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## **DEVELOPMENT OF A ANALYSIS SYSTEM FOR COMPANIES FINANCIAL STATEMENTS ANALYSIS**

**Abstract**

*Balance Consulting Ltd is a Finnish company specialised in the analysis of companies. The writers have participated in making an expert system for the ratings and making verbal analysis based on the financial statements. With a computer program can be produced cost effective analysis that can be compared to the makings of a experienced human analyst.*

**Keywords:**

*Prolog, Financial Statement analysis,*

# 1. Introduction

**Balance Consulting Ltd** is a Finnish company specialised in the analysis of companies and industries. For both own and customer use it has developed several of expert systems. In this paper, an expert system called **FinancialStatementAnalyser** is introduced. It is specially designed for the analysis of companies financial statements, company ratings and verbal evaluations of the company's financial position and development.

## 1.1 *Need for a financial statement analyser*

**Financier companies** and other organisations having to make large investments will need to evaluate the economical state and development of companies. In principle, the greater the risk the more carefully the risk will be evaluated. The starting point will always be the analysis of the financial statement.

The financial statements of a company will always be presented in numerical form. The interpretation of the numerical information requires not only ability to perceive numbers but also experience about financial statements analyses. A coherent picture will be more easily discovered based on a verbal analysis than based on a large numerical table. For example, in wholesale the satisfactory level of operating margin is two percent of the net sales. For a machine shop company the corresponding satisfactory level is about 15 percent of the net sales. The interpretation of the key figures is thus dependent on the industry. The figures in the profit and loss account and Balance sheet are related to each other. Therefore the analyst must be able to focus attention into several aspects at the same time.

From the complexity of the task a problem arises: an analysis made by a person is very expensive. If a financial statement analyst writes a two to three page analysis about the economical state and development of a company, the job will take approximately from two to three hours. Banks and insurance companies have thousands of companies as customers and the making of verbal analyses would require too much human (and so financial) resources.

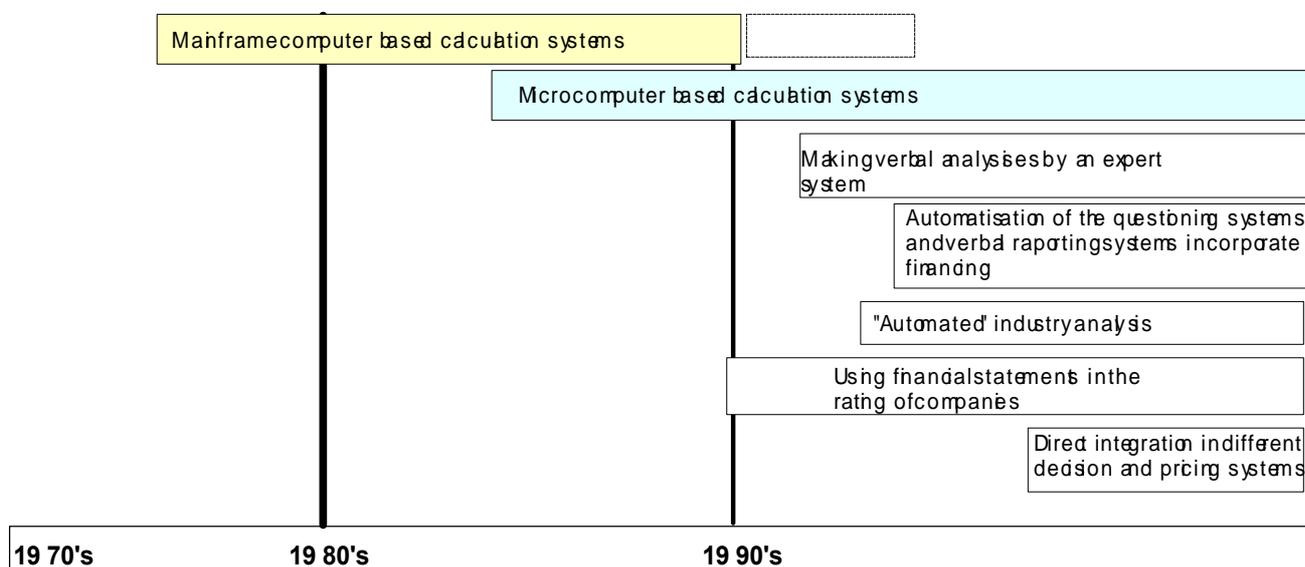
The making of **company analyses** and **financial statement analyses** are well structured and standardised activities with years of research and experience about them. An expert system can be fairly easily built around these activities while still keeping the resulting programming costs below the earnings produced by the analyses made with the expert system.<sup>1</sup>

A financial statements analysis made by a computer program can not reach the level of an analysis made by an experienced human analyst who does his job carefully and has a good intuitive ability to combine different aspects of the information. The program, on the other hand, can handle large amounts of information with low costs and produce on every run results that may go unnoticed by a human analyser. The information may for example be too complicated or the human analyst may be tired or busy.

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<sup>1</sup>Expert systems are often criticized for large costs compared to the resulting profit. One explanation for this are the initial unreasonable expectations for the resulting expert system. Many unsuccessful expert systems were planned to handle too large areas of expertise. As a result, the expert system programming projects have become too complicated and the costs have exceeded those expected.

## 1.2 Computer software used in Finland for the analysis of financial statements, five development stages



### I STAGE      COMPUTERIZING CALCULATIONS

In the end of 1970's the first computer based calculation systems designed for the analysis of financial statements were made. The programs were designed for mainframe computer environments. The first system used in professional environment was used in the Industrialisation Fund of Finland Ltd.

The system shortened the time needed for calculations by an analyst and the making of different kind of prognosis simulations became easier.

### II STAGE      DATABASE CAPABILITIES AND THE AUTOMATION OF FOLLOW-UP ACTIVITIES

Along with the development of the computer software and hardware the database capabilities were added into financial statement analysis software. Thus it became possible to compare companies with each other and collect statistical information about larger groups of companies.

Second generation main frame financial analyser software was made in a project by Industrialisation Fund of Finland Ltd, in which also Union Bank of Finland Ltd (today Merita Ltd) and Postipankki Ltd participated.

### III STAGE      COMPUTER SYSTEMS TRANSFERRED INTO PC-environment

At the beginning of 1980's the fast development of personal computers started. Because the real time requirements for large scale company analysis activities are fairly modest Industrialisation Fund of Finland Ltd got the idea of transferring financial statement analysis systems into PC environment. An important stimulus for this kind of development came from the high costs of main frame computer systems. In 1985 the first Micro-TRENNUS was made. In 1987 a project was started in Industrial Fund of Finland Oy, in which the whole financial statement analysis system was transferred into PC environment. At the same time, the maintenance and purchasing costs of financial statement analysis systems diminished into a small fraction of the former costs.

Most Finnish banks and insurance companies that make large amounts of financial statement analyses use tool made for PC environment.

#### **IV STAGE      COMPUTERIZING INTERPRETATION**

By the 1980's the computing capacity of PC environment has grown to a large extent. The expert systems have developed from academic toys into useful tools along with the development of programming languages.

The most important obstacle in the full blown use of a financial statements analyser is the requirement for an experienced eye that can interpret numerical tables produced by the programs. However, this numerical information can be transformed into text and pictures and in the future straight into speech (the computer will speak the economical state of a company).

#### **V STAGE      AUTOMIZATION OF THE COMPANY ANALYSIS ACTIVITIES**

Economical fluctuations and tightening competition in the field of financing sets new challenges for the methods of company analysis. The growing usage of computers in company analysis does not mean, that computers will replace people. Rather, it means that company analysts can produce more information more efficiently than before.

### **1.3 Financial Statement Analyser - Goals Set for the Expert System**

The utility of an expert system specialised in verbal financial statements analyses depends on the following:

- 1) the accuracy of the knowledge base (the more information available the better the chances for an accurate analysis) and
- 2) the size of rule base (in general, the more rules the more accurate and good-quality analysis)

The following goals were set for the expert system in the planning phase.

- 1) The analysis made by the expert system is comparable to an experienced company analyst (taken into account the limited knowledge available about the external world and the company)
- 2) The verbal description made by the expert system is many-sided, easy to read and helps to form an opinion about the company.
- 3) The interpretation focuses on the essential and does not produce unnecessary text.
- 4) The system can be connected to existing financial statements analyser systems and it is simple to use.

During the planning a decision was made not to allow the user to modify and extend the rule base himself, he has to send us his suggestions. Otherwise we could not have been responsible for the output of the expert system<sup>2</sup>. Moreover, the user interface would have become unreasonably complicated and the necessary training needed to operate the system could have decreased interest to use it. The programming costs would also have gone up.

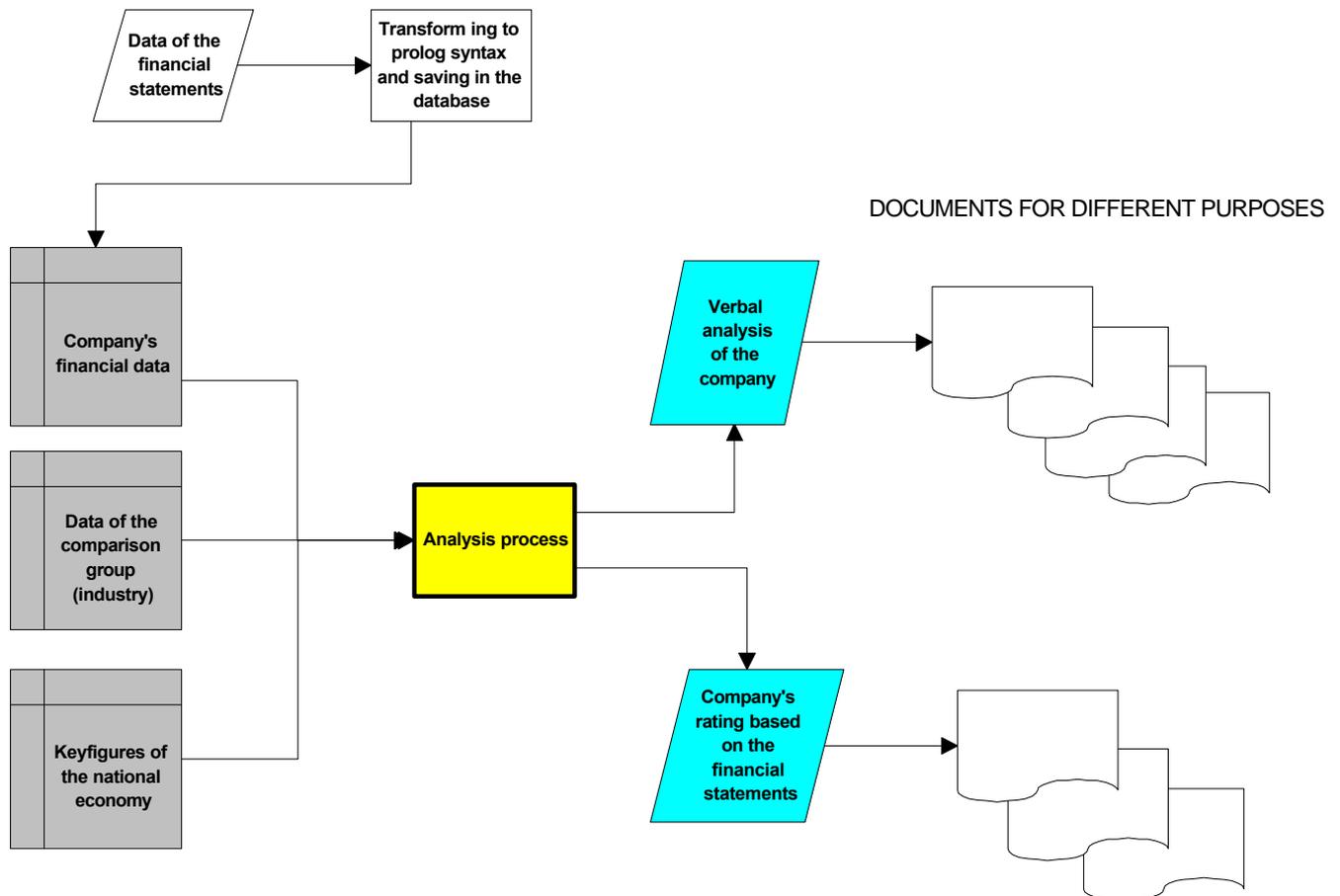
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<sup>2</sup> Company analysing is a responsible activity. A bad analysis or one containing wrong conclusions may cause credit loss for the financier or result in difficulties in the company's operation.

## 2. Technical design of the expert system

### 2.1 Design on a general level

In the following diagram the design of the system is introduced on a very general level



The financial statements information of the company are transferred from a program designed for calculating the financial statement information. The key figure information will be transformed into Prolog syntax and saved into an external database.

The actual analysing process utilises three databases. The first one contains the figures of the company analysed, the second the figures about the group of companies used as a comparison and the third one the general economical time series.

The output of the analysis will be both a verbal description about the economical state of the company and a rating based on the financial statements information. The analysis text can be freely edited by the user. The final analysis will be stored into a database. The system produces several documents of different type.

## 2.2 Structure of the Rule Base

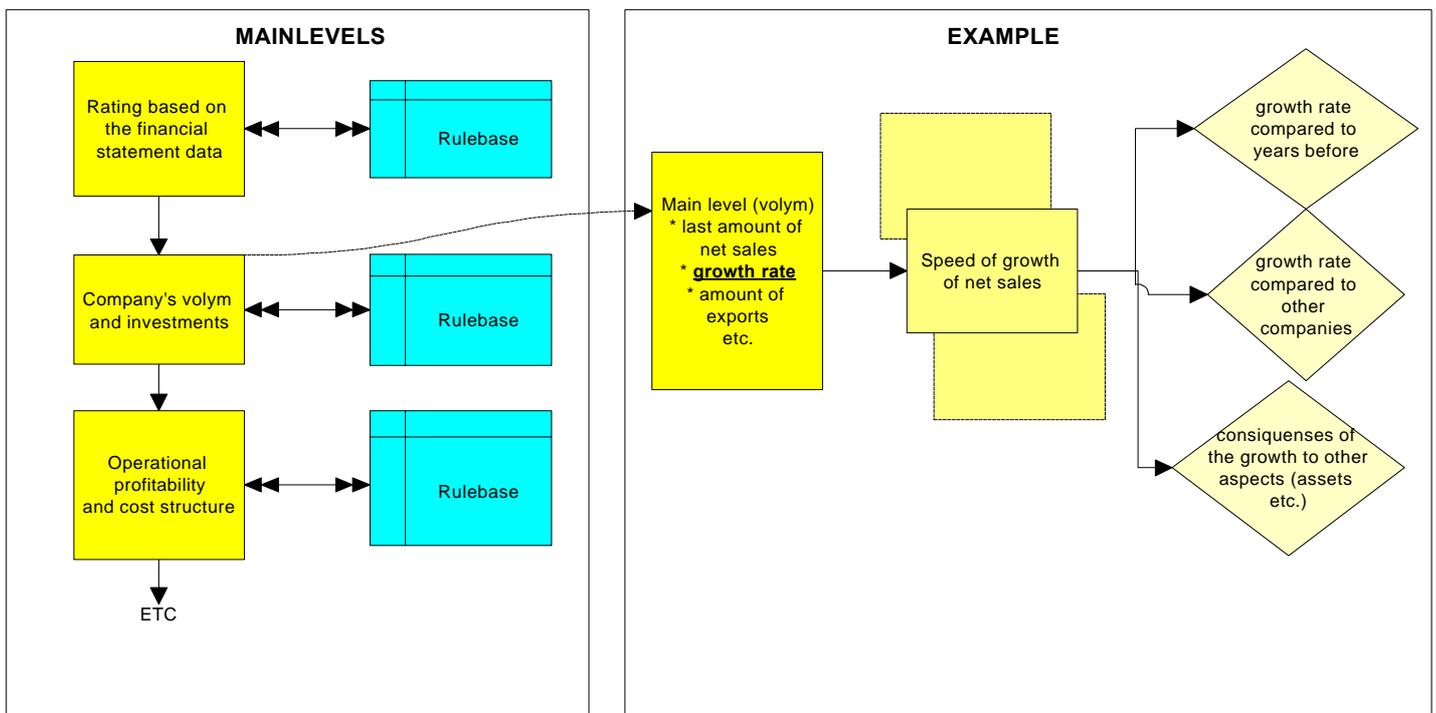
The financial statements analyser is a typical **from top to bottom type** of a diagnosing system. The program is based on testing different hypotheses. A hypothesis is structured according to the following:

**hypothesis(X) is true if  
condition(1) is true and  
hypothesis(3) is true if  
condition(7) is true etc.**

An example:

**Hypothesis fast growth of net sales is true if  
growth of net sales > 30 percent  
and age of the company > 3 years  
and net sales > 25 million FM  
write growth was fast**

Each hypothesis can contain several alternative solutions, that will be processed until the right solution will be found or it can be concluded that a solution does not exist. Each hypothesis can contain information from both the key figure analysis, median and quartile information of the line of business or the group of companies used as comparison, rating information or general economical information. In the diagram below the structure of the analysing process is represented.



In the current version there are several dozens of main levels that divide into one or more sublevels. Each sublevel can contain own sublevels. The sublevels can be divided into one or more rule options. The rule base of the analysis system is composed of several thousands of rules.

Prolog programming language with its flexible structure and self-documenting syntax is an excellent tool for developing this kind of large programs consisting of many levels. The economical processes of companies change along with time and the levels of good and bad change. Also the society changes laws concerning book-keeping and other company activity. Thus the rule base is under continuous demands for change and in many ways this kind of program is never quite complete.

The financial statements analyser is programmed with Danish **Prolog Development Center (PDC)** compiler. The first version of the program was published in 1991. There available both Windows and DOS versions from the program and the language options for the verbal analyses are Finnish, Swedish and English.

## 2.3 **An example of the verbal description produced by the expert system**

The following excerpt is a small fraction of a verbal analysis. An example company is Nokia Telecommunications, a part of Nokia group.

### **THE RATING OF NOKIA TELECOMMUNICATION REMAINED AT A**

*The rating of NOKIA TELECOMMUNICATION was A or in other words the company was in excellent condition. The company received a score of 92 for the accounting period. An indication of the company's strong position is that its rating has stayed in the highest category (A) for the past four accounting periods.*

### **THE SUCCESS OF NOKIA TELECOMMUNICATION CONTINUES**

*In its comparison group (manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy) NOKIA TELECOMMUNICATION is a large company. The accounting period of NOKIA TELECOMMUNICATION for the year 1996 ended in December. The turnover was FIM 10.5 billion. The development of the turnover slowed down and the growth percent was 72.8 (previous year 138.1 %). The growth of the company was still very fast. NOKIA TELECOMMUNICATION could increase its turnover faster than the major part of other companies in the industry.*

*Export formed the main part of company's turnover. The share of exports in turnover was 85.7 percent and the value of exports was FIM 9.0 billion. The importance of exports increased, its share of turnover increased by 6.2 percentage.*

*In addition to the investments made, the company has directed its funds generated from operations to decreasing the amount of loans with interest. Investments were reduced compared to the previous accounting period. However the total amount of the investments still exceed the company's depreciation requirement, which means that investments also include capital expenditure for purposes of expansion. The company's investments were FIM 856 million or in other words 8.1 percent of the turnover. 91.6 per cent of the investments were self-financed. The rate of investment exceeded the average in the industry.*

### **PROFIT DEVELOPMENT WAS GOOD**

#### **Gross Profit and Cost Structure**

*The profitability of NOKIA TELECOMMUNICATION's activity improved further. The gross profit continued to grow from 31.3 % in the previous year to 33.1 %. The improved of the gross margin was mainly caused by the reduced share of procurement and production costs. With the present capital structure and the present interest rate and volume levels the company's gross margin could fall to the level of 8 percent, before the net earnings would be in the red. In other words the company has a margin of safety.*

Table 1:

Cost Structure, percent of turnover

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### **3. Other issues in developing the expert system**

#### **3.1 *Financing and marketing***

The programming and maintenance of the Financial Statements Analyser was financed altogether with the profits of Balance Consulting Ltd. Great financial help came from a few customers who had the courage to purchase the right to use the half finished program prototype. Societal financial was not applied for because the required bureaucratic paper work would have taken too much of the limited resources.

Financial Statements Analyser programs are in use ca. 20 Finnish banks, insurance companies and governmental institutions. The marketing has been efficient not only because of the favourable economical development of the Finnish national economy but also because the potential user group of the program is small and mainly situated in the metropolitan area of Helsinki.

Although the marketing of the program has been relatively easy, there has been some indications of existing fears against this kind of expert system software. The fear is based on thinking that the program would replace the job of a person. Such fear is partly ungrounded because the program does only part of the necessary analysing job. The majority of those who had a chance to become acquainted with the program realised, that it would disengage limited human resources for more interesting and challenging activities, for the assessment of the development of the company.

#### **3.2 *User feedback***

Feedback from the users has been mostly positive. The use of the program has strengthened their position in their organisation. The users have been able to manifold their visible input. Moreover, the use of financial statements analyses has become more efficient inside the organisations.

The users have participated actively in the development of the program by sending proposals, e.g. the users have pointed out a need to deepen or specify analysis in some sub area of financial statements analysis, suggested new rules to the rule base, and found bugs in the program. The feedback has guaranteed fast development of the program.

#### **3.3 *Future role and development of expert systems in company analysis in Finland***

In the 1980's considerable amounts of money were used in expert system experiments in Finnish banks and insurance companies. The large project budgets compared to the modest results and profits resulted in a mildly sceptic attitude towards expert systems.

Nevertheless, developing expert systems in financier organisations is essential in the future. The goal is to both prevent the mistakes made in the 1980's (the making of bad investments) and to increase the cost effectiveness of the banking business without increasing the risk.

The expert system tools that will be developed in the future will first be systems, that diagnose the current state of a company and how it was accomplished. Along with the accumulating experience, systems will be developed the role of which will be to analyse the future prospects of a company.

In the near future it seems realistic that such systems will be developed that combine the analysis of the current economical state of a company and credit pricing.

In the development of expert systems it will be essential that clear and limited subgoals can be set. Gradually more extensive systems handling broader problem areas can be developed.