Medición de la gestión de la innovación en las universidades mediante sistemas expertos

Measuring management innovation at universities utilizing expert systems

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Resumen

Actualmente las universidades se encuentran en un ambiente de incertidumbre, lo cual ha generado el análisis de la gestión de la innovación tecnológica para poder contar con instrumentos de reflexión y bases para la implementación de estrategias. Hoy la implementación de modelos, técnicas, procesos y productos innovadores se presentan como un arma estratégica para mantenerse en el mercado.

Tomando en cuenta lo anterior, es necesario investigar en las universidades para generar propuestas de análisis en la gestión de la innovación tecnológica, dirigidas fundamentalmente al sistema de indicadores de I+D, Tecnología, Innovación, recursos humanos, captación de recursos y estrategias; e incorporar herramientas con el fin de regir el proceso de recopilación y trabajo matemático con los indicadores de I+D, Tecnología e Innovación.

Palabras clave: ELVIRA, Estrategias, Innovación tecnológica, Sistemas expertos, Redes bayesianas.

Abstract

The universities are currently in an environment of uncertainty, which has generated the analysis of management of technological innovation for relying on instruments of reflection and bases for the implementation of strategies. Today the implementation of models, techniques, processes and innovative products are presented as a strategic weapon to stay on the market.

Taking into account the above, it is necessary to research in universities to generate proposals for analysis in the management of technological innovation, fundamentally aimed at the system of indicators of R&D, technology, innovation, human resources and recruitment resources and strategies; and incorporating tools in order to govern the process of compilation and mathematical work with R&D, technology and innovation indicators.

Keywords: ELVIRA, strategies, technological innovation, expert systems, Bayesian Networks.

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Introduction

The universities have turned their efforts in the formation of integral professionals highly qualified, able to face and solve the multiple problems of the production and services and contribute to the economic and social development of the country. In addition, it is a process of universalization of higher education that has voltage all the potential of schools. Companies and agencies apply systems of strategic planning as a means for improving management processes and the implementation of organizational change processes, such as technological innovation. In this way, the mentioned research aims to identify the keys to local competitive advantages to

develop new technologies and enhance territorial competitiveness, because globalization compete to both, external and internal organizations.

Opportunity in innovation

Currently, the demand for higher education has increased in the world, and its effect has been the expansion of the University offer. In this sense, the universities have been affected by the international trend and, to some extent, its function has gone beyond a variety of academic institutions. Thus, globalization has exercised a strong influence in higher education.

Educational institutions have had to respond quickly to changes in society and ensure the quality and relevance of its academic offerings by providing few resources. Institutions of higher education must respond to the diverse needs and requirements of your environment and be able to adjust to the constant changes. The higher education system has undergone several changes, among which is its rapid growth, necessitating a self-analysis to see if their quality (Rodriguez Ponce et al., 2011) is maintained.

Literature review

According to the Oslo Manual (2006, p. 146), "Innovation is the introduction of a new or significantly improved product (good or service) of a new marketing method or a new organizational method in the internal practices of the company The organization of the workplace or external relations ".

For there to be innovation, according to the Oslo Manual, it takes at least that the product, process, marketing method or organizational method are new or significantly better. At the same manual "minimum" and "significantly" for each component and in different circumstances are explained. The essence of the innovation process is continuous in nature, it is the accumulation of knowledge over time; the increase of knowledge is achieved by conducting R & D, although other forms associated with different creative mechanisms (Bravo, 2012) there.

From the perspective of Innovation Management, which seems more interesting is to understand and intervene how a new device is introduced into a particular environment, that is, the process by which a network of interactions certain order intervene to introduce a change. Therefore, the

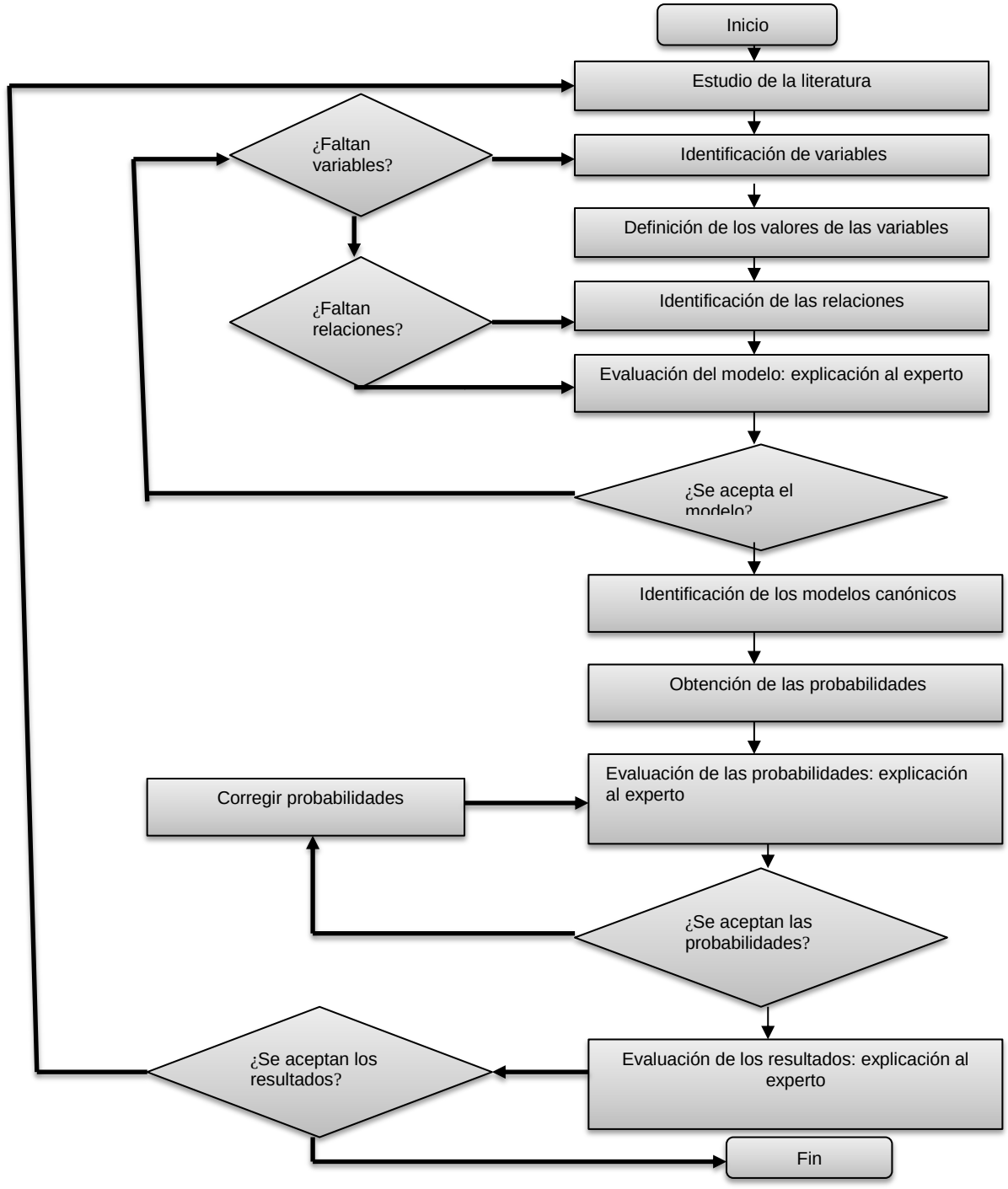
Innovation Management could deal with managing the interactions of existing devices, the new device and its environment, and try to anticipate changes in this (Arango, 2012).

INVESTIGATION METHODOLOGY

The research methodology implemented for the achievement of our objectives is shown in diagram 1 and consists of different phases. Begins with a brief definition of expert systems and software analysis ELVIRA.

EXPERT SYSTEMS. Expert systems are so called because they emulate the reasoning of an expert in a specific domain and are sometimes used by them. With expert systems seek better quality and speed of responses thus leading to improved productivity expert. One of the tasks performed by an expert system is monitoring in a particular case of interpretation, and is the continuous comparison of the values of the signals or data input and values that serve as normality criteria or standards.

ELVIRA. It is a program for editing and evaluation of probabilistic graphical models, in particular Bayesian networks (see Appendix 1) and influence diagrams. Elvira has its own format for the type code, an interpreter for coded reader models, a graphical interface for building networks, with specific options for canonical models (OR gates, AND, MAX, etc.), exact algorithms and approximate (stochastic) reasoning for both discrete and continuous variables, methods explanation of reasoning, decision-making algorithms, learning models from databases, fusion of networks, etc.; the process for developing the model is shown in diagram 1. The Bayesian network emanating from this process.



1. algorithm diagram for the construction of Bayesian networks. Source: Lacave C.

FIRST STAGE WITH REGARD TO DIAGRAM 1

Variable identification

This research, according to the raised and in accordance with the classification made by Balestrini (2006) goal is descriptive in the precision with which the singularities are studied investigate a reality. This particular work will focus on the praxis of the R + D + i of SMEs, adapted to be applied in universities. Innovation comes from a global concept, stating the types of innovations, their applications, their potential and to clarify other issues that drive the internalization of innovation as a strategic line for any organization. The conditions that characterize an innovative environment are analyzed and, therefore, these facilitate the generation and development of R + D. The implementation of a technological solution, the adoption of a new management model or the start of an innovation project need to assess, as if the product launch were, their viability.

In recent years, we have promoted various methods of innovation management in several countries (such as MCI, KLINE, CCI, Linear, Marquis), but has not yet been able to establish any definitive standard because they are not yet sufficiently implanted. Some of these methodologies have been applied in different companies or organizations, but despite the positive adoption generalization has been very limited. Therefore, the instruments used for conducting this research correspond to a questionnaire that measures the ability of innovation within an organization, while a second questionnaire was used to evaluate the percentages experts in technological innovation give the various blocks in the previous questionnaire is divided.

Reagents applied to the guide were developed to manage innovation (first edition) Barcelona, Spain: CIDEM, the Practical Guide for SMEs innovation agreement social responsibility for the economy. Malaga, Spain: CEM 2010 and UNE 166002. The questionnaire was based on the following categories: Achievement in Innovation, Vision of Innovation, Innovation Strategy, Innovation Support, Attracting Innovation, Human Resources and Finance and Innovation

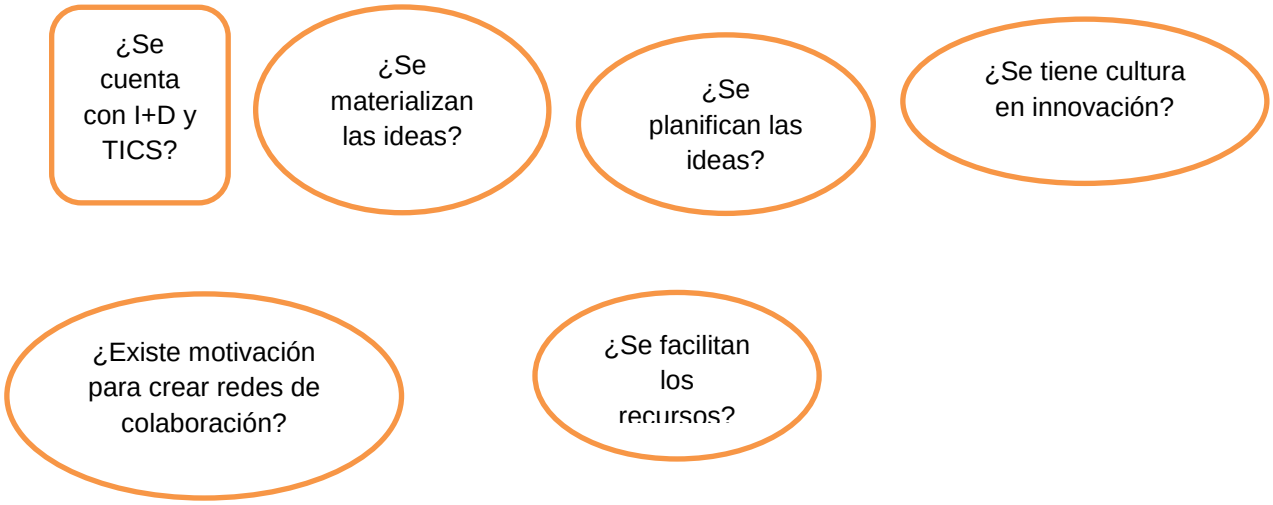
Innovation. In developing the questionnaire they had to reconcile two opposing aspects: first, methodological rigor, and the other a maximum simplification guide designed to facilitate the consultation. Categories and sub-categories given above, are based on theories developed by the UNE 166002 AENOR (2006), in addition to those raised by Hidalgo (2007), Ortiz (2006), Jiménez and Sanz (2004), and the Center CIDEM Business Innovation and Development (2002).

Defining the values of the variables

Construction of qualitative graph

The identification of variables was carried out through the study of the aforementioned questionnaires. In this case, the variables are due to possible causes of that technological innovation is present or not in an organization. Since the objective of this study is to analyze an organization to see if there is technological innovation, we started with the creation of this node and its causal factors, where practically there are three levels were identified: the first corresponds to the causal nodes, the second It represents the blocks in which divides the case study questionnaire and finally, the result, that is, the objective of this research.

The causal nodes within the SW-Elvira for building the Bayesian network is created, these were as follows:



2. causal diagram nodes.

Being in the SW release mode and as this has a graphical environment were designing the nodes, in this case we chose the discrete random nodes, while giving them the importance that each has within the network Bayesian, which is reflected in the following figure 1:

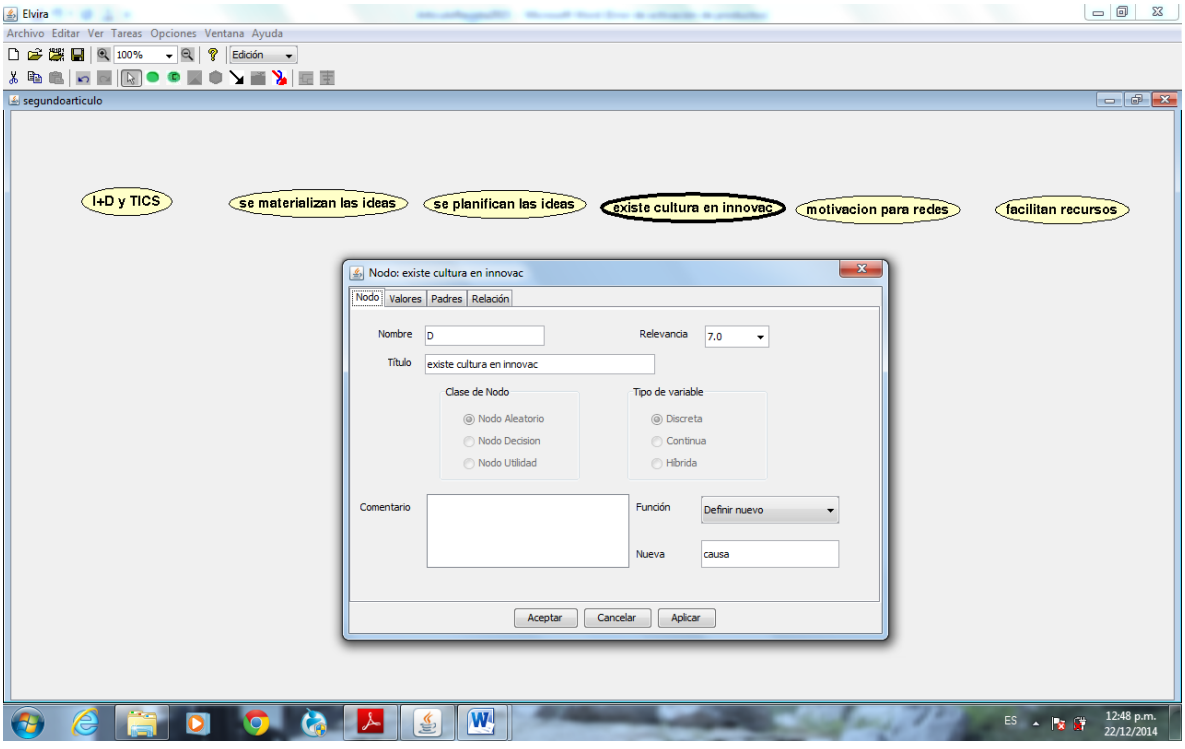


Figure 1. Assigning values to variables

Identification of the causal relationship between nodes

The causal relationship between nodes is chosen as a general probabilistic, so that for each node, the parameters present or absent take a value of 0.5, as shown in Figure 2.

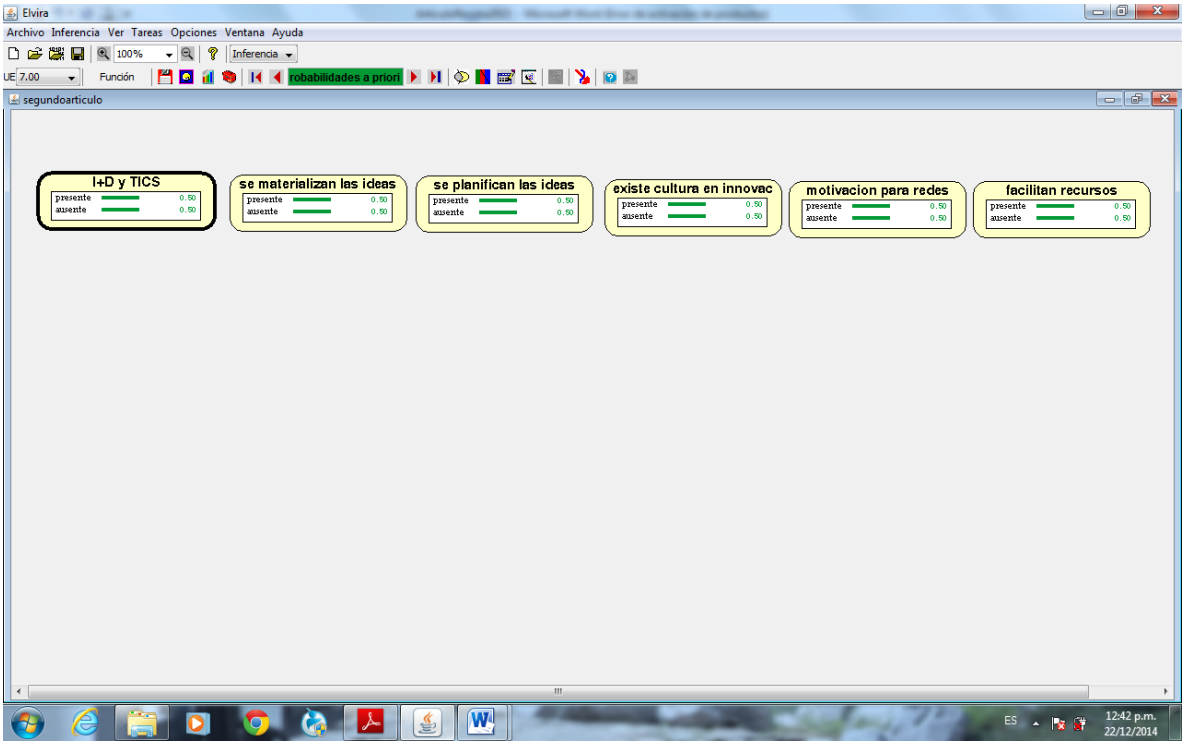


Figura 2. Asignación de parámetros

Evaluation Model

To decide if the model was the desired proceeded to carry out the tests as shown in the diagram 1. A cycle was performed where:

- First the variables were identified based on the proposed questionnaire, creating and debugging each to find the right research.
- • the values of the above variables are defined, debugging and again in the ELVIRA software.
- The relationships between nodes were identified as: the path node has a father named R & D and ICT, the collection has a parent node called planning ideas, etcetera. See Figure 3.

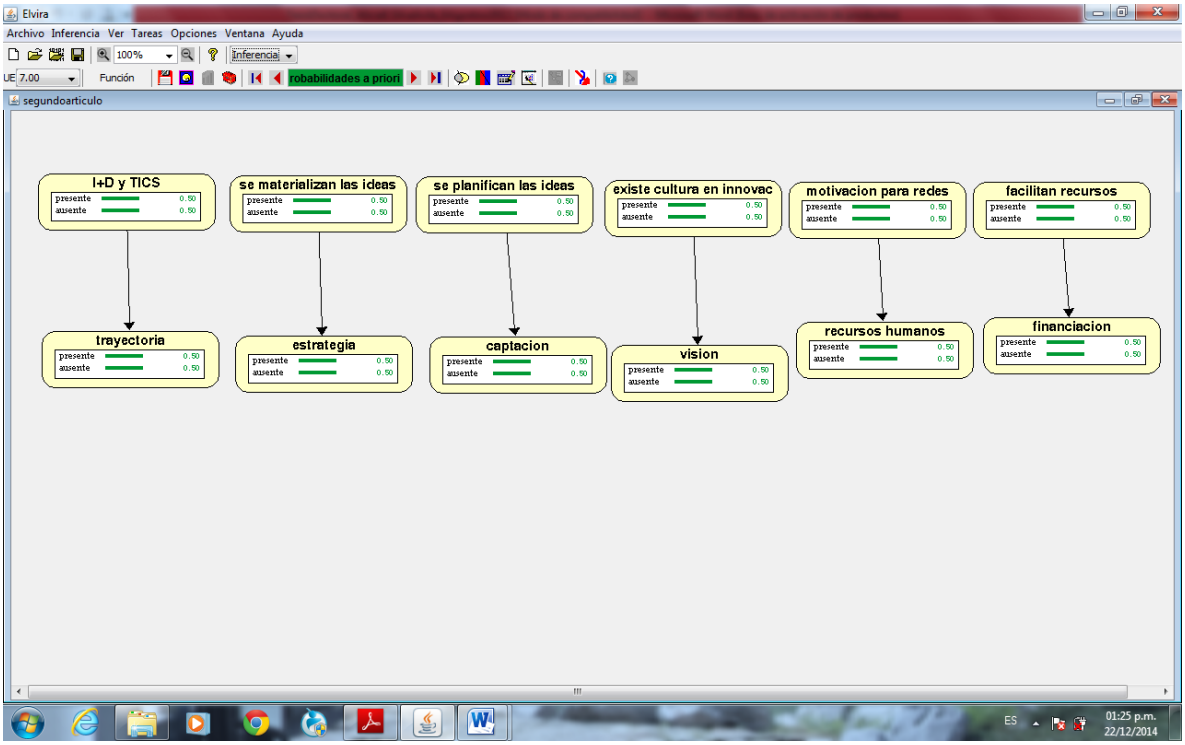


Figure 3. Relationship of the nodes

The cycle was conducted in a comprehensive manner to define and identify the most appropriate variables to help achieve the objectives outlined in the proposed research. If the model is accepted, the next step based on the plot 1 is:

STAGE WITH REGARD TO DIAGRAM 1

Identify the canonical model

There (OR gate, gate MAX, gate, etc.) canonical probabilistic models based on the interpretation of the parents of a node as causes or conditions for that node and the assumption of independence of causal interactions. These models reduce the number of network parameters, simplifying the acquisition of knowledge and even producing more efficient calculations. In this case, the model used was the OR since there is synergy between nodes causes.

With this situation, the innovation model associated with the node corresponds to a probabilistic OR gate, whose chances of reflecting the figure 4, which is taken from the software Elvira in edit mode.

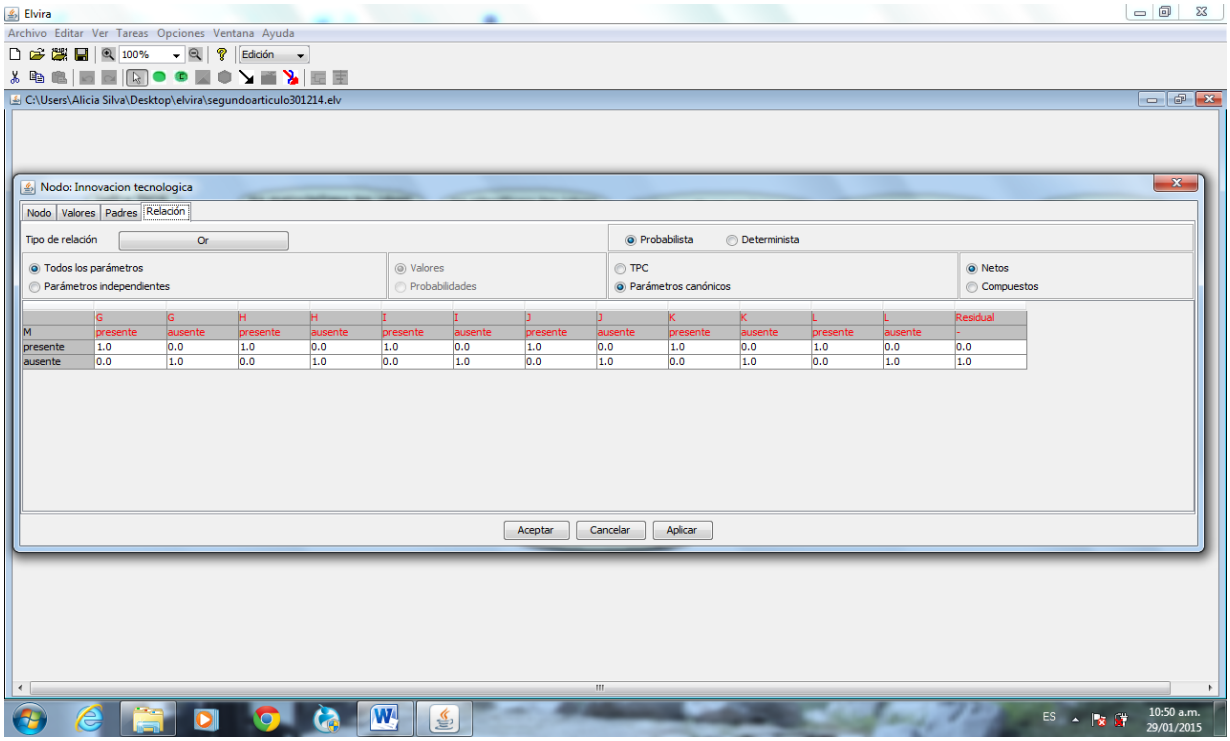


Figura 4. Probabilidades del nodo innovación con relación a los nodos causales

Obtaining probabilities

The probabilities assigned to each node of the network were obtained from the surveys of the faculties, which correspond to the first level of the Bayesian network, while the second level of the same correspond to the results of surveys made experts in the area, as seen in Figures 5 and 6.

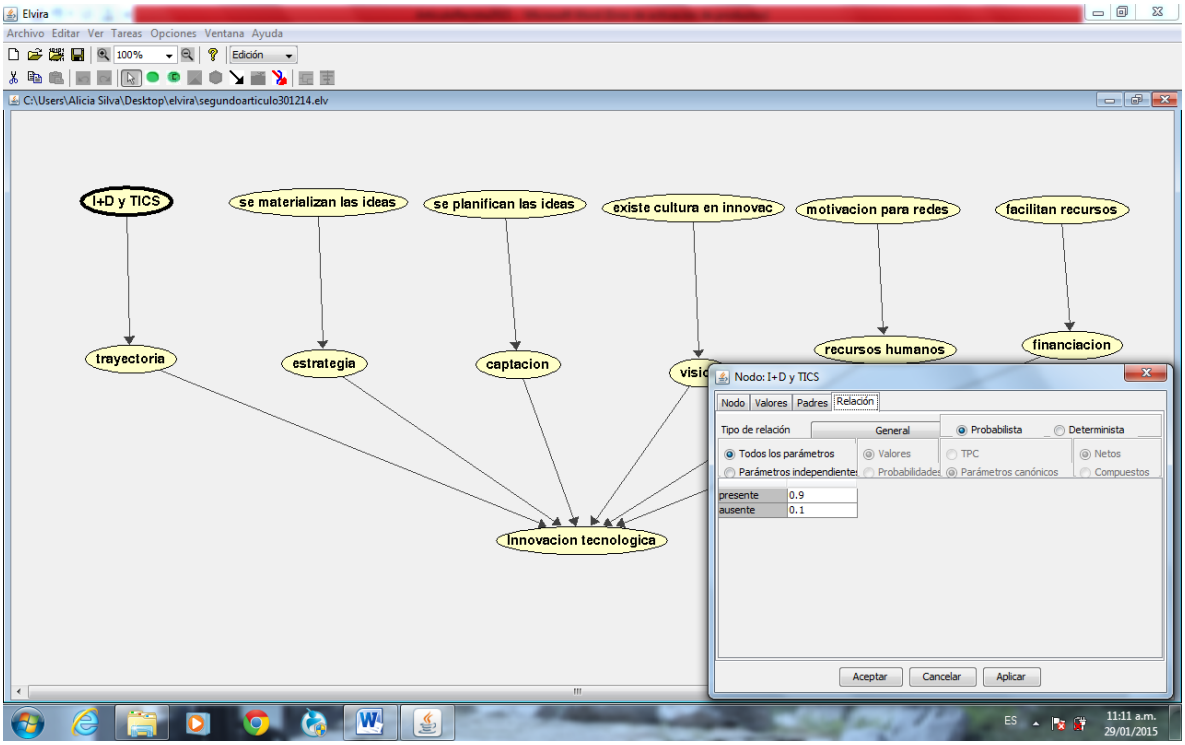


Figure 5. Mapping chances

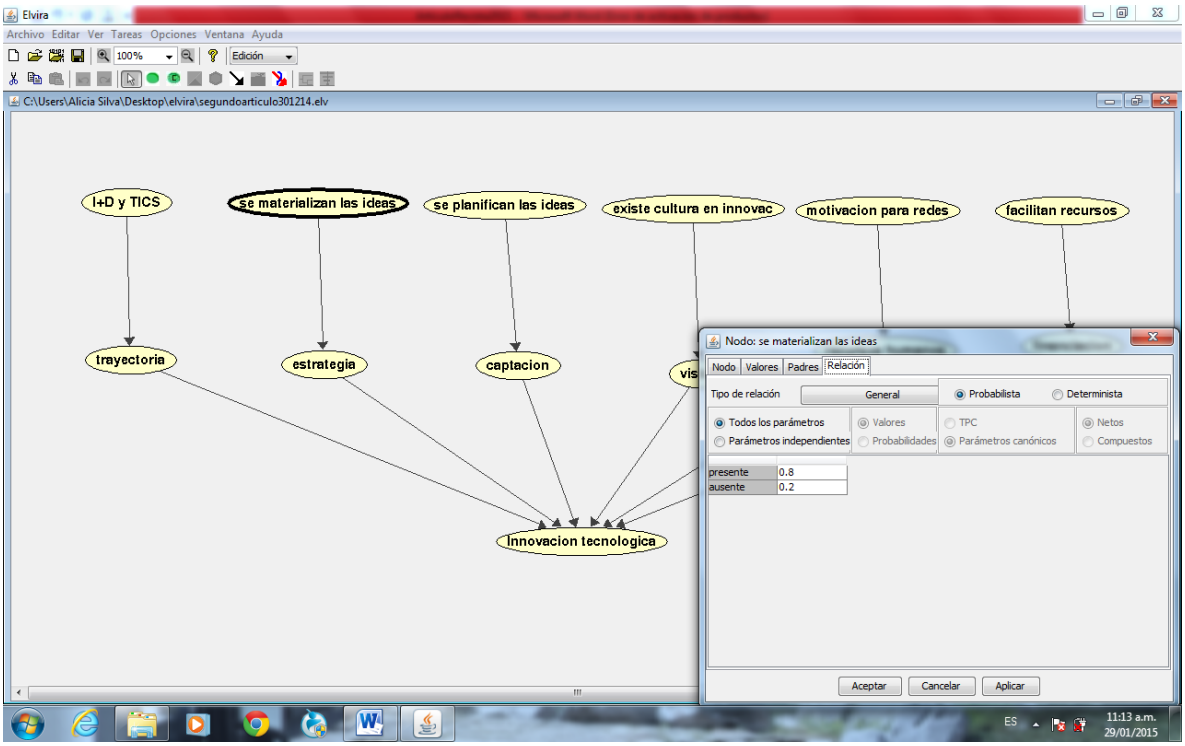


Figure 6. Mapping chances

Based on the above data, the network that feeds proceed to show how these values behave when viewed in the SW ELVIRA the inference mode.

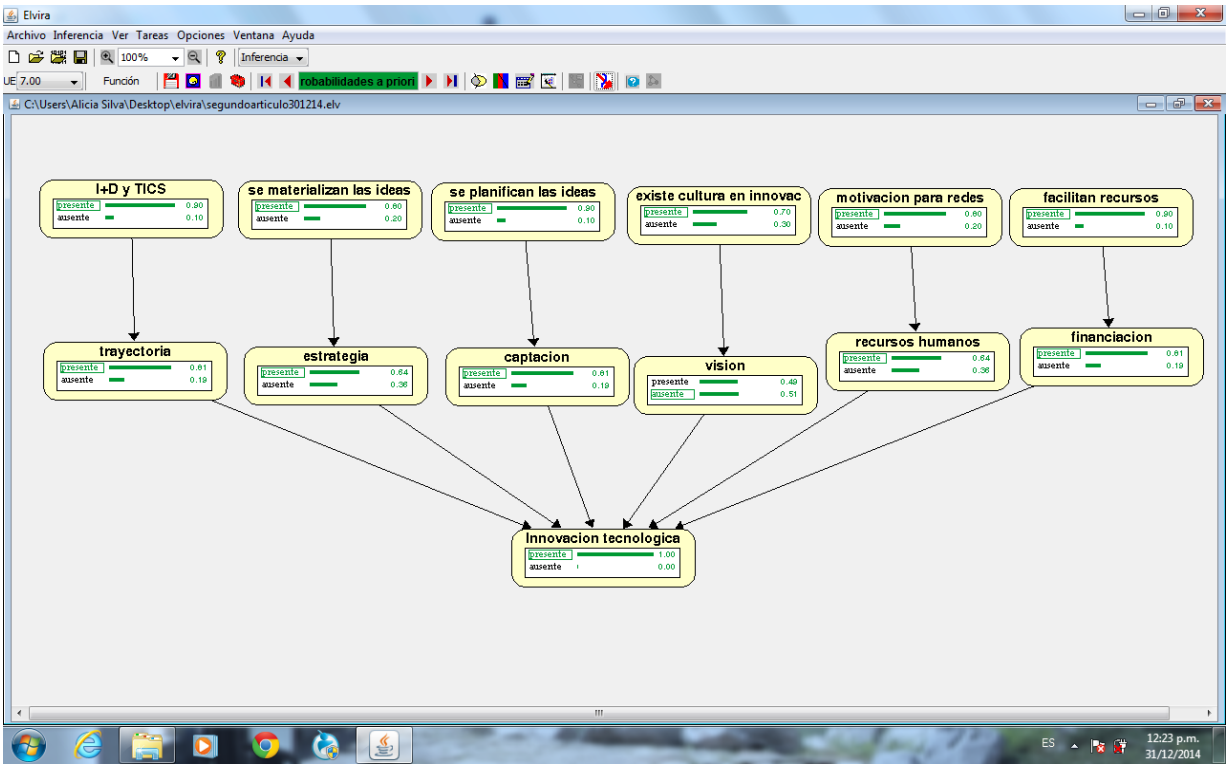


Figure 7. Securities taking nodes when innovation has probability 1.00

Assessment of possibility

The evaluation of probabilities was performed by experiments again and again with the SW-ELVIRA to expected according to expert opinion and previous studies values.

Results

By developing the expert system has the ability to respond through the model represented in the Bayesian network and these explanations can be presented verbally and graphically:

- The verbal explanation of the model is to display the information associated with a node or link selected by the user.

- The graphic explanation is to represent the kind of influence that each node transmits their children drawing links with different colors.

- The ability to manage different cases of evidence, which favors the visualization of the results of the sensitivity analysis of each node with respect to evidence and hypothetical reasoning, offering a simple way to study the results.

- The classification of findings that form the evidence depending on the type and the amount of influence they have on a particular variable, provides information on why the results obtained on that variable.

- Explanations are given only when the user requests it.

- In addition, the software is controlled by ELVIRA possible inconsistencies that can occur when attempting not permitted actions.

The results of tests performed using the model of expert system developed show that by managing innovation are organized and addressed both human and economic resources in order to increase the creation of new knowledge, generate ideas to obtain new products, processes and services or improve existing ones, and transfer of those same ideas to the stages of production, distribution and use.

Appendix 1. Bayesian networks

Bayesian networks model a phenomenon through a set of variables and the dependency relationships between them. Given this model, Bayesian inference can be made; that is, estimating the posterior probability of the unknown variables based on the known variables. These models can have various applications, for classification, prediction, diagnosis, and so on. They can also provide interesting information about how the variables in the domain, which can sometimes be interpreted as cause-effect relationships are related.

Bayesian networks are a graphical representation of dependencies for probabilistic reasoning, in which the nodes represent random variables and arcs represent direct dependency relationships between variables.

In a RB all conditional independence relationships represented in the graph correspond to independence in relations probability distribution.

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