politehnica University of Timisoara, Romania

Abstract. This paper presents solutions for enterprise risk assessment using various development environments and analyzing risk management implications. Risks are essential in the progress of an enterprise, they are key elements of learning, and of the continuing development of the. The objective of risk assessment is to reduce different risks related to current processes of the enterprise. Using an optimal tool for risk assessment leads to the possibility of developing new business opportunities, so this evaluation is essential in any ventures. This whole process of identification, evaluation, analysis, treatment, monitoring and control of the risk form a whole, the risk management.

Keywords: Risk, Risk Management, Cloud Computing, Expert System, Web Platform

1. Introduction

Risk is present in any situation in which intervenes the human factor. Basically, the risk is present in all cycles of the enterprise's processes. The notion of risk is a complex task given the diversity of the business implications [1]. The authors say that risk is the probability of an undesirable outcome, the probability of failure, and the opportunity to achieve development opportunities. Risk is not a bad concept, the risks are essential in the progress of a system and the failures are key elements of learning. By analyzing various interpretations, it can be concluded that the risk involves two elements: the probability of undesirable outcome and/or likelihood of developing opportunities.

All these implications of risk assessment can be found in risk management. The Risk management is applied to issues predetermined to result in adverse or unwanted consequences. For these organizations, the definition of risk which refers to risk as "a function of the probability (chance, likelihood) of an adverse or unwanted event, and the severity or magnitude of the consequences of that event" will be more relevant to their particular public decision-making contexts. The retrenchment of an employee due to financial difficulties afflicting the company can be justified if it is carried out for profitability, economic or operational convenience of the employers business [2].

There are various ways of assessing risk, most using checklists for risk assessment. The use of these checklists involves a long time to cover a full evaluation of the enterprise's process cycle. Therefore the development of optimal instruments for the duration/identification contributes to enterprise development and the creation of new business opportunities. The authors have developed various risk assessment tools using various development environments. These approaches have been applied in companies from Romania, thus obtaining different results on the same classes of risks and hazards (initial lists were established with hazards that lead to the identification of risks). Development and use of a tool for risk assessment contributes to the sustainability of the enterprise, to achieve goals and new opportunities.

At the end of the paper, the authors conducted an analysis of these solutions considering various indicators (cost, complexity of implementation, system risks, emerging risks, evaluation time).

2. Risk Assessment Software Solutions for Enterprises – the Authors' Approaches

⁺ Corresponding author.

E-mail address: larisa_ivascu@yahoo.com

The authors have developed several tools for risk assessment and thus they can analyze the implications of various programming environments in the evaluation process. Below are three tools that have been developed in different development environments:

- the tool developed using the facilities offer by WampServer software, 2.1. version from 07.01.2011 that includes: Apache 2.2.17; Php 5.3.5; Mysql 5.5.8; XDebug 2.1.0-5.3-vc6; XDC 1.5; PhpMyadmin 3.3.9; SQLBuddy 1.3.2; webGrind 1.0;
- the tool developed using VP-Expert expert systems generator;
- the approach witch considers Cloud computing environment as its primary hosting infrastructure.

2.1. The Web Platform

The information system design process was developed using the facilities offer by WampServer software, 2.1. version from 07.01.2011 that includes: Apache 2.2.17; Php 5.3.5; Mysql 5.5.8; XDebug 2.1.0-5.3-vc6; XDC 1.5; PhpMyadmin 3.3.9; SQLBuddy 1.3.2; webGrind 1.0. The advantage Web Platform is a provided web service that allows access to data from any device and development environment that can make Internet (HTTP) calls. This includes but is not limited to devices such as desktop/laptops, mobile phones, PDAs, and tablets. The web system has a user friendly interface that allows: step by step analysis of the enterprise, with the possibility of interrupting the process at any time and resume at a later date. The web system allow saving partial data/information of the analysis (when the risk assessment process take place in several days) and the visualization of different steps of the assessment process. Finally, after the risk assessment process is done, a Report can be generated, visualizing and then printed. The proposed information system's diagram for risk assessment in the sustainable enterprise is in figure 1.

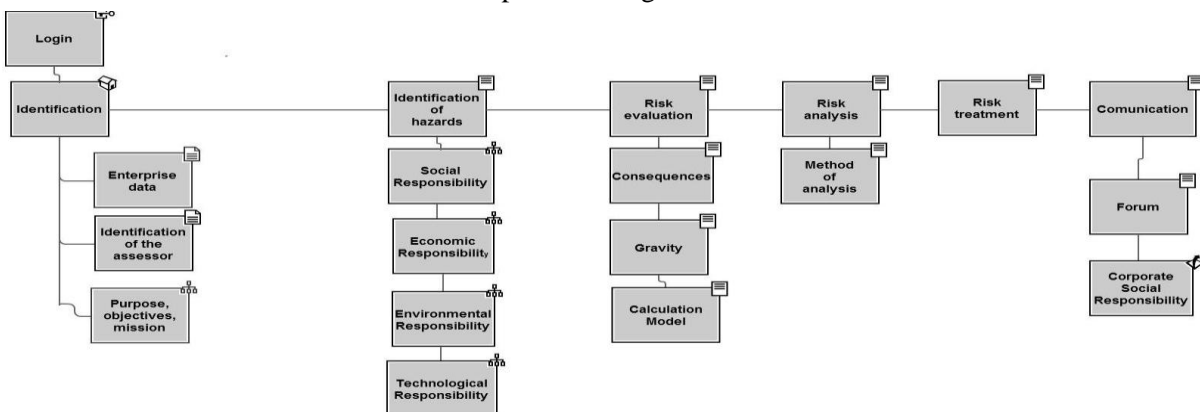


Fig. 1: The proposed logical diagram for risk assessment

The database underlying the computer system for occupational risk assessment can be made public. In this way, the company can develop and highlight its corporate social responsibility through active participation in enriching information of the public database system with questions about risk, consequences and measures specific to its own domain.

Thus, there is a system of continuous improvement and widening of the scope. Through these integrated concepts the information system thus proves two other benefits: advertising and communication (self-help between the enterprises). Integration of the defining factors for the concepts used lead to an optimal risk management cycle [3].

2.2. The VP-Expert Expert System Generator

Using VP-Expert expert systems generator and the general list for identifying hazards we have created the knowledge base RISK.KBS. The advantages of this method of risk assessment are: provides consistent answers for repetitive decisions, processes and tasks; holds and maintains significant levels of information's level, encourages organizations to clarify the logic of their decision; never "forgets" to ask some questions, as a human might; work round the clock; is used by the user more frequently and concurrent users [4].

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 (see figure 2).

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.

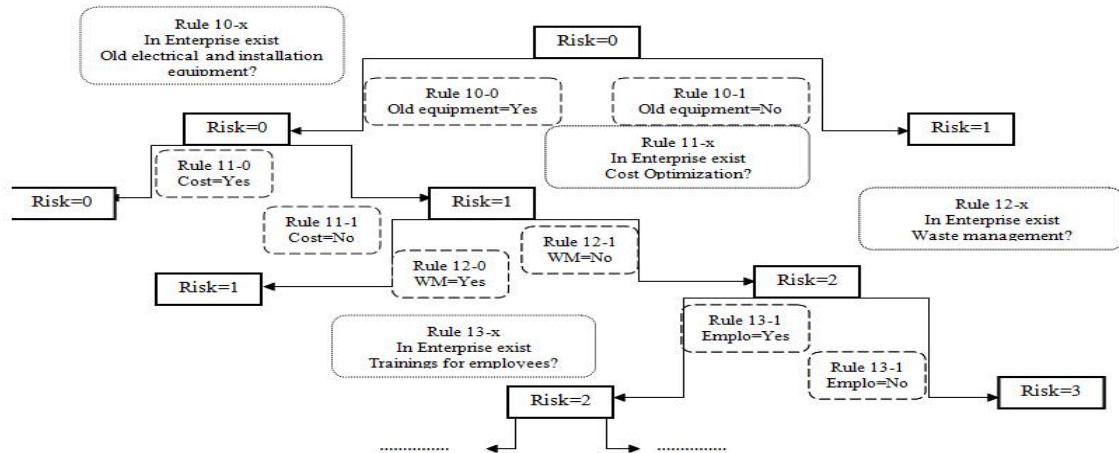


Fig. 2: The arborescence with production rules

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 [4].

2.3. Risk Assessment using Cloud Computing

Information technologies (ITs) are systems of hardware and/or software that capture, process, exchange, and/or present information, using electrical, magnetic, and/or electromagnetic energy. It refers to anything related to computing technology, such as networking, hardware, software, the Internet, or the people that work with these technologies [5],[6]. The new system for access to IT - Cloud Computing - significantly reduces costs, IT complexity and scope while increasing the optimization for workloads and delivery services. Cloud computing allows a very high degree of scalability, offering superior user experience and is based on the new Internet-based evaluation principles. Cloud computing includes 3 three fundamental models: Infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS) [7], [8].

- Software as a service (SaaS): The applications are hosted by a cloud service provider and made available to customers over a network, typically the Internet.
- Platform as a service (PaaS): The development tools are hosted in the cloud and accessed through a browser. The developers can build applications installing any tools on computer.
- Infrastructure as a service (IaaS): The cloud user outsources the equipment used to support operations, including storage, hardware, servers, and networking components.

This approach considers Cloud computing environment as its primary hosting infrastructure.

The importance of a risk assessment system is that for the sustainability of the organization it contributes the safe working environment and staff motivated and interested. These technologies, tools, emerging techniques can be implemented only with people and for helping them. A proper risk assessment to prevents and treats occupational injuries and/or illness, loss of production, damage to equipment, business interruption in one or more areas, environmental pollution, motivate staff by creating an optimal working environment within the organization . The proposed platform is shown in figure 3.

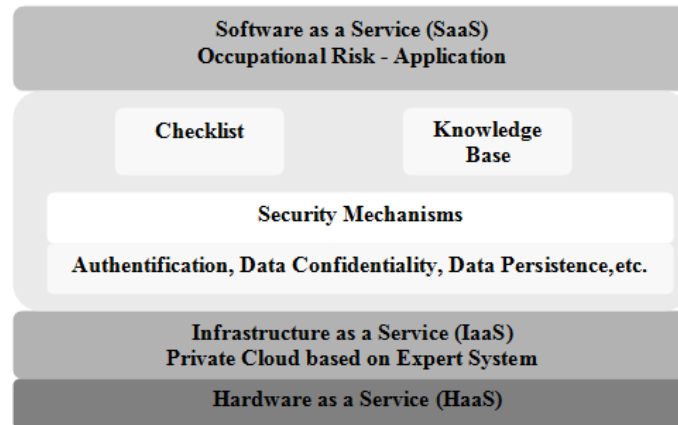


Fig. 3: Conceptual structure of the proposed platform

To identify hazards in the workplace it has been prepared a checklist which is included in PaaS. This list may be extended depending on the activity of the organization. Active involvement of all employees in the process of gathering information helps to correctly identify the hazards. In this list there is a given score (0 - unidentified hazard, 1 - hazard identified) then given the likelihood and severity of harm it is assessed the risk arising from a hazard that can be small, medium or large (high-unacceptable risk, low risk -acceptable). Using the expert systems generator based on a general hazard identification list it was created a knowledge base containing: award rules, rules for calculating the scores and probability assessment rules. After querying the knowledge base for a sector, you will see the result of the risk assessment, the assessment conclusion and methods of prevention, protection and proper treatment.

At the bottom are Security Mechanisms, which are used to meet the authentication, data integrity and confidentiality requirements. Infrastructure as a Service includes the required base for developed application. The applications are hosted by a cloud service provider and made available to customers over a network, typically the Internet, SaaS.

Cloud Computing - cloud services and storage are accessible from anywhere in the world over an Internet connection and occupational risk assessment is easily to achieve.

3. Analysis of Proposed Solutions

Risk analysis tools described above differ by the development environment used. Basically, the same elements of the enterprise are analyzed and the results should have the same implication (result). However, the application of these tools in enterprises in Romania, there were small differences in the obtained results. Further, the authors performed an analysis of these solutions, revealing the advantages and disadvantages of the tools developed in the three different environments.

In Table 1, the authors conducted the analysis of these solutions considering various indicators (cost, complexity of implementation, system risks, emerging risks, evaluation time). These indicators have been evaluated taking into account the presented solutions, having as reference for each category the optimal indicator. After analyzing these development environments, it is observed that each environment has advantages and disadvantages. By analyzing the table above it can be concluded that the cloud computing allows a very high degree of scalability, offering superior user experience and is based on the new Internet - based evaluation principles.

Table 1. Analysis of proposed solutions

Environment	Advantage	Disadvantage	Conclusion
WampServer software	<ul style="list-style-type: none"> - duration of evaluation - online collaboration - are always available - lead to minimal costs - security and privacy 	<ul style="list-style-type: none"> - duration of development - system risks - limited resources - start up costs -dependence on being online 	<ul style="list-style-type: none"> - emerging risks - shared reports -complete evaluation -sharing computing resources
The VP-Expert Expert System Generator	<ul style="list-style-type: none"> - complexity approach - security and privacy - lead to minimal costs 	<ul style="list-style-type: none"> - duration of development -online collaboration - limited resources 	<ul style="list-style-type: none"> - emerging risks - high performance -complete evaluation
Cloud Computing	<ul style="list-style-type: none"> - duration of development - outsource processes - online collaboration - are always available - offer infinite resources - green benefits, start up costs 	<ul style="list-style-type: none"> - security and privacy - system risks - loss of control - additional cost of data transfer fees - knowledge and integration - dependence on being online 	<ul style="list-style-type: none"> -emerging risks -shared reports -high performance -sharing computing resources -complete evaluation

4. Conclusions

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 risk assessment methods are multiple, so the best option to choose is very important. Development and use of a tool for risk assessment contributes to the sustainability of the enterprise, to achieve goals and new opportunities. All these developments have been implemented in various companies in Romania, obtaining some results to be analyzed and presented in future research.

5. Acknowledgements

This work was partially supported by the strategic grant POSDRU 107/1.5/S/77265, inside POSDRU Romania 2007-2013 co-financed by the European Social Fund – Investing in People.

6. References

- [1] L. I Cioca, R. I. Moraru: Explosion and/or fire risk assessment methodology: a common approach, structured for underground coalmine environments, *Archives of Mining Sciences* vol. 57 (1), Poland (2012).
- [2] H. P. Berg. Risk Management: Procedures, Methods and Experiences, RT&A (vol.1), 2010.
- [3] M. Izvercian, and L. Ivascu. System Information For Risk Evaluation In The Sustainable Enterprise, *Proc. Of International Conference on Energy and Environmental Science (ICEES)*.Phnom Penh, Cambodia, 2012.
- [4] M. Izvercian, L. Ivascu, and S. Miclea. An Expert System for Enterprise Risk Assessment, *Proc. of International Conference on Economics, Business and Management*. Kuala Lumpur, ISSN 2010-4626.
- [5] P. Aksoy, L. Denardis. *Information Technology*, Thomson Publisher, 2011.
- [6] A. Mu-Hsing Kuo. Opportunities and Challenges of Cloud Computing to Improve Health Care Services, *Journal of Medical Internet Research*, 2011.
- [7] K.H. Hassan, A. Ali. Workers' Retrenchment during Economic Downturn and Dispute Resolution under Malaysian Law., *International Conference on Economics and Business Information IPEDR* vol.9. Bangkok, Thailand, IACSIT Press, 2011, pp-57-61.
- [8] Jamsa, K.. *Cloud Computing*, Jones & Bartlett Publishers, 2012.