A TOOL OF DECISION SUPPORT FOR THE NATURAL RISK MANAGEMENT

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Abstract: In this paper, we propose a space balanced scorecard for the seismic risk management. Indeed, to install an effective policy of prevention against the natural risk, the phenomenon should be controlled. This can be carried out only after a good knowledge of this last. From where, the need for having a large volume of information coming from various sources. The Geographical information systems (GIS) are largely used for the decision support. However, they give a rather static vision whereas the management of an environmental process in general and natural risk in particular requires tools based on dynamic models. In addition, the scorecards are often used to build decision support systems. In this paper, we propose a balanced scorecard for the management of a seismic risk which is established on the basis of spatial indicators.

1 INTRODUCTION

This paper propose a tool of decision support for the natural risk management, in particular the seismic risk.

Various fields are interested more and more in the risks in particular in environment. In this context, the objective is to control the natural phenomena through, simulation, prevention and decision support tools. The problem arises even more when they are natural risks such as the seism. Indeed, the disastrous effects of the seism as well on the human lives as on their works (infrastructures, houses...) reach sometimes important proportions. If it is not possible to currently envisage with exactitude a seism, it is possible to evaluate the whole of the socio-economic consequences on the areas where it can occur (Djeddi, 1994)

The purpose of the research undertaken in this direction, is to evaluate and manage the effects of this type of "dangerous" phenomenon in order to limit its occurrence. The results of these works generally integrate a strong geographical component which results in the use of the Geographical Information systems (GIS) (Chatelain and al, 1995)(Glassey and al, 1997).

Indeed, these tools offer means for the identification of the concerned sectors and the impacted stakes in order to do an evaluation of the damage following a seismic catastrophe. So, the GIS are largely used for the decision support. However, they give a rather static vision whereas the management of an environmental process in general and natural risk in particular requires tools based on dynamic models. (Koch, 2001).

In addition, decisional data processing in order to increase the flexibility and the reactivity of the organizations, introduced more and more new information and communication technologies such as the scorecards.

In this paper, we propose a balanced scorecard for the management of a seismic risk. It is established on the basis of spatial indicators describing the variations.

It relates to the research works carried out by the laboratory of the information processing systems (LSI) of the data-processing department (USTHB) in collaboration with the Research Center in Astrophysical and Geophysical Astronomy (CRAAG) concerning the impact of the use of the GIS for the reduction of the seismic risk in Algeria.

In the first phase, we used an object approach to simulate the scenario of an earthquake. The cross-referencing data are carried out from various maps (geological, topographic,...) as well as data relating

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to the seismicity of the area of study(Abdat and al, 2005 a), (Abdat and alimazighi, 2005). Like principal results of this phase, we can quote:

-a geographical data base (Geo-Relational DataBase) is built covering the whole of the concepts handled in seismic management (Abdat and al, 2005 b)

-The study of the historical seismicity.

-The real time study of the seisms : the instrumental seismic monitoring is done starting from seismological stations distributed on the whole of the territory. The data collected by the seismometers are centralized and saved in the GeoDataBase.

-graphical documents describing the area seismicity are produced such as the chart the magnitudes, the aftershocks on one or more areas and the chart of the intensities following the results of the macro seismic investigation or a simulation.

-The simulator of seism makes it possible to estimate the intensities of areas touched by a seism. The intensity is regarded here as a classification of the gravity of an earthquake according to the effects observed in a limited zone. Its calculation is a function of the characteristics of seisms and the areas where they occur : magnitude, depth, the distance epicenter-area, the type of ground, the type of construction and associated intensity according to the European Macro scale seismic (EMS).

-A prototype is constructed using ARC GIS. It was applied to the seismic risks of Algiers (Abdat and al, 2005 b).

This first phase enabled us to show the contribution of the GIS in the seismic risk management. In the second phase, object of this present paper, we present a space balanced scorecard (SBSC) applied to the seismic risk. The indicators of the SBSC are calculated starting from the Geodatabase (figure 1) .

2 THE BALANCED SCORECARDS (SBSC)

A scorecard or a dashboard is a means allowing to represent a complex reality by using a simplified model. It gives an incomplete and often vague of reality but sufficient vision to make fast decisions. The dashboards of decision such as the balanced scorecard (Kaplan and Norton, 2001), concentrate especially on the quality of information and not on its quantity. They represent the indicators in a comprehensible and suggestive way in order to facilitate their visualization. They present an outline representative of the situation, then making it possible to reach the more detailed data. The dashboard must be contextual, one can select his own indicators, with the representation which he prefers, in order to produce his personalized dashboard.

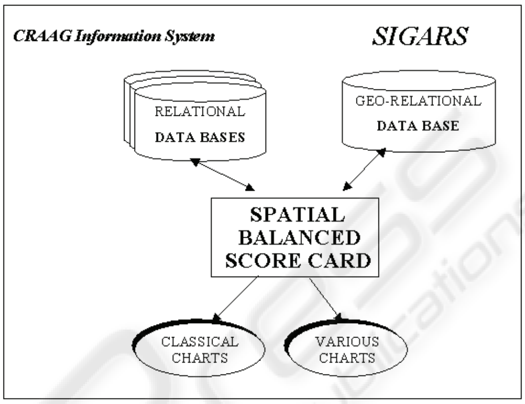


Figure 1: Functional architecture of the system.

Many organizations use dashboards. For example, administrations, banks. International organizations such as the United Nations also use social, economic, geopolitical or environmental indicators. In the field of geomatic, there are some work such as (Devillers and al, 2005) which proposes a space dashboard for the management of the quality of the geographical data. Certain works were made to adapt tools of the Business Intelligence in the field of geomatic, such as Spatial Data Mining, the SOLAP (Spatial On-line Analytical Processing) and the spatial data warehouses (Miller and Han, 2001), (Rivest and al, 2001).

The GIS users handle the geographical data in order to obtain information being able to be used in a process of decision-making (e.g. to identify the areas of risk, to identify the vulnerable buildings to a seism with given magnitude or intensity). For that, They perceive signals of the real world, interpret them, and proceed to an abstraction in order to generate a cognitive map being used for this decision-making. The decisions are made in order to achieve a goal, according to many criterias such as the perceived situation, the experiment and the reference of values of users and their motivations, according to the measurement of the risks and the available means (Devillers and al, 2004). (Klein, 1999) affirms that the mental intuition and simulations are central in the decision-making, based respectively on the experiment and imagination. He stresses the importance of the relevant indices which help to recognize a situation.

An indice or indicator is an information or a set of information contributing to the general appreciation of a situation (Fernandez, 2000). The objective of an indicator is to measure a situation and to initiate a reaction. The value of an indicator can be based on a single data or result from a calculation implying several data. These data must be technically accessible. They can be already available in a data base or come from other sources.

3 OUR SPACE BALANCED SCORECARD (SBSC) APPLIED TO THE SEISMIC RISK

We have applied the Balanced Scorecard approach for the CRAAG. To develop a coherent dashboard, it is inevitable to have a perfect knowledge of the organization. The principal mission of the CRAAG consists in studying the seismicity of the territory and the seismic monitoring with like principal objective "the reduction of the seismic risk in Algeria”. To succeed in achieving this objective, the CRAAG will have to plan intermediate objectives such, the improvement of the seismic monitoring by improving the performance of the seismic monitoring networks and the participation in the sensitizing of the citizens.

We worked out a strategic chart which is defined according to the four axes of the Balanced Scorecards (customer, financier, internal processes, research and development) (figure 2).

Characteristics of our SBSC :

-to communicate information on a visual basis,

-to avoid an overload of information,

-to allow the users to adapt their dashboard to their needs

- to provide indicators in real time

- to allow the users to select the relevant indicators in their context or to define their own indicators

- to allow the users to visualize the indicators at various levels of details: the indicators are organized in a hierarchical way (indicators and under-indicators)

- to offer various representations of the indicators which the users can select (ex. histograms).

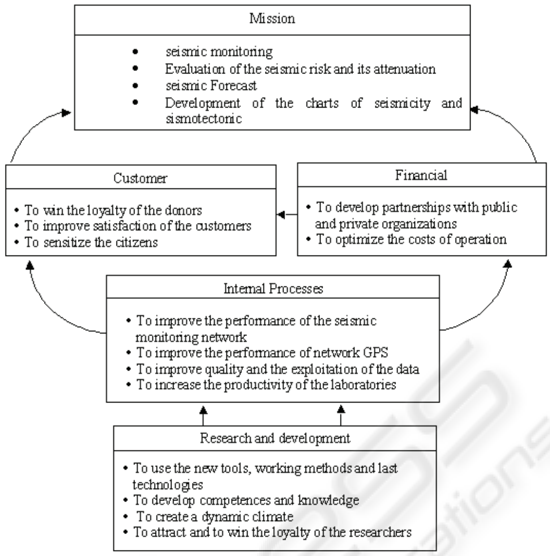


Figure 2: The strategic chart of the SBSC of the CRAAG.

The indicators can represent various types of information, as well quantitative as qualitative:

- Indicators of status: A status indicator gives information about monitoring network status, GPS network status.

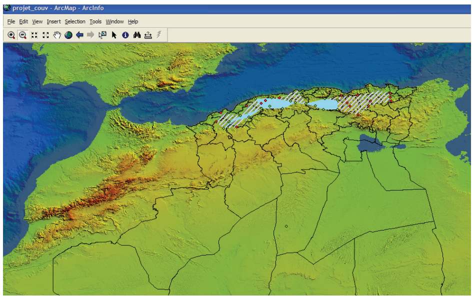
- Indicators of measure : A measure indicator gives information on measures relating to recorded seismic waves of soil movements.

Users have access to proposed indicators description in different aspects such as: definition/meaning of the indicator; method used to calculate the indicator value; representation mod of the indicator.

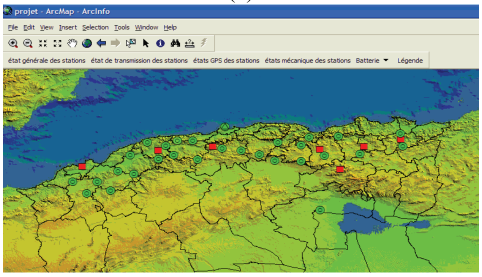
Various representations can be used to visualize the value of an indicator, such as numbers, symbols, icons, pictograms, tables, graphs, texts, images, etc.

Moreover, to take into account the space component, one offers a cartographic mode of visualization of the indicators (figure 3).

A prototype is constructed using the Visual Basic language. The cartographical functionalities of the prototype are developed using ARC GIS (ARC MAP). This prototype is integrated to SIGARS (figure 1).



(a)



(b)

Figure 3 : Cartographic mode of visualization of the indicators:
(a) Capacity of cover of the telemetric network;
(b) Telemetric network of seismic monitoring.

4 CONCLUSIONS

In conclusion, this paper presents a new approach allowing to communicate information relating to the dynamic of geographical data in order to reduce natural risks. In order to avoid an overload of information and to support adequately the decision process, this approach advocate the integration to a GIS a spatial balanced scorecard. The information relating to the dynamic is communicated to the user in forms of indicators which he can select, modify in need, then consult in different levels of details.

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