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Expert systems as a tool supporting the assessment of the financial condition of business units

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ABSTRACT

The ubiquitousness of information systems means that more and more areas of the company's activity are moving into the virtual sphere. IT systems take over most of the complicated tasks performed by people, which has a positive impact on time and costs incurred for the implementation of these tasks. One of the areas in which IT systems are used is the area of financial management, and thus the management of the financial condition of the unit. This article aims to test the suitability of expert systems as tools that can support the analysis and assessment of the financial condition of business units. The theoretical part discusses the essence of IT systems, theoretical foundations of expert systems and their advantages and disadvantages. The research part shows the use of an expert system to conduct the analysis of the financial condition of selected enterprises based on data from the financial statements of these units from 2015. The expert system provided information on the financial condition of selected companies. These results were compared with the results of the analysis carried out in the traditional way. This confirmed the author's assumption that it is possible to replace the financial analysis carried out with traditional methods by using a properly prepared expert system.

Keywords: expert system, IT management systems, financial analysis, index analysis

1. INTRODUCTION

The information system is the foundation of every business unit. It allows the collection and processing of information and knowledge necessary for the functioning of the unit.

Nowadays, information systems are supported by IT systems that perform part of their tasks using computer techniques. Therefore, the IT system must effectively perform functions related to the acquisition, collection, processing and sharing of information [1].

The purpose of the IT system is to work with the received data and to return specific information to the end user. Based on this definition, it can be concluded that the IT management system processes data that is valuable from the point of view of broadly understood management [2]. In this case, the concept of "management" is not limited to managing an enterprise as a unit, but also covers more elementary and more abstract issues such as knowledge management, production process management, data records management, etc. [3]. Information management systems cover a very large number of IT systems of various types. Their division into specific groups is problematic, as the systems are constantly developing and intersect with each other. The currently used division criteria refer to information, hardware, functional, technological and constructional features.

The division of IT management systems interesting from the point of view of this article is a division according to the criterion of the scope of management support functions. Due to their specificity, IT systems are mainly used to support planning and control processes that are inseparable elements of the management process. The management itself is treated as a process that consists of decision sub-processes. This approach allows to adapt IT systems to individual sub-processes and determine to what extent they support and optimize a given area of activity [4]. Taking into account the criterion of supporting the individual stages of the entire decision-making process, the following systems can be distinguished [5]:

- Transaction Systems (TS),
- Executive Information System (EIS),
- Decision Support Systems (DSS),
- Knowledge Base Systems (KBS; with its sub-type expert systems ES).

Figure 1 shows the areas covered by these types of systems.

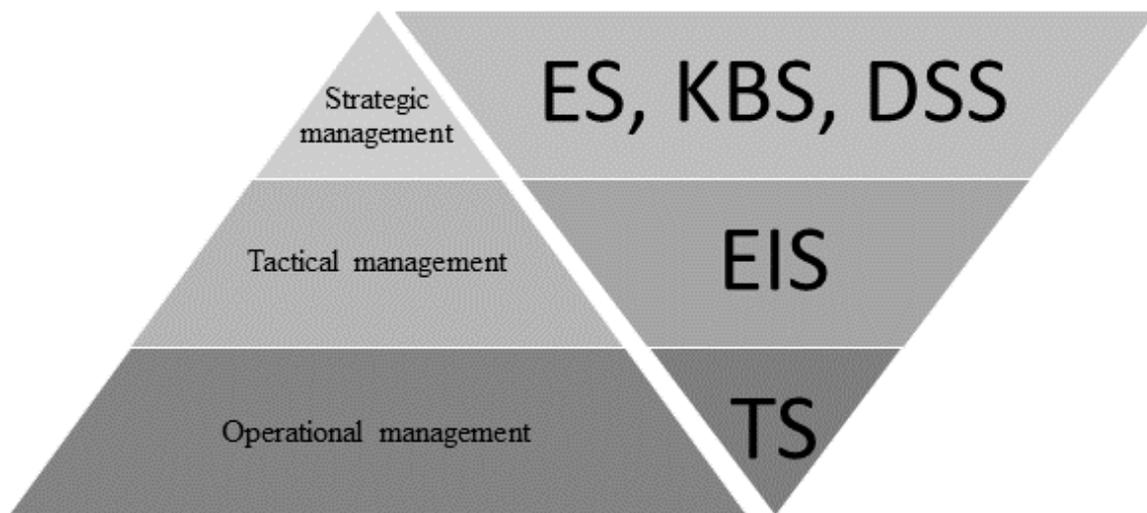


Figure 1. The scope of application of IT management systems in the decision-making process

Source: Author's own elaboration.

Transaction Systems are the first type of IT management systems. The low level of technological development makes them inconvenient to use. They cover only the most elementary areas of activity, such as current records and preparation of reports [6].

Executive Information Systems were created as a result of growing requirements and demand for comprehensive systems. They are an improved version of Transaction Systems. Due to greater flexibility, Executive Information Systems provide the desired information at different positions, including managerial positions [7].

Decision Support Systems were the next step in the development of IT management systems. They enable searching, processing and simulation of information necessary for making decisions by the company's management [8].

Knowledge Base Systems are based on the idea of artificial intelligence. They can be defined as programming systems in which specialist knowledge on the area of application is presented clearly and independently of general knowledge on how to solve the problem. These systems deal with weakly structured or non-structured problems [9].

The basic elements of such systems are knowledge base, rules of inference and interface. A special feature of these types of systems is their ability to learn. Knowledge Base System is in a sense an intelligent guide that can explain, justify and present the effects of possible decisions taken by the user. Another important aspect of the functioning of this type of systems is heuristics, or the rules of inference. They reflect the user's reasoning process when solving a given problem. The simplified type of Knowledge Base System is an expert system. They too are based on artificial intelligence, and their task is to imitate an expert in a specific field [10].

The aim of this article is to show the usefulness of Knowledge Base Systems in the field of financial condition analysis. For this purpose, the author created a database and rules of inference for an expert system that was further used to conduct a financial analysis for a few selected enterprises. The theoretical part of the study discusses the characteristics of expert systems, their construction, and their advantages and disadvantages. In order to conduct the research part, the author selected several companies from various industries. Based on their financial statements, the author has conducted a traditional financial analysis and analysis using the previously prepared expert system. Next, the obtained results were compared in order to determine the accuracy and usefulness of the expert system for conducting the analysis.

2. THE ESSENCE OF EXPERT SYSTEMS

Expert systems owe their name to the concept of an expert understood as a qualified person with knowledge in a given field and the ability to use this knowledge to solve given problems occurring within this domain of knowledge [11].

The expert system itself is a computer program designed to support the decision-making process. This task can consist of both simple assistance to the expert and their complete replacement, which is possible thanks to the ability to infer and make decisions based on the knowledge provided to the system. Expert systems are classified as artificial intelligence. The structure of these systems is functional and consists of the following elements:

- a knowledge base,
- inference system,
- explanatory module,
- dynamic database,

- knowledge base editor,
- user interface.

The knowledge base is a set of data representing the knowledge of the program. It is one of the basic components of the expert system. Data entered into the base cannot be contradictory, cohesion must be maintained [12]. Therefore, systems should themselves check the consistency of knowledge when the user enters new data or rules. The data constituting the knowledge of the system can be represented differently, so the knowledge bases can take the form of a database, a text database, a database of rules, a database of models or common sense knowledge [13].

The inference system is another basic element of the expert system. It is responsible for the processing of user knowledge and queries as well as for drawing conclusions and making decisions. Inference methods include forward, backwards, fuzzy and mixed methods [9-14].

The explanatory module enables the user to view the inference process. Its task is to explain to the user why the program gave a specific answer, why it asked a specific question, etc. [14]. The dynamic database has the task of storing data entered by users while solving the problem and saving the results of inference [15].

It is an additional element of the expert system. The knowledge base editor is another auxiliary element in the expert system. It allows access to the knowledge contained in the program and its formulation and modification. It allows the constant development and improvement of the system [16]. The user interface allows the user to communicate with the expert system. Through it, the user answers questions, provides it with the required information, asks for an explanation and receives a response from the system [17].

An exemplary structure of an expert system is shown in Figure 2.

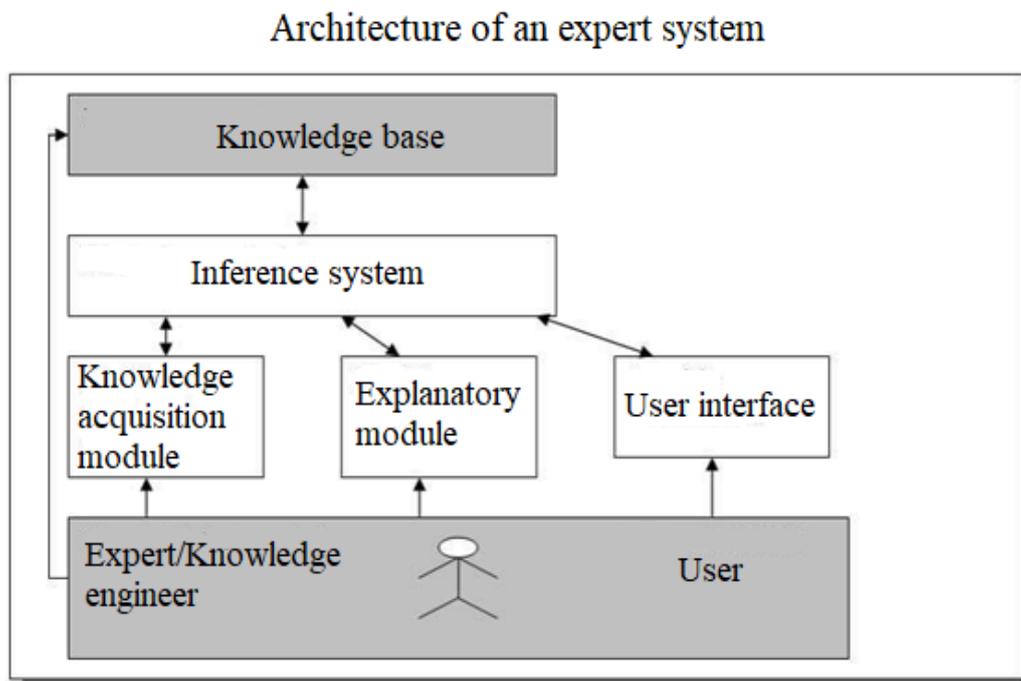


Figure 2. The structure of an expert system

Source: Liao S. H. [14]

As in the case of ordinary IT systems, expert systems can also be considered in the category of their advantages and disadvantages. The advantages of these systems include [18]:

- they are capable of quickly solving complex problems,
- the user gets an answer from the system, they do not have to solve the problem themselves, they only assess the quality of the obtained answer,
- the answers returned by the system are understandable to the user, no specialized IT knowledge is required to interpret the results,
- they are based on the knowledge of many experts in a given field, which increases the efficiency of work compared to one expert who uses only their own knowledge when solving a problem,
- once introduced to the system, knowledge can be used many times in an unchanged form, which affects the efficiency of the analysis and inference process,
- the risk of a mistake is much lower than in the case of a human being,
- the system accurately documents its inference process, which is impossible in the case of a human being,
- the knowledge on which the system is based can be easily modified.
- Some of the system's disadvantages include:
 - a limitation to a narrow field, the system is highly specialized,
 - it is impossible to predict what impact new knowledge will have on the inference process,
 - the transformation of the expert's knowledge to the form on which the system is based is an atypical and difficult task,
 - the system is able to present its inference process step by step, however, it is unable to explain why it used a specific approach to solve a given problem,
 - the system is not able to generate new knowledge yet, it can only use and duplicate existing knowledge,
 - it is problematic, and sometimes even impossible, to check the correctness of the system operation; this difficulty increases with the expansion of the system database and the degree of combinatorics used in the inference process.

Due to their diversity and flexibility, expert systems have many applications in various fields. Systemizing them according to the criterion of the area of use is difficult because they are used in many fields of science [19].

They can be useful for both clothing sellers and designers of space shuttles and nuclear reactors. Examples of areas in which expert systems are used include: monitoring of the telephone network, diagnostics (medical, technical etc.), speech recognition, interpretation of results obtained from physical objects (reactors, machines), identification of chemical compounds, interpretation of the results of measurements of various factors (chemical, physical), forecasting of various types of phenomena (weather, trends), analysis of enterprises or the market, supporting the creation of projects, supporting planning and scheduling, analysis of processes, factors, machines and devices as well as phenomena, supporting accounting, supporting service and customer relations, supporting logistic processes [20].

3. THE USE OF EXPERT SYSTEMS ON THE EXAMPLE OF SELECTED ENTERPRISES

For the purposes of this article, five companies from various industries were selected. All selected units are Polish joint-stock companies, due to the scope of data disclosed in their prospectuses. Based on data from their financial statements, the functioning and use of the expert system in the area of financial analysis were simulated.

Selected business units include:

- Berling S.A.,
- CD Projekt S.A.,
- Indykpol S.A.,
- Wawel S.A.,
- Wittchen S.A.

On the basis of financial data from financial statements from 2015, a simulation of the use of the expert system to assess the financial condition of selected enterprises was made. The database was created in the CAKE system, while the analysis was performed using the PC-Shell system. Both of these systems belong to the SPHINX artificial intelligence package created by the Aitech Artificial Intelligence Laboratory.

The indicators that the system asks the user for include: current liquidity ratio, quick ratio, debt to assets ratio, long term debt to assets ratio, debt to equity ratio, cash flow coverage ratio, return on assets, return on equity, return on sales, receivables turnover ratio, payables turnover ratio, inventory turnover ratio. Sample question from the system asked during the analysis of the company Berling S.A. is shown in Figure 3.

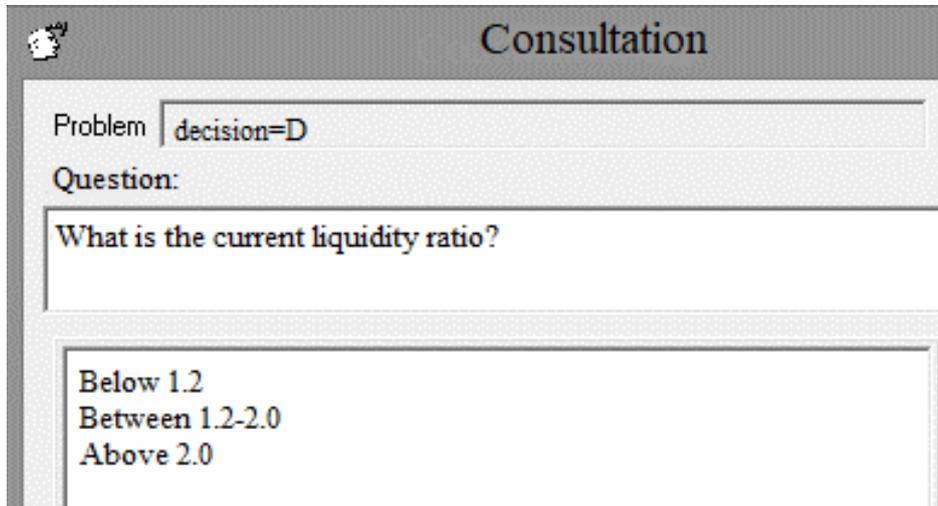


Figure 3. A question from the PC-Shell system for Berling S.A.

Source: Author's own elaboration in the SPHINX package

Based on the answers provided, the system determined the financial situation of Berling S.A. The solution proposed by the system is presented in Figure 4.

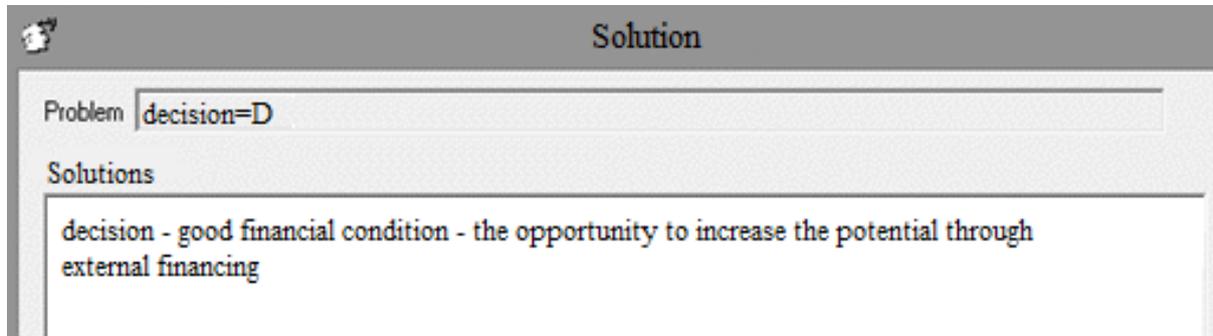


Figure 4. The PC-Shell system solution for Berling S.A.

Source: Author's own elaboration in the SPHINX package

Analysis carried out using the PC-Shell system showed that the financial condition of Berling S.A. can be described as good. Based on the answers provided, the system determined that the share of foreign capital in the entity is low and increasing the level of external financing may contribute to the growth of the entity's potential and achievement of better financial results. In addition, the entity has a fairly high over-liquidity of assets, but this does not significantly affect its operations and financial stability.

Sample question from the system asked during the analysis of the company CD Projekt S.A. is shown in Figure 5.

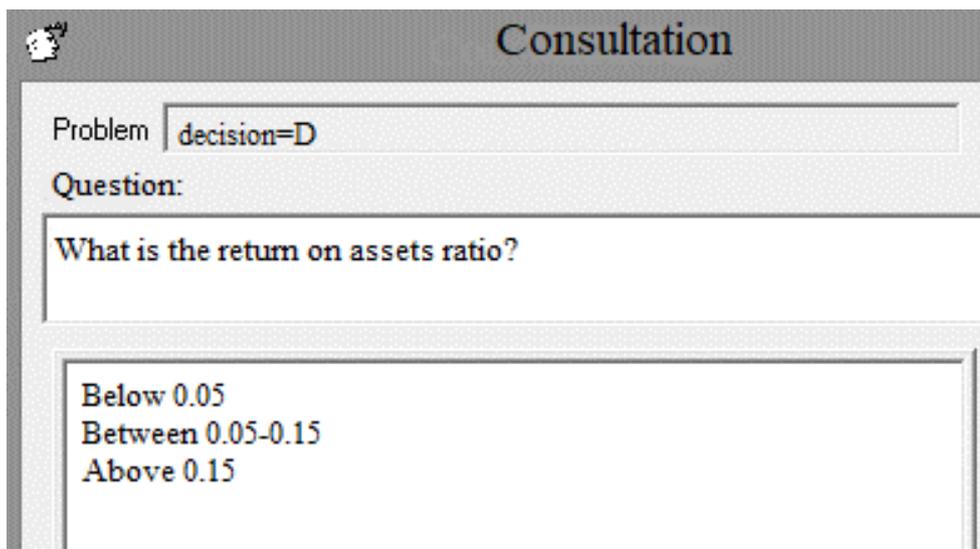


Figure 5. A question from the PC-Shell system for CD Projekt S.A.

Source: Author's own elaboration in the SPHINX package

Based on the answers provided, the system determined the financial situation of CD Projekt S.A. The solution proposed by the system is presented in Figure 6.

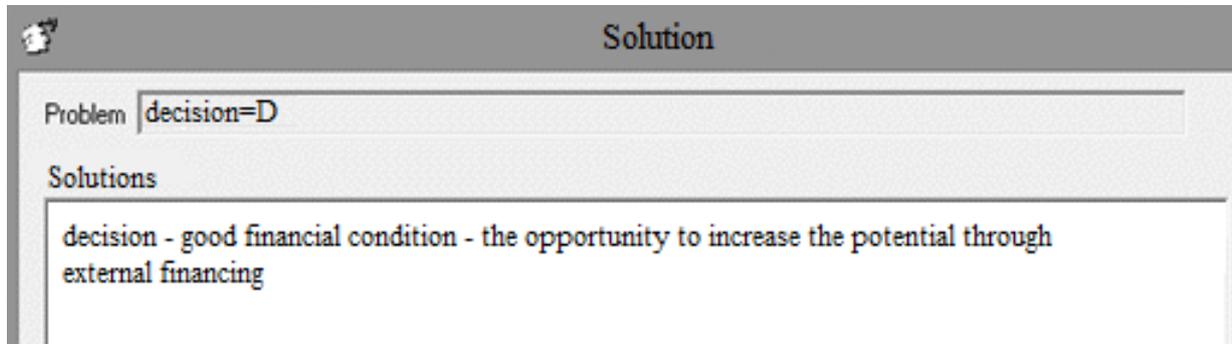


Figure 6. The PC-Shell system solution for CD Projekt S.A.

Source: Author's own elaboration in the SPHINX package

As in the case of Berling S.A., based on the answers provided, the PC-Shell system determined the financial condition of CD Projekt S.A. as good. Also, in this case, the system recommends increasing the share of external financing due to the very high share of equity in the financing of the unit. The unit also has a low over-liquidity of current assets, however, it does not cause a significant deterioration of its financial results. In addition, CD Projekt S.A. is characterized by high profitability of resources.

Sample question from the system asked during the analysis of the company Indykpol S.A. is shown in Figure 7.

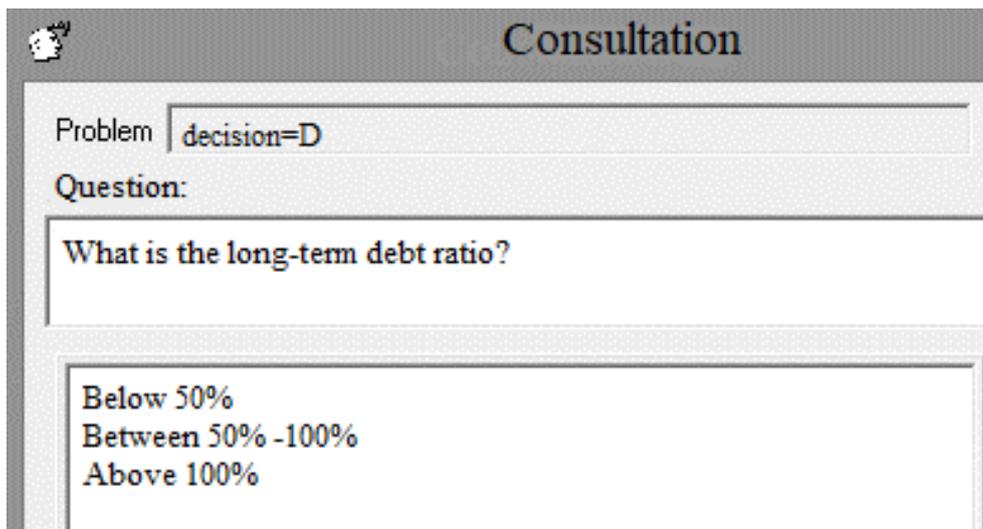


Figure 7. A question from the PC-Shell system for Indykpol S.A.

Source: Author's own elaboration in the SPHINX package

Based on the answers provided, the system determined the financial situation of Indykpol S.A. The solution proposed by the system is presented in Figure 8.

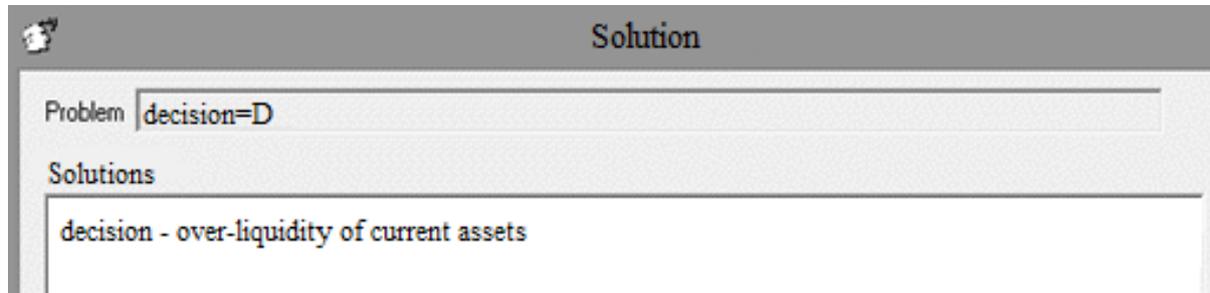


Figure 8. The PC-Shell system solution for Indykpol S.A.

Source: Author's own elaboration in the SPHINX package

In the case of Indykpol S.A., the PC-Shell system has determined that the answers provided indicate too high liquidity of the entity's assets. Also, its profitability is quite low, however, combined with the optimal use of its own and external financing, this does not deteriorate its financial results. The general condition of the company can be described as good. Sample question from the system asked during the analysis of the company Wawel S.A. is shown in Figure 9.

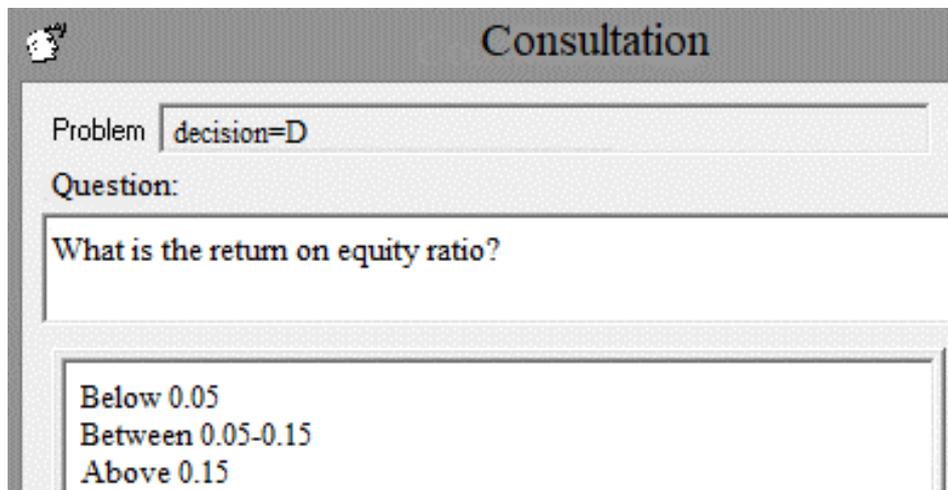


Figure 9. A question from the PC-Shell system for Wawel S.A.

Source: Author's own elaboration in the SPHINX package

Based on the answers provided, the system determined the financial situation of Wawel S.A. The solution proposed by the system is presented in Figure 10.

The PC-Shell system described the financial condition of Wawel S.A. as good. As in the case of Berling S.A. and CD Projekt S.A., it recommends increasing the share of external financing, as the share of foreign capital in the entity's balance sheet is very low. In addition, the entity achieves high profitability of its resources, which translates into an increase in its financial stability. Sample question from the system asked during the analysis of the company Wittchen S.A. is shown in Figure 11.

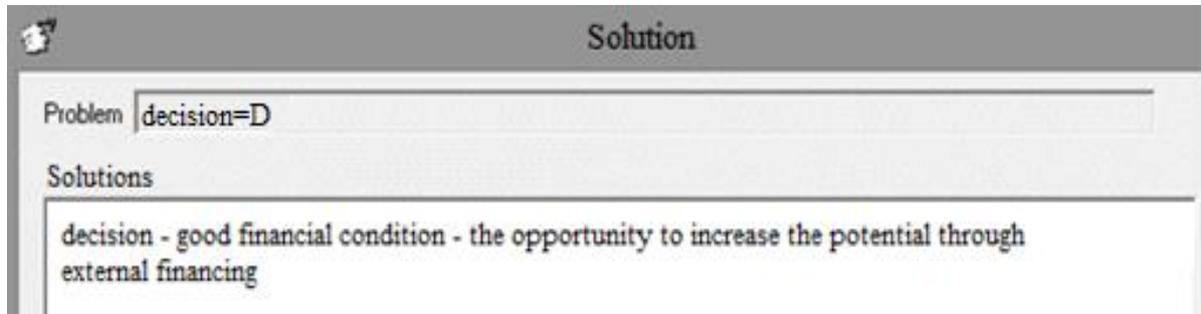


Figure 10. The PC-Shell system solution for Wawel S.A.
Source: Author's own elaboration in the SPHINX package

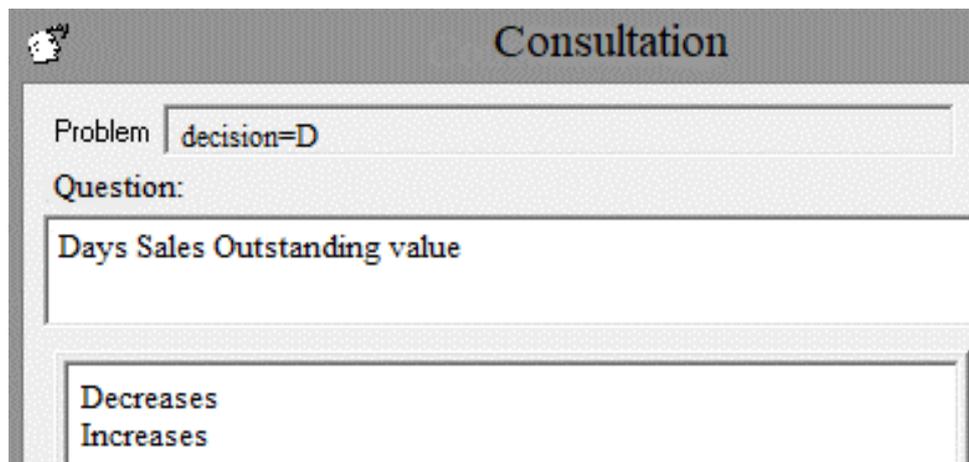


Figure 11. A question from the PC-Shell system for Wittchen S.A.
Source: Author's own elaboration in the SPHINX package

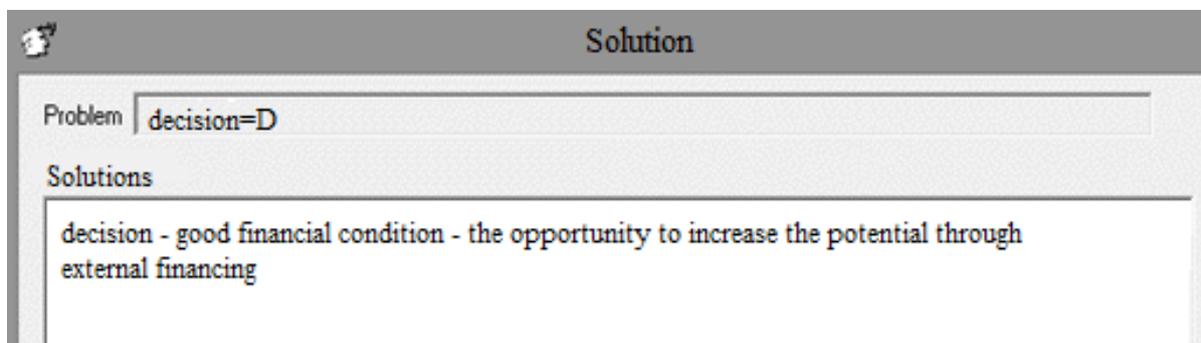


Figure 12. The PC-Shell system solution for Wittchen S.A.
Source: Author's own elaboration in the SPHINX package

Based on the answers provided, the system determined the financial situation of Wittchen S.A. The solution proposed by the system is presented in Figure 12.

In the case of Wittchen S.A., the PC-Shell system provided information about the good financial condition of the entity and pointed to the possibility of increasing the potential by increasing the level of external financing. The unit also has a small over-liquidity of assets and high profitability, which means that an additional burden of debt servicing costs would not jeopardize its financial stability.

4. CONCLUSIONS

The simulation of the use of the expert system was based on the PC-Shell system of the SPHINX package. The analysis was based on the index analysis. Answers obtained from the PC-Shell system indicate that none of the surveyed enterprises is threatened with bankruptcy. Berling S.A., CD Projekt S.A., Wawel S.A. and Wittchen S.A. are characterized by a good financial condition. These entities use foreign capital to a very small extent, so the program suggested an increase in the share of external financing, which in appropriate conditions may lead to further growth of the company's potential. Of course, this is not a necessary condition and each unit should determine on its own whether it wants to take advantage of such a possibility and whether the nature of its activities and development plans determine such a possibility as favorable.

A summary of the results of the conducted simulation is presented in Table 1.

Table 1. The results of the simulation.

No.	Enterprise	Simulation result
1.	Berling S.A.	Good financial condition
2.	CD Projekt S.A.	Good financial condition
3.	Indykpol S.A.	Over-liquidity of current assets
4.	Wawel S.A.	Good financial condition
5.	Wittchen S.A.	Good financial condition

Source: Author's own elaboration

The company that obtained a different result from the others was Indykpol S.A. In the case of this enterprise, the PC-Shell system reported over-liquidity of current assets. The analysis of individual indicators shows that in the case of other entities there was also excess liquidity, however in the case of Indykpol S.A. this area was highlighted due to the optimal management of equity and foreign capital, and therefore the program chose another area in which improvement can be made.

Simulation of the use of the expert system for assessing financial condition has shown that proper preparation of the knowledge base and determination of rules according to which the system is to operate will bring positive results and adequately reflect the financial situation of the surveyed enterprises. Only the basic indicators in the field of financial analysis were

introduced to the knowledge base, thus the solutions proposed by the system were quite limited and were based on the most appropriate answers, omitting less important nuances. It can, therefore, be concluded that a properly prepared expert system is an adequate tool to support the process of assessing financial condition, and the greater its accuracy, the more its usefulness in this area increases. Furthermore, the system used in this study contained only basic financial indicators. It is possible to expand it with more advanced tools, such as discriminatory analysis, and to add qualitative measures, making it an even more efficient and comprehensive research tool.

In conclusion, this article aimed to examine the suitability and reliability of expert systems as tools for assessing the financial condition of business units. The results obtained from the system are identical to the results obtained when conducting the analysis using the traditional method. This means that a proper preparation of an expert system may lead to a reduction of the need to employ an expert in financial analysis, which will shorten the time of analysis and reduce the costs that an enterprise would have to incur to employ a said expert.

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