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**A managerial early warning system for sustainable  
knowledge based organizations**

***ABSTRACT***

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**Keywords:** knowledge, sustainable knowledge based organizations, managerial early warning system.

### **Research context**

The current researches from the strategic management field are focusing on highlighting the importance that planning on short, medium and long term and exploiting knowledge have it on organizational competitiveness. But how can companies, in general, and the ones that focus on knowledge creation and use, especially, plan their activity on medium and long term when the economic environment is complex, dynamic and marked by uncertainty and the time series model cannot be applied?

We aimed to this question in the doctoral thesis entitled „A managerial early warning system for the sustainable knowledge based organizations”.

### **Methodological design**

*The research goal* was to develop a managerial early warning system, based on an artificial neural network, which will allow to the sustainable knowledge based organizations’ managers to anticipate potential threats and opportunities.

In order to achieve this goal, we established a couple of *general objectives*:

- analyzing the specialized literature regarding the managerial early warning systems, the bureaucratic

organizations, the sustainable firms and knowledge based ones;

- identifying the characteristics of the sustainable knowledge based organizations from the Romanian and Spanish knowledge management specialists' perspective;
- analyzing the influence of cultural specificity on the way in which the sustainable knowledge based organizations are described;
- selecting at least one sustainable knowledge based organization from the business environment from Iasi and Madrid;
- designing, testing and validating the managerial early warning systems developed for the selected sustainable knowledge based organizations.

***The main research hypothesis*** is:

*In order to allow anticipating the threats and opportunities that a sustainable knowledge based organization could face, a managerial early warning system, based on an artificial neural network, should include intangible elements as hidden layers.*

The hypothesis is presented as a solution and is based on an inductive – deductive approach. It's validation and testing support is provided by the following working hypotheses:

**H<sub>1</sub>:** *There are elements that distinguish the sustainable knowledge based organizations from both sustainable and knowledge based firms.*

- H<sub>2</sub>:** *Sharing the same cultural profile, the Romanian and Spanish specialists adopt the same approach in defining the construct of “sustainable knowledge based organization”.*
- H<sub>3</sub>:** *Sharing the same cultural profile, the Romanian and Spanish specialists adopt the same approach in characterizing the sustainable knowledge based organization.*
- H<sub>4</sub>:** *The sustainable knowledge based organizations’ characteristics focus on intangible aspects.*
- H<sub>5</sub>:** *The knowledge management specialists consider that the aspects regarding human resources are the most important.*
- H<sub>6</sub>:** *Sharing the same cultural profile, the Romanian and Spanish specialists adopt the same approach in identifying the influence factors of the sustainable knowledge based organization.*
- H<sub>7</sub>:** *The managerial early warning system of the sustainable knowledge based organizations includes elements that are referring to present and future human resources.*
- H<sub>8</sub>:** *The managers’ attitude towards the studied problem influences the results offered by the managerial early warning system.*

In order to highlight the specificity and the goal of the developed tool, we will call it A.N.S.A.S.C. (*Artificial Neural System for Anticipating Strategic Changes*).

## **Research strategy**

In order to achieve our goal, we developed an exploratory and diagnostic research with a holistic, interdisciplinary and diachronic approach.

We used a constructivist *methodological system* based on a quantitative – qualitative approach. Triangulation was the research strategy. Data obtained by different methods, techniques, procedures and also the methods of processing and analyzing data were subjected to triangulation.

The main methods that we used are:

- *documentary study* – in order to identify the sustainable knowledge based organizations' particularities, the actors from the business environment from Iasi and Madrid, and also to determine the evolutionary trend of the factors that influence these entities;
- *survey based on questionnaire* – in order to highlight the characteristics and the influence factors of the sustainable knowledge based organizations;
- *statistical analysis* – in order to test and validate the working hypotheses; we focused on using frequency analysis and nonparametric tests;
- *semi-structured interview* – in order to determine if the identified organizations, in a first stage, are meeting all the conditions for being described as sustainable knowledge based organizations, to

identify the weak signals and to classify the factors from the micro- and macro-environment in inputs, hidden layers and outputs of an artificial neural network;

- *direct observation* – in order to determine if the selected firms meet all the conditions for being “sustainable knowledge based organizations”;
- *modeling* – in order to develop a managerial early warning system for the selected sustainable knowledge based organizations (Zetra IT Services Iberia S.R.L., Daris Consulting S.R.L., IASITEX S.A.); for developing and testing A.N.S.A.S.C..

### **Theoretical framework**

A sustainable knowledge based organization is a complex concept whose features are revealed differently depending on the perspective from which is analyzed.

From a theoretical point of view, a sustainable knowledge based organization is the result of a merger between sustainable firm and the knowledge based one. It is a formal entity that combines the economic, social and environmental objectives with the ones that are oriented to creating, disseminating and using knowledge in order to develop a good relationship with all the stakeholders. It distinguishes itself by: establishing long term economic, social and environmental objectives, using strategic knowledge and developing programs that bring



benefits to the company, its stakeholders and its environment.

From the 268 Romanian and Spanish knowledge management specialists' perspective (Figure 1), these economic entities are not a merger but a subsequent stage to the knowledge based organization. They claim that the sustainable knowledge based organization is a complex and adaptive system in which managers are oriented to achieving multiple objectives (economic, social, environmental and regarding the knowledge stock), planning on short, medium and long term, adapting in a timely manner to economic challenges and adopting an ethic attitude to all the stakeholders.

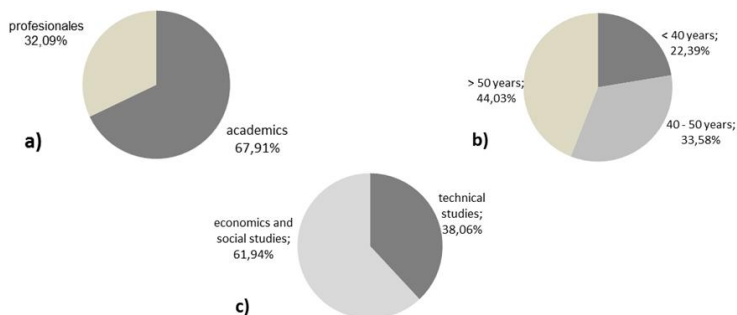


Figure 1. Romanian and Spanish knowledge management specialists' sample by occupation (a), age (b) and type of formation (c)

It may be identified in the current business environment thanks to the elements that focus on the

medium and long term orientation, organizational culture, leadership and motivation, organizational structure, reputation and resources (Table no.1.).

Table no.1. Specific elements of the sustainable knowledge based organizations

<b>Dimension</b>	<b>Characteristics</b>
<i>Short, medium and long term orientation</i>	<ul style="list-style-type: none"> <li>• establishing short, medium and long term objectives that focus on economic, social, ecological and knowledge issues.</li> </ul>
<i>Organizational culture, leadership and motivation</i>	<ul style="list-style-type: none"> <li>• open organizational culture;</li> <li>• programs and activities that stimulate sharing ideas between employees and develop their capacity of taking decisions.</li> </ul>
<i>Organizational structure</i>	<ul style="list-style-type: none"> <li>• activities organized around interdependent and self-managed teams;</li> <li>• reduced number and roles of the first line and middle managers;</li> <li>• flexible organizational structure.</li> </ul>
<i>Resources</i>	<ul style="list-style-type: none"> <li>• specialized employees;</li> <li>• high level of innovation's absorption.</li> </ul>
<i>Reputation</i>	<ul style="list-style-type: none"> <li>• programs that bring benefits to the employees, clients, providers and other members of the community.</li> </ul>

So, we can define the sustainable knowledge based organization as *an economic entity that focuses on increasing its short, medium and long term market value by dealing with knowledge, economic, social and ecological issues.*



Figure 2. Distribution of the strategic factors that influence the sustainable knowledge based organizations

Taken into account the specificity of these companies, the knowledge management specialists sustained that the most important strategic factors are those that focus on the owners of the most critical resource – knowledge – and on the environment in which this may be used (Figure 2). Therefore, the first three positions are occupied by *human resources* (16,33%), *technological environment* (13,89%) and *economic environment* (12,31%). The first one provides the necessary “raw material” while the other two highlight the environment in which knowledge becomes action.

## Developing and testing A.N.S.A.S.C.

Starting from these, we decided to develop an strategic tool that is capable to combine the advantages of management involvement with the abstract character of an artificial neural networks. This tool will be entitled A.N.S.A.S.C. (*Artificial Neural System for Anticipating Strategic Changes*). It is an integrated model since it aims to harnessing the advantages of the previous researches (Table no. 2.).

Table no. 2. Retrieved aspects in designing A.N.S.A.S.C.

Retrieved element	Source	Advantage
<i>Procedural approach (structure based on 3 phases)</i>	Flores, 2009; Liebl, 2000; Schwarz, 2005	<ul style="list-style-type: none"> <li>• clear delimitation of outputs and responsibilities;</li> <li>• highlighting system's role and its bound with strategic planning.</li> </ul>
<i>Scanning the environment on 360°</i>	Freeman, 2001	<ul style="list-style-type: none"> <li>• offering a complete image of the environment.</li> </ul>
<i>Artificial neural network</i>	Li and Davies, 2001; Cao et al., 2011	<ul style="list-style-type: none"> <li>• allows analysis and forecast of complex, dynamic and nonlinear phenomena;</li> <li>• high level of objectivity.</li> </ul>
<i>Managerial debate</i>	Kotler and Caslione, 2009	<ul style="list-style-type: none"> <li>• specialized approach on the analyzed issues;</li> <li>• managers involvement in defining the strategy.</li> </ul>

During the research that we had developed in the firms from Iasi (Daris Consulting S.R.L. and IASITEX S.A.) and Madrid (Zetra IT Iberia Services S.R.L.), we noticed that A.N.S.A.S.C. must include three phases in order to be able to identify the threats and opportunities that may affect company's profitability. These phases include: prediction (based on environment scanning and managerial debate), diagnosis (focused on identifying the threats and opportunities based on the results offered by the artificial neural network) and reacting (oriented to developing scenarios and defining the business strategy).

Therefore, in order to identify the weak signal, the environment must be monitored. The environment in which company operates has to be scanned on 360°. Data regarding *socio-demographic, economic, technological, political* and *legal environment* are collected. Must also be collected information about company's *profitability, competition, consumers, human resources, services / products*.

The importance of these data is analyzed during a managerial debate. This focuses on answering to the following questions:

1. What are the factors that may influence company's profitability?
2. Which elements from the micro- and macro-environment may influence these factors?
3. Which are the company's strengths?

4. What were in the past firm's vulnerabilities? What is happening now in these areas?
5. Is there any instructive analogy in another sector?

The structure of the managerial early warning systems, designed for three companies, included between 30 and 35 factors that influence profitability. Only 28 of these were common to all the three systems designed. 50% of these are referring to intangible aspects like efficiency, bureaucracy, education, innovations, quality and satisfaction. These reflect the necessary processes for creating and disseminating knowledge and also the forms that it may take and the effects that it may produce.

So, the standard artificial neural network on which A.N.S.A.S.C. is based includes 28 elements, namely:

- *inputs*: inflation and legal system's efficiency;
- *hidden layers*:
  - on the first level: interest rate, share of FDI inflows in GDP, unemployment rate, corruption and market deregulation;
  - on the second level: economic growth, share of taxes in company's turnover, bureaucracy, socio-demographic characteristics of the population, sector atomization, share of public investments in education and R&D in GDP;
  - on the third level: socio-economical characteristics of the population, number of entry

barriers, employees' education and annual growth rate of innovations;

- on the fourth level: market size, expenditure on human resources and quality – price ratio;
- on the fifth level: market share, sales growth, clients' satisfaction, certain clients' dependency and variable costs;
- on the sixth level: incomes and expenses;
- *output*: profit.

Data regarding the evolution of these factors during 2007 – 2011 were introduced in an artificial neural network, based on a back-propagation. For all the analyzed organizations, it offered information about the estimated value of firm's profitability during 2012 – 2015. So, we identified the most important threats and opportunities that may appear during 2012 – 2015.

The system received both internal and external validation. The internal validation was carried out inside the *Alyuda NeuroIntelligence* software and was based on the value of the average error (which is the difference between the expected results and the forecasted ones). According to this, the results may be guaranteed with a 90.5%, respectively 95% probability.

The external validation of A.N.S.A.S.C. was realized based on the results that system offered for 2012. So, in a first stage, we used the system in order to determine firm's profitability in 2012 and the opportunities and threats that appeared during that year. Then, we

presented this information to the management team of each firm. The fact that they confirmed our results represented a way of validating our system and also the input that we needed for continuing the process and anticipating the threats and opportunities that may appear during 2013 – 2015.

## **Conclusions**

Through the research that we had developed from October 2010 until March 2013 we demonstrated that:

- there are elements that distinguish the sustainable knowledge based organizations from both the sustainable firms and the knowledge based ones;
- sharing the same cultural profile, the Romanian and Spanish specialists adopt the same approach in defining and describing the concept of “sustainable knowledge based organizations”;
- the sustainable knowledge based organizations’ characteristics focus on intangible aspects;
- the knowledge management specialists consider that the aspects concerning human resources are the most important ones;
- the managerial early warning system, developed for sustainable knowledge based organizations, includes elements that make references to intangible aspects;
- the attitude that management adopts on the analyzed issue influences the results offered by the managerial early warning system.



## **Personal contributions**

Research results have theoretical and methodological implications.

*On theoretical level:*

- we synthesized the issues presented in the national and international specialized literature regarding post-bureaucratic firms typology and the structure of the early warning systems;
- we extended firms' typology by proposing the "sustainable knowledge based organization" as a successor of the knowledge based firms;
- we defined the concept of "sustainable knowledge based organization";
- we extended the theory regarding strategic organizational toolkit by developing a new model of managerial early warning system.

*On the methodological level:*

- we identified the characteristics and the influence factors of the sustainable knowledge based organizations, from the Romanian and Spanish knowledge managements specialists' perspective;
- we developed a comparative analysis on the approach adopted by the Romanian and Spanish knowledge management specialists regarding the construct of "sustainable knowledge based organization";

- we identified the sustainable knowledge based organizations from the business environment from Iasi and Madrid;
- we developed a strategic tool that combines the abstract character of the artificial neural networks with the multiple perspectives offered by managerial debates;
- we designed and tested a managerial early warning system, entitled A.N.S.A.S.C. (*Artificial Neural System for Anticipating Strategic Changes*), for three sustainable knowledge based organizations from Iasi and Madrid;
- we demonstrated that, at the procedural level, a managerial early warning system must include three phases: prediction, diagnosis and reacting;
- we have identified the most important strategic factors that should be included in the structure of an artificial neural network on which A.N.S.A.S.C. is based, no matter the size and the activity of the firm;
- for three companies from the business environment from Iasi and Madrid, we anticipated the opportunities and threats that each of them will face during 2013 – 2015.

## **Research limits and further research**

The main *research limits* are generated by:

- developing the research regarding sustainable knowledge based organizations in the context of an economic recession.
- developing the survey regarding the sustainable knowledge based organization on a homogenous sample, in terms of cultural and educational profile.
- designing exclusively the managerial early warning system A.N.S.A.S.C. based on an artificial neural network, with multiple hidden layers and based on back-propagation.
- including a reduced number of time series in the structure of the artificial neural network.
- the incapacity of generalizing the results for all the sustainable knowledge based organizations from Madrid and Iasi since the sample is not representative.

Based on these considerations, we propose the *future research directions*:

- extending on international level the research regarding the sustainable knowledge based organizations;
- repeating the research regarding the sustainable knowledge based organizations in the context of economic growth;

- identifying a higher number of sustainable knowledge based organizations in order to generalize the structure of the A.N.S.A.S.C.;
- extending the research on A.N.S.A.S.C. in order to adapt it to the activity domain;
- developing an index for the environment volatility which could highlight its instability and could be included in the structure of the managerial early warning system A.N.S.A.S.C..

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