CREDIT EXPERT – EXPERT SYSTEM FOR CREDIT APPLICATIONS EVALUATION

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Abstract: In today's world there are a lot of examples of collaborations between information technology and economics. However, there are still some importatnt areas of economy, in which contribution of modern technologies is too small. Author has decided to focus on the credit scoring evaluation process management. The main goal of the author's study was to develop the computer tool to support management of credit applications evaluation process, using artificial intelligence techniques. To achieve this purpose, author has decided to build an expert system – CreditExpert. This paper describes the credit scoring phenomenon, shows how to build good scorecard, and then carries the reader step by step through the whole process of developing the expert system.

Keywords: expert systems, artificial intelligence, credit decision, credit scoring, credit.

1 Introduction

Due to the rapid development of technology, especially information technology, which can be seen in past few years, many areas of science are able to explore the entirely new, undiscovered cognitive opportunities. One of such areas is economy, which is currently using, at almost every step, the latest achievements of modern technology. Cooperation of these two disciplines of science made it possible to better know, understand and facilitiate the management of economic processes.
However, there are still some important areas of economy, in which contribution of modern technologies is too small. Author has decided to focus on the credit scoring evaluation process management. This process is crucial in today's world. Moreover, it is hard to imagine the world without banks, credits or credit cards. People all over the world are almost addicted to them and need them in life nearly as much as oxygen.
Nowadays, the credit scoring evaluation process depends on human experts, who are responsible for evaluation of the credit applications and making decision to accept or to reject it. The problem appears, when there is lack of such human experts on the labor market. Another thing is that the assessment made by human expert could be subjective to some extent. He may also commit some mistakes due to fatigue, stress or other negative factors. One of the solutions for this problem is automation of the credit scoring evaluation process, by developing computer expert system, which could eliminate the necessity of human expert participation in this process.
The main goal of the author's study was to develop the computer tool to support management of credit applications evaluation process, using artificial intelligence techniques. To achieve this purpose, author has decided to build an expert system - CreditExpert.

2 Credit Scoring

2.1 What is Credit Scoring?

There are a lot of definitions of credit scoring in literature. However, author has chosen two of them, which seems to capture the whole essence of this phenomenon. The first one has been proposed by Anderson, who in very simple words states this term as:

"…the use of statistical models to transform relevant data into numerical measures that guide credit decisions."[1]

The second one, which has been stated by Thomas, Edelman and Crook in their "Credit Scoring and Its Applications", and according to them:

"Credit scoring is the set of decision models and their underlying techniques that aid lenders in the granting of consumer credit. These techniques decide who will get credit, how much credit they should get, and what operational strategies will enhance the profitability of the borrowers to the lenders."[3]

2.2 Scorecard Development Process

One of the most important things in the credit scoring process is the scorecard development. According to E. Mays:

"A scorecard is a system for assigning points to borrower characteristics in order to derive a numeric value that reflects how likely a borrower is relative to other individuals to experience some event or perform some action."[2]

The process of developing the scorecard is very complex and consists of six main stages: Project preparation, Data preparation, Scorecard modeling, Finalization, Decision-making and strategy, Security. The simplified development process is presented in figure 1.

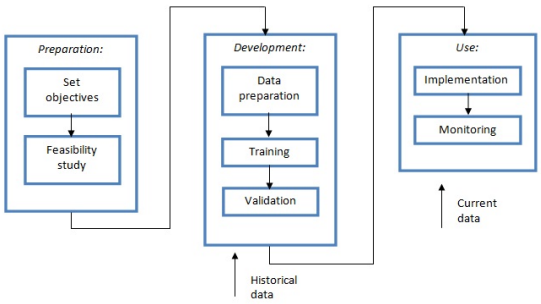

Figure 1 Scorecard Development Process.
Source: [1]

3 Building the Credit Scoring Expert System

The main goal of the author's study was to develop the computer tool to support management of credit applications evaluation process, using artificial intelligence techniques. For this purpose, author has decided to build an expert system – CreditExpert. Development process of the system has been managed by the author on the basis of scorecard development process.

3.1 Project Preparation

Preparation for developing CreditExpert system mainly refers to setting objectives and feasibility study. Author has planned functionality of the system precisely. According to his assumptions, CreditExpert has to be able to:

- evaluate the credit application and decide if it should be Accepted, Rejected or Consulted with the superior,
- save the solution of evaluation to the database,
- evaluate customer's profile,
- evaluate customer's financial situation,
- evaluate credit guarantees,
- browse the database with solutions.

Feasibility study has shown that there are no contraindications to develop the system. Implementation has been dependent on the minimal requirements of AITECH Sphinx package [5], which author has decided to use to build his system, and availability of MS Access Database. Fortunately, minimal requirements of the Sphinx package can be fulfilled by PC with a clock rate of only 486 MHz processor and 8Mb RAM, using Windows 98 operating system or newer. And MS Access Database is one of the components of the well-known and widely used MS Office package.

3.2 Data Preparation and Scorecard Modeling

CreditExpert, expert system for credit application evaluation, consists of one knowledge base and four knowledge sources, which include 312 rules. Rules have been built with the help of the expert from the field of banking and credits, who is responsible for judging if the customer's application should be accepted or rejected in every day work. Moreover, during the building of the system, author had the opportunity to observe and analise the module of the system developed for one of the Polish commercial banks in Microsoft Excel environment, which is in use in daily work in this bank.
Author has decided that credit decision depends on 3 main factors: customer's profile, financial situation and credit guarantees. These main factors depends on another smaller factors. Dependencies diagram is shown in figure 2.

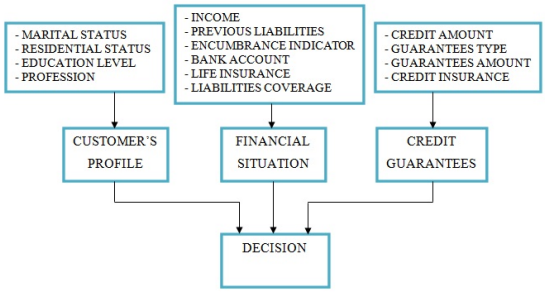

Figure 2 Dependencies Diagram.
Source: Own Study.

Credit Expert system consists of 4 knowledge sources: *Decision.zw*, *Guarantees.zw*, *Finance.zw* and *Profile.zw*.
Decision.zw knowledge source, assesses the credit application on the basis of customer's profile, guarantees and financial situation. Decision could be defined as one of three values: to reject, to accept or to consult the decision with the superior. Before developing CreditExpert system, author has made some assumptions relating to rules coded in knowledge sources. In case of making credit decision, the main assumption is that the bank does not grant the credit to customers with bad financial situation, bad guarantees or sufficient financial situation and bad profile. In other cases, in which the financial situation is only sufficient or the customer's profile is bad, the final decision should be consulted with the superior, because there is a high risk for the bank and customer may be asked to submit the additional credit guarantees, which would decrease the level of risk. In other situations, the decision should be to accept the credit application. The example of rule from *Decision.zw* knowledge source is presented below.

```
16:     decision = "Consult" if
        guarantees = "Very Good",
        finance = "Sufficient",
        profile = "Very Good";
```

As it has been mentioned before, credit decision depends on three factors. The basic condition for receiving the credit is to provide adequate guarantees for the bank. Most banks would like to receive the guarantees, which cover the amount of credit at least twice. Credit guarantees are defined in the *Guarantees.zw* knowledge source. They could be assessed as 'Bad', 'Good' or 'Very Good'. The value of guarantees depends on the credit amount, guaratees type, level of coverage of the credit amount by the guarantees and credit insurance.

```
53:     guarantees = "Bad" if
        credit_amount = "50 000 - 100 000 PLN",
        guarantees_amount = "< 1",
        insurance = "No";
```

The next condition for receiving credit is stable financial situation of the customer. This factor is defined in the *Finance.zw* knowledge source. Customer's financial situation could be assessed as 'Bad', 'Sufficient', 'Good' or 'Very Good', depending on his monthly income, previous liabilities payment, encumbrance indicator, level of liabilities coverage and facts if the customer has the bank account and life insurance.

```
154:    finance = "Good" if
        income = "> 5000 PLN",
        previous_liabilities = "Yes",
        encumbrance_indicator = "50 - 55%",
        account = "No",
        life_insurance = "Yes",
        liabilities_coverage = "Yes";
```

The last condition, which influences the credit decision is customer's profile. It is described in *Profile.zw* knowledge source. Customer's profile could be assessed as one of three values: 'Bad', 'Good' or 'Very Good'. The assessment basis on the answers for couple of questions concerning customer's marital status, residential status, profession and education.

```
224:    profile = "Very Good" if
        marital_status = "Married",
        residential_status = "Flat Ownership /
                             House Ownership",
        profession = "Own Business",
        education = "Secondary";
```

3.3 Finalization – CreditExpert Knowledge Base Coding

All of knowledge sources, which have been previously described are used by the *CreditExpert.bw* knowledge base. Knowledge base is the main program file, which defines the whole program, its menu and functionality. It is build from 2 main blocks – sources block and control block. The sources block is responsible for definition of all of the knowledge sources used by the knowledge base. While control block determines the main program and all of its functions.
After running the application, its vignette appears and user is asked to log into the system.

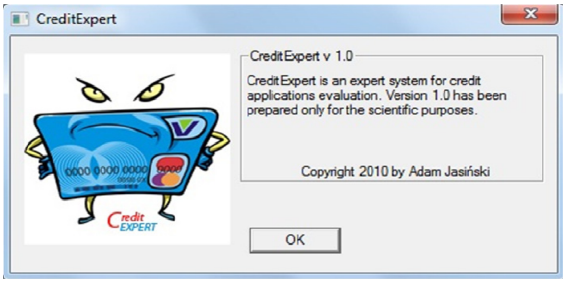

Figure 3 Vignette From the CreditExpert System.
Source: Own Study.

If the log in procedure is successful, user sees the main menu and can choose system's option he is interested in. In this paper we will focus only on the main option of the system – Credit Application Evaluation.
After choosing this option, the questionnaire appears on the screen and user has to fill the information about credit (credit amount, crediting period, total amount of guarantees), financial situation (average income, monthly liabilities) and personal data (name, surname, pesel number). On the basis of this information system adds new facts, which are necessary in guarantees and financial situation assessments.

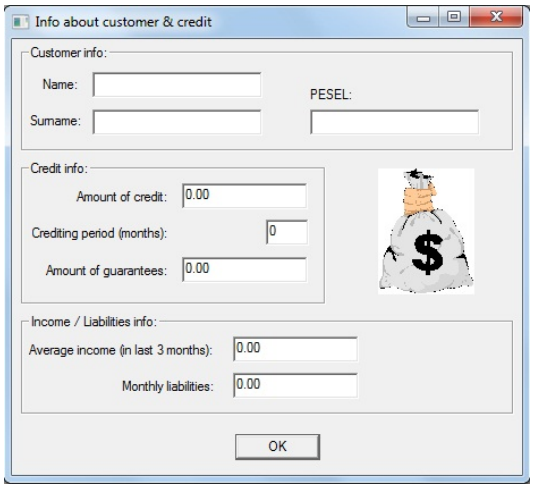

Figure 4 Questionnaire From CreditExpert System
Source: Own Study.

Then CreditExpert asks a few questions to user and performs the evaluation of customer's profile, financial situation and guarantees, which lead to the final, credit application evaluation.

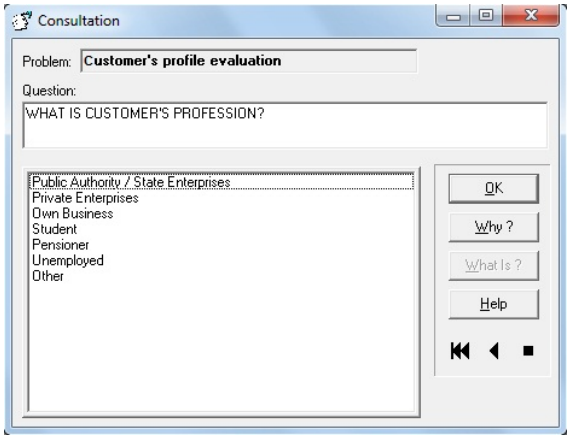

Figure 5 Example of Question Asked by CreditExpert System..
Source: Own Study.

After answering for all of the questions in consultation, system displays the solution and connects with the MS AccessDatabase – *CreditExpert.mdb*, where using sql statements the solution is saved.

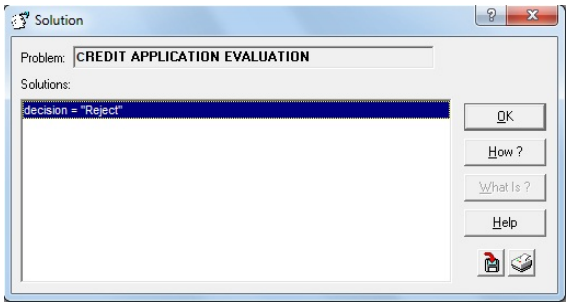

Figure 6 Decision Made by CreditExpert System.
Source: Own Study.

3.4 Validation

The purpose of the validation stage is to ensure the developer that the system will be working well in practice. To validate the CreditExpert system, author has made some research. 100 credit applications have been analyzed by the CreditExpert and by the expert from bank simultaneously. Both types of consultations have been performed on the same, sample data.
It is assumed that expert system's quality is on satisfactory level, when system can resolve over 75% of cases, and the number of errors does not exceed 5%. [4]
CreditExpert has been able to resolve 81% of cases, while 19% of cases have required the consultation with human expert. Only these 81% could be used in comparison of results between CreditExpert expert system and human expert evaluations. From this 81 cases, CreditExpert system has made only 4 mistakes – 3 applications, which have been accepted by expert system, has been rejected by human expert, and 1 application, which has been rejected by CreditExpert should be accepted.

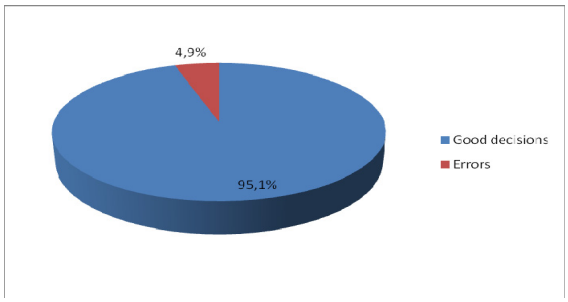

Figure 7 Percentage of Good Decisions and Errors Generated by CreditExpert System.
Source: Own Study.

After validation, CreditExpert system is ready to be implemented and used in everyday work in bank. Despite of this fact, it is important to remember that development process is not finished. The last step is ongoing monitoring.

4 Summary and Conclusions

The main goal of the author's study was to develop the computer tool to support management of credit applications evaluation process, using artificial intelligence techniques. To achieve this purpose, author has decided to build an expert system – CreditExpert, which should be able to replace or to decrease the role of human experts in credit application evaluation process.
On the basis of the research results (validation stage), it can be stated that CreditExpert system can be effectively used in financial institutions and for sure it will support and facilitiate the management of the credit scoring evaluation process. However, author realizes that his system is not free of defects or weaknesses. He thinks that this version of CreditExpert cannot eliminate human experts from the credit application evaluation process at all. He assumes that the version 1.0 of CreditExpert could be rather used by customers before applying for a credit in bank, instead of using it for making final credit decisions.
In the future versions of the system, author will try to increase system's efficiency and to decrease a number of its mistakes. His purpose will be to improve CreditExpert in such way that it will be able to resolve 100% of cases and to eliminate the participation of human expert in a process of credit applications evaluation.
In a few years, systems basing on artificial intelligence technology, including expert systems, will be used all over the world, in almost every area of business. They will enable automation of different business processes, which will facilitate the work of enterprises and will reduce unnecessary risk of making mistakes. As a final conclusion, it has to be said that it is worth to invest in modern technologies, because they allow rapid development of enterprises and being competitive in today's highly demanding market.

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