

# The Innovative Information System for Systemic Approach of the Sustainability in the Enterprise

M. Izvercianu, L. Ivascu

**Abstract**—This paper presents an innovative computer system that contributes to sustainable development of the enterprise. The research refers to a rethinking of traditional systems of collaboration and risk assessment, present in any organization, leading to a sustainable enterprise. This concept integrates emerging tools that allow the implementation and exploitation of the collective intelligence of the enterprise, allowing the exchange of contextual, agile and simplified information, and collaboration with networks of customers and partners in an environment where risks are controlled. Risk assessment is done in a systemic way: the enterprise as the system compared to the contained departments and the enterprise as a subsystem compared to: families of international standards and sustainability's responsibilities. The enterprise, in this systemic vision, responds to the requirements that any existing system to operate continuously in an indefinite future without reaching key resource depletion. The research is done by integrating collaborative science, engineering, management, psychology, obtaining thus a cornerstone of sustainable development of the enterprise.

**Keywords**—Enterprise 2.0, ISO, Risk management, Sustainable development

## I. INTRODUCTION

THIS paper presents an approach to the impact of collaborative technologies that are adapted inside the enterprise and for the risk management on sustainable development of the enterprise. Currently a common concern, both nationally and internationally, is sustainability.

Problems affecting sustainability is the opposition between the needs of population growth on the one hand and the planet's resources, the continuous degradation of the environment and new technologies on the other part. Enterprises' sustainability generates value and develops opportunities so that this concept has become the concern of all. The sustainable development of the company is influenced by two major complementary elements: risk assessment and implementation of collaborative platforms emerging in the enterprise or between enterprises and their partners or customers. Risk assessment is done in a systemic way: the enterprise as the system compared to the contained departments and the enterprise as a subsystem compared to: families of international standards and sustainability's responsibilities.

M. Izvercianu is with Politehnica University of Timisoara, 300197 Romania, (e-mail: monica.izvercianu@mpt.upt.ro).

L. Ivascu is with Politehnica University of Timisoara, 300197 Romania, (e-mail: larisa\_ivascu@yahoo.com).

In investigating the complex problem of enterprise, the systemic approach is expanding more and more, based on the general theory of systems. Acceptance of the broader notion of system is that of a group of components that meet a set of rules of operation and work together to achieve a common goal. In the same research, the subsystem is defined as a branch of the system that includes equipment, components, human resources, facilities, processes, documentation, procedures and various connected programs to achieve common goals [1].

In the industrial activity, the systemic approach of specific problems may be considered as any technical means, machine tool, work items, workshops, departments, companies, industries are sets of systems merged according to certain rules and meet a well-defined purpose. As an industrial system we can consider any type of industrial production unit or division thereof and any reunions of such units. Thus, it may be that the company as a system consists of subsystems, and it becomes itself subsystem in relation to the national economy.

## II. THE PILLARS OF A SYSTEMIC VISION

### A. Risk evaluation

Achieving the company's objectives requires knowledge of, and multiple risk-taking. Their treatment leads to a sustainable development of the enterprise. The process by which the enterprise is directed and coordinated in terms of risk represents the risk management. Risk management is the process of identifying loss exposures that the organization is facing and to select the most appropriate techniques for treating each exposure separately [2].

In another vision, risk management is a systematic process by which risks are identified, assessed, analyzed, reduced or eliminated in order to achieve the objectives [3].

The authors conclude that risk management in sustainable enterprises is a cyclical and continuous process which is coordinating activities to direct, control or treat risks including monitoring, communication and consultation with satisfying the needs of present generations without compromising the ability of future generations to meet their own needs [4].

Risk assessment leads to enterprise's stability, to enterprise's sustainable development.

Risk management contribution to sustainable development is substantial being a pillar in the enterprise's stability.

### B. The Sustainable Enterprise

Currently a common concern, both nationally and

internationally, is sustainability. Problems affecting sustainability is the opposition between the needs of population growth on the one part and the planet's resources, the continuous degradation of the environment and new technologies on the other part.

The origin of the concept of sustainable development is rooted in Greek and Roman philosophy (where the relationship man - nature is respected), but only in the last four decades is systemic defined "long-term development is viable only understanding the respect for the environment, social justice and economic profitability" (World Commission on Environment and Development - 1987).

The sustainable enterprise will be characterized by its ability to achieve a proper balance between the long-term production capacity (product with the generic sense here) and own resources or the ones from the environment. This company will be involved in supporting local and regional sustainable development and will have to integrate itself in the horizontal and vertical development of an economic environment [5].

The European Commission launched on April 2000 the tool of "triple basis line" on the request of measuring their value, having as subordinated problems:

- the environment: the impact of the campaign activities on the environment broadly – natural resources usage, rejecting the entire nature, territory occupation.
- economic: in collecting financial performances, the sustainable development means taking into consideration the long term perspectives of the companies, their impact on the economic growth in their field of activity and obeying the ethical principles in business.
- social: the social consequences of the company as a whole its representatives: employees, solicitors, clients, local community[6].

In another theory, a forth base line appears, now very important, and that is the technological responsibility, an important element in the development of any organization, as in Fig. 1 [7].

The technological management is one of the most important direction by which the company should go by. The technological management principally defined by the implication and engagement of technology for a corroborating and simultaneous action for all the company functions. As this concept is accepted, we also have to accept the fact that technology is an important resource and a variable with high grade of impact on all the management functions and on the risk management cycle. It doesn't matter if the market actors are: the producer, the customer or the user. This approach sharpens in the context of sustainable development. The technological management is presuming that any other managerial function is going to use this technology by one hand and by the other will have to consider it as a form of input, as a resource as much as in the strategic visions and the operational procedures and methods. In this context we need a technological goal that of making it more coherent and consistent with all the short or long term activities of all the sustainable company's departments and sectors. Therefore the company shall achieve a higher level of business performances as well as its goals and will easily integrate in the local, regional, national or global sustainable development [5].

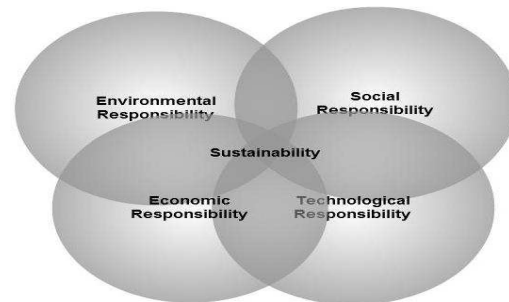


Fig. 1 The responsibilities of the sustainability

#### C. Enterprise 2.0.

Openness, transparency, agility, collaboration and 'social' computing are currently highly fashionable values, but applying them to achieve specific business value with both existing and new web 2.0 technologies whereas attempting to manage employee change for effective use is highly challenging.

Andrew McAfee of Harvard Business School in 2006 referred to this concept the "Enterprise 2.0" in his paper, Enterprise 2.0: The Dawn of Emergent Collaboration, MIT Sloan Management Review. McAfee's latest definition reads thus: "Enterprise 2.0 is the use of emergent social software platforms within companies, or between companies and their partners or customers". McAfee's suggests that Enterprise 2.0 has become a reality because three broad and converging trends: simple, free platforms for self-expression, emergent structures, rather than imposed ones and order from chaos.

The requirements for which Enterprise 2.0. is seeking to answer in the literature, as [8], cover six dimensions: a sense of belonging to a community, social networking, network access to information and knowledge, emerging collaboration, adaptive reconfigurability and global mobility.

The advantages of implementing Enterprise 2.0, as [9]: productivity, retention of knowledge, information discovery, agile businesses, cross pollination, encouraging innovation, competitive advantages, modern working places, increased transparency, reduced redundancy, better communication and lower costs. The concept of Enterprise 2.0 is implemented by combining the technologies of blogging, SNS, Wiki and RSS, as well as open-source software. Basically, Enterprise 2.0 is a mechanism for promoting information within and outside the enterprise by adopting Web 2.0 technologies and concepts. Enterprise 2.0 implies a continuous development, integration of virtual communication, authentic products and services, everything that involves evolution. The whole innovation process involves a clear identification of the enterprise in the cooperative environment.

#### D. International Standards

For a correct alignment with international standards several companies have integrated approaches and methods of risk assessment in the complex context of families defined by international standard ISO 9000 (Quality Management Systems), ISO 14000 (Environmental Management Systems), ISO 18 000 (Management Systems Occupational Health and Safety), ISO 26000 (Corporate Social Responsibility) and ISO 27000 (Information Security Management).

INTERNATIONAL STANDARDS

Family of International Standards	Defining elements	Benefits of implementation
ISO 9000	Effective designing, implementing and managing quality management systems. (International Organization for Standardization, 2011)	<ul style="list-style-type: none"> <li>- Increasing the efficiency</li> <li>- Reducing losses</li> <li>- Improving the quality of products / services</li> <li>- Customer satisfaction</li> <li>- Customer confidence</li> </ul>
ISO 14000	Includes standards and guidelines on environmental management, which is what the organization makes to minimize harmful effects on the environment, from its activity. (International Organization for Standardization, 2011)	<ul style="list-style-type: none"> <li>- Reduced consumption of raw materials and energy</li> <li>- Reduction of pollution</li> <li>- Increases appreciation from the society and the inhabitants of the area</li> <li>- Increasing domestic and external competitiveness, reliability and durability of products.</li> </ul>
ISO 18000	It focuses on identifying and eliminating risks that may arise at work and on continuous improvement of specific processes. (International Organization for Standardization, 2011)	<ul style="list-style-type: none"> <li>- Identification and controlling in efficient way of the risks related to health and safety at work</li> <li>- Compliance and harmonization of activities with specific labor laws</li> <li>- Continuous improvement of technological processes and equipment related to the activity.</li> </ul>
ISO 26000	Includes defining elements and rules for corporate social responsibility (International Organization for Standardization, 2011)	<ul style="list-style-type: none"> <li>- Improving enterprise's image</li> <li>- Involvement in social network</li> <li>- Increasing society's appreciation</li> </ul>
ISO 27000	Its field of application is information technology management and data security management. (International Organization for Standardization, 2011)	<ul style="list-style-type: none"> <li>- Data security</li> <li>- Optimum development of activities in the enterprise</li> <li>- Reduction of new and emerging risks</li> </ul>

International standards are standards developed by international standards organizations. International standards are available for consideration and use, worldwide. The most prominent organisation is the International Organization for Standardization. A comprehensive analysis of these standards is made above.

### III. PROPOSAL AN INTEGRATIVE RISK ASSESSMENT TOOL FOR SYSTEMIC RISK EVALUATION

This research facilitates the development of risk assessment solutions for the company as a system approach that integrates: systemic vision of the enterprise, enterprise sustainable development and mathematical expression of the overall risk that will be calculated in the enterprise system.

The most common risk assessment methods are the checklists, instrument involving a considerable number of resource mobilization.

By integrating them into a platform for evaluating, the authors, developed a risk assessment process optimization. This platform helps identify hazards in the system / subsystem risk-assessed and risk analysis for the identified, new or emerging risks. The development of this platform helps to better understand the complexity of risk assessment, the risk management cycle. These preliminary research results are convergent to a adequate behavior of the risk assessors and their teams (e.g. risk mitigation, preventive, pro-active behavior etc.). The information system design process was developed using the facilities offer by WampServer software, 2.1e version from 07.01.2011, which 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 web platform has a user friendly interface that allows: the analyze step by step for the enterprise. The web platform 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 development process is related to a web platform design that can easy support the risk assessment processes in different organizations.

Risk assessment is done in the enterprise as a system, in relation to the departments that make it up and in the company as a subsystem in relation to the national economy. Basically the vision involves risk assessment approach in the enterprise system and enterprise subsystem. The pillars for systemic approach of the enterprise, as a subsystem, are shown in Fig. 2.

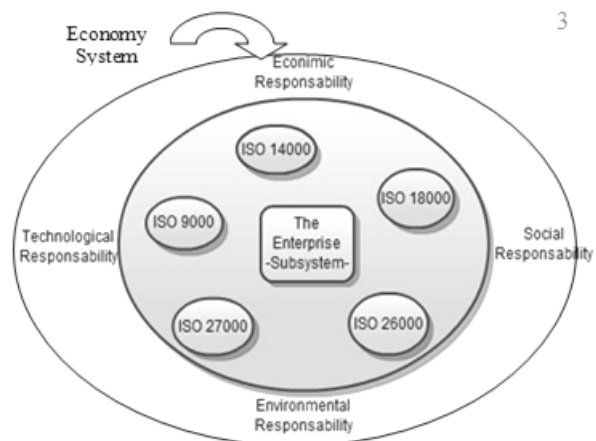


Fig. 2 The Subsystem Enterprise

The enterprise is subsystem compared to the national economy, so that risk reporting is made in relation to this. Thus, international law recommends implementation of international standards for sustainable development of the enterprise. these families of international standards (ISO 9000, ISO 14000, ISO 18000, ISO 26000, ISO 27000). Risk assessment is based on the principles incorporated into the international standards of sustainability on the four responsibilities: technological, economic, environmental and social responsibility.

In the presented model, the enterprise becomes the system to the departments that it contains, practically the company is the sum of the contained departments, as in Fig. 3.

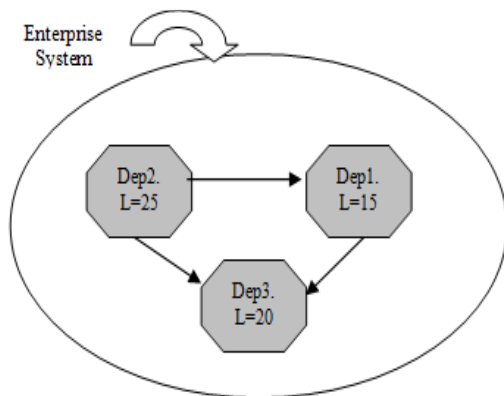


Fig. 3 The System Enterprise

In this case the company comprises the sum of employees of each department. The risk management cycle involves an assessment from the individual to the general, namely, a risk assessment on the job, the enterprise as a system is a sum of such risks. On the other hand, there are risks in the relationships of interaction between departments also, so that the total risk that can be identified in the enterprise as a system is equivalent to identifying risks on the workplace and on the arrangements of the relations between departments.

The evaluation is to assess existing, new and emerging risks at the workplace and on the relationships between the contained departments.

The identified total risk can be calculated using the following formula:

$$R = \sum_{i=1}^n \sum_{j=1}^m RL_{mij} + \sum_{k=2}^n A_k^n R_{interaction_{dep}} ; i = \overline{1, n}; j = \overline{1, m} \quad (1)$$

where,

$R$  = total risk of the enterprise system;

$i$  = number of departments in the enterprise;

$j$  = number of jobs / department;

$RL_{mij}$  = risk at the workplace  $i$  from department  $j$ ;

$R_{interaction_{dep}}$  = risk of interaction between departments.

After identifying how the company behaves in relation to the contained departments and the national economy, basically we can reach identifying risks at the workplace, both in the

enterprise as a system and in the enterprise as a subsystem. We can say that the human factor is a key element in the system / subsystem. Thus, the associated risks are inherent in an assessment for occupational risks.

The authors conclude that the risk management cycle requires two sides, as in Fig. 4.

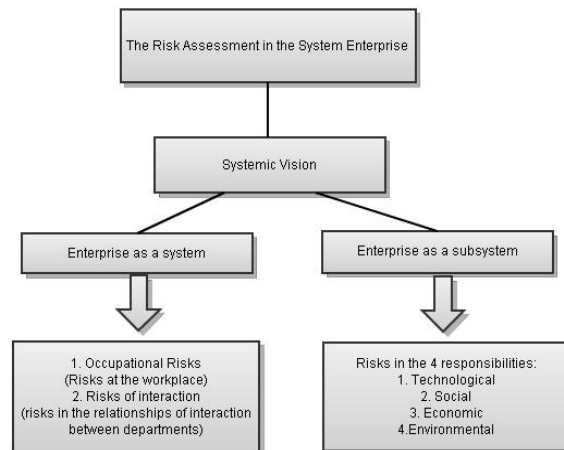


Fig. 4 The risk management cycle

Health and safety problems at work are very topical in the desire to reduce/eliminate duration and exposure consequences of human operators to various occupational hazards. Accidents and occupational diseases involve direct and indirect costs as follows: human costs for employees and their families, financial costs for companies / organizations (absent in case of accident or illness, insurance costs, productivity, profits, competitiveness, etc.), costs for the whole society (a burden increasingly larger on the health systems) [10]. The European Occupational Health and Safety Strategy (2007-2012) propose a target of 25% Reduction of Working Accidents and Professional Diseases [11].

#### IV. THE INTEGRATION OF PRINCIPLE COLLABORATION

A new perspective on risk management and an attitude of collaboration-empowered by Enterprise 2.0 tools and technologies- leads to a sustainable enterprise. A comprehensive and integrated full-web solution, this approach allows enterprises to automate and centralize the entire risk management cycle. The approach developed aims to develop a computer system, easy to use, for risk assessment and allows resumption at any time from any point on the desired responsibility: social, economic, environmental or technological. With this tool, responsible (managers at different levels) of within the enterprises can better define their strategies, policies and tactics. This tool includes social collaboration, using open source tools thus achieving a sustainable enterprise. To assess risks in the enterprise, the authors propose the following diagram, as in Fig. 5, which shows the steps to achieve the underlying system (platform developed), namely: defining purpose, description of the analysed system, hazard identification in the four responsibilities risk identification, risk analysis, risk treatment, communication and control.

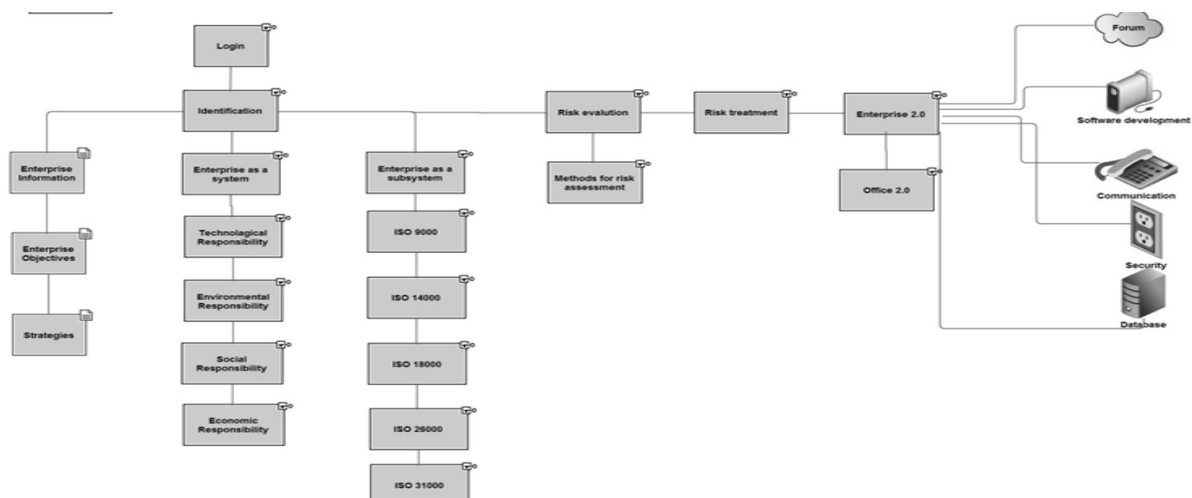


Fig. 5 The proposed diagram for risk assessment

The Integrating social collaboration leads to an optimal system analysis, which is a pillar for the enterprise's decision system.

Communication and control are essential in the management process. Corporate communication for business sustainability, corporate communication component that integrates communication activities with stakeholders relevant to the organization, has as the central theme the organization's growth prospects for sustainability in the context of sustainable development.

The information system will be developed using WampServer software and comprising: 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 si webGrind 1.0.

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.

These Connection, Communication, Collaboration and Contents are 4 main factor of WEB2.0. I call these 4 components as "4C" and interaction of the 4C is "4C model". Each component of the 4C model has own value. It communicates with each other and generates value (Connection - Finding right person and right information, Communication - Communicate with people, Collaboration - To generate value, co-work with other people, Contents - Store value in www) [12].

The model of the "4 Rs" (Reduce - process optimization, Re-arrange - to combine individual features of existing products; Re-build - to change or enhance the existing functions; Reverse - to think in the reverse mode from different directions for inspirations and new concepts and 4 Ps (Profit - cost optimization, Protests - employees' solidarity, Policies - compliance with current legislation and norms, Preservation - protecting the environment and natural resources of sustainability [13].

The integration of these models "4Cs" and "4Rs" in the enterprise contribute to the sustainable development of the enterprise, brings added value. The authors developed a model for integrating these models in the enterprise that is a proposal supported, Fig. 6. This tool was tested in a Romanian company.



Fig. 6 Risk management cycle

## V.CONCLUSIONS

The paper presents a cross-disciplinary approach for occupational/professional risks assessment integrative tools development. Preliminary results have been focused on achieving a full-web solution to achieve an optimal risk management cycle. It helps with decision making, it helps with communication, it helps prioritize.

This tool of evaluation allows for easy usability and makes a complete identification of risk in the enterprise as a system and subsystem. Understanding of all the factors' disadvantages is very important. This the probability of success increases and the losses are reduced in the organization.

Future research directions involve: conducting exploratory research to define and implement safety / security culture in organizations (determining motivational factors specific to individual and organizational behavior appropriate for safety at work), the development of modeling based on emerging risks discovered during platform testing , and making an application using the expert system using VP-Expert generator.

## ACKNOWLEDGMENTS

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.

## REFERENCES

- [1] O. A. E. Clifton, "Hazard Analysis – Techniques for System Safety", Wiley-Interscience, 2005
- [2] R. J. Rejda, "Principles of Risk Management And Insurance", Prentice Hall Publisher, 11th Edition, London, 2008
- [3] M. Greenfield, "Risk Balancing Profile Tool", Hanley Publisher, California, 2005.
- [4] L. Ivascu, M. Izvercianu, M., "An Approach to Identify Risks in Sustainable Enterprises", 2nd Review of Management and Economic Engineering International Management Conference, Cluj-Napoca, Romania, September 2011.
- [5] M. Izvercianu, M. Lobontiu, M., A. Draghici, A., "The Sustainable Enterprise From Automation Field", The International DAAAM Symposium (18th ed.), Viena, 2007.
- [6] International Organization for Standardization, <http://www.iso.org/iso/home.html>, uptadated 2011, accessed 11.01.2011.
- [7] M. Izvercianu, "Risk and Sustainability", Politehnica Pub., Timisoara, 2011.
- [8] P. Ordóñez de Pablos, „Web 2.0 The Business Modell, Chapter 12, Ed.Miltiadis D. Lytras, Springer Science Business Media, 2009.
- [9] D. Hinchcliffe, D., " Enterprise 2.0: How Business is transforming in the 21st Century", pp.21-45, Springer Berlin Heidelberg Publisher, 2010.
- [10] D. Hillson, R. Murray-Webster, "Understanding and Managing Risk Attitude", Gower Pub Co., 2007.
- [11] A. Draghici, M. Izvercianu, L. Ivascu, L., G. Dragoi, „Integrative Research Approach for a Risk Evaluation Ontology Design", International Conference, CENTERIS 2011 – Enterprise Information Systems, pp. 270- 279, 2011.
- [12] N. Cook, "Enterprise 2.0 – Social Software will change the future of work", Grower Pub. Limited, pp. 10-13, 2008.
- [13] A. Ping-Kwan Lau, "The "Great" Model for Sustainability and High Performance of SMEs", Asian and Pacific Centre for transfer of Technology, Pollince Hilling Pub., Honk-Kong, pp.24-30, 2010.



**Monica Izvercianu** was born on May, 30<sup>th</sup> 1948 in Sibiu, Romania, and since 1955 I live in Timisoara, Romania. In 1971 I graduated from the Faculty of Civil Engineering, specializing in Civil, Industrial and Agricultural Engineering at Traian Vuia Polytechnic Institute, Timisoara, following that in 1984 I obtained the Ph.D. title in Civil Engineering, specializing in Engineering Sciences. In 1973 she became assistant professor at Polytechnic Institute "Traian Vuia" Timisoara, Department of Concrete - Faculty of Civil Engineering, in later years she had an upward trend, becoming professor in 1997 at the Department of Management, University "Politehnica" Timisoara. Since 1996, she became dean of the School of Management in Manufacturing and Transportation, Politehnica Timisoara, a position which she occupies today. She wrote a number of relevant scientific papers and served on numerous national and international research contracts.Prof. Izvercianu is president of Economic Engineering Consortium, vice president - Managers and Economic Engineers Association of Romania, evaluator for NURC (National Council for Scientific Research in Higher Education), member of AGIR (General Association of Engineers in Romania) and member of CEEMAN (International Management Development Association).



**Larisa Ivascu** was born on October, 17<sup>th</sup> 1983 in Resita, Romania, and since 2002 she lives in Timisoara, Romania. In 2007 she graduated from the Faculty of Computer Science, specializing in Software at Politehnica University of Timisoara. In 2010 she graduated Master in Business Administration, from the Faculty of Management in Production and Transportation, and in that same year she started the PhD in Engineering and Management field. The area studied is the risk in sustainable enterprise. After graduation she worked in the IT field, giving up this position in favor of specialization in the field of technological risk in sustainable enterprises. She wrote a number of relevant scientific papers.