An expert system for strategic analysis

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Abstract
In recent years a number of tools have emerged claiming to contain expert knowledge in the field of strategic analysis. Generally they are based on a combination of marketing tools and techniques, and expert knowledge. Most of these systems focus on financial analysis but also qualitative characteristics are of importance. Aspects concerning the management (quality), the product (stage of the life cycle) or the market certainly contribute to the strategic performance of the business. SESAM is a model providing an aid for the (external) strategic analyst who has to report about a business strategic marketing performance within 24 hours, mainly based on publicly available information. SESAM is the keystone of an expert system that uses rules of thumb and that is based on 24 tools and techniques. This paper discusses the characteristics of this expert system. One of its advantages is that it can easily be expanded, e.g. to support strategic analysis in an environment with more than one strategic business unit (SBU).

Keywords: decision support systems, expert systems, strategic analysis, company performance

1. Introduction

Experts in various fields heavily lean on their expertise in decision-making. This expertise is one of the major characteristics of the expert. Whether he is involved in medicine (diagnosing medical complaints, interpreting medical data and prescribing a therapy), in credit assessment (deciding whether an individual or small business loan can be supplied) or in strategic analysis (determining a company's performance), the expert uses his experience to solve the problem to his best knowledge. This knowledge can be formalized using various forms of knowledge representation and implemented in expert systems. Briefly stated, an expert system has built-in procedures (inference engine) to handle the production rules leading to an advice or a solution, based on some kind of reasoning.

Strategic analysis contains knowledge that is well suited to formalize and the aim of this research has been to build an expert system that is able to carry out a strategic analysis and to report about his findings and to give advice. For this purpose an existing model is used, SESAM, that provides a (paper) framework of models and techniques from the theory of strategic management. As such it can be used as a guide for the analyst. SESAM is designed and developed to give advice only based on externally available data. Although this will remain a major task of the resulting expert system it will certainly not be restricted to this. It will be designed in a modular way so that various modules will be able to carry out various tasks (external analysis, internal analysis etc.).

This article describes design and development of the expert system. In the next section a brief

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introduction is given to strategic analysis. SESAM is a tool that supports a analyst in determining the strategic performance of a company. It is based on a number of models and techniques from the theory of strategic management. In a separate section the characteristics of SESAM are briefly described. Because automating SESAM in the form of an expert system has been one of the major objectives of this research project a separate section is devoted to expert systems in relation to strategic analysis. Finally, it is discussed how SESAM is implemented in an expert system.

2. Strategic analysis

The modern entrepreneur does not rely any longer on fortune-tellers and oracles, but has developed his own methods to predict the future: the strategic analysis.

The strategic analysis is used in the process of formulating and evaluating the strategic business policy. Gathering information and interpretation - both are necessary for a strategic analysis - are more or less continuous activities requiring much time and effort. Generally a strategic analysis will be carried out under significant time pressure. This pressure is motivated by aspects of cost reduction and by the relatively short period in which the results of such an analysis have to be available. The aim of the strategic analysis is to map the present situation of the company and to predict possible future developments. Companies base their strategy on these analyses. The stakeholders of the company are dependent of the quality with which a company estimates its future and the strategies that are based on these expectations. They, on their turn, use the analysis to quantify the company performance. The external analysis based on publicly available information, such as annual reports and company profiles, is usually restricted to the field of financial analysis.

The quality of the strategy is an important factor for the potential success of an organization. A diverse group of stakeholders of a company has great interest in the insight in the strategic performance. They depend on the way the companies analyze, anticipate and finally perform. Examples are loan providers (banks), major customers, employees and suppliers. From a different point of view sales people and competitors are interested in a company's future. They carefully follow and study a company's performance and for this purpose they use a great number of methods. Which tool will be chosen depends on the analyst's background, the kind of available information, the objective of the analysis and various financial considerations. Seen from the point of view of an external analyst a strategic analysis can be defined as follows: *Systematically mapping, analyzing and interpreting a company's characteristics, environment and strategy with the aim to come to an assessment of the company's strategic performance*.

The internal analysis concerns to understand the strategic position of a company. The aim is to get insight in the key influences on present and future functioning of the company and consequently the choice of the strategy [Jo 93]. Within the company the internal strategic analysis is used by the analyst as a tool that supports or evaluates the (strategic) company policy. Then it is implicitly supposed that all necessary internal information is available. This is a key problem for the applicability of any tool or technique that is to be used by the external analyst: he lacks the internal information.

It would be very helpful to the external analyst if he could apply the same methods, tools and techniques as much as possible as those used for the benefit of the internal analysis. The insight in the company's strategy would increase by mimicking the company's approach as much as possible. Furthermore, the use of standard tools and techniques would improve the speed and falsifiability of the analysis.

An external analysis needs to be carried out only based on publicly available information such as annual reports, industry reports or any other report that is available to the external analyst. Particularly on the level of company analysis this will cause severe problems when standard analyses are used. This in contrast to the level of industry where this information is generally accessible to anyone who is interested. Consequently, gathering and interpreting the information of the market and competition differ less compared to the information that is used by the internal analyst.

On macro level both the internal and external analyst have access to the same information. Consequently the applicability of tools and techniques to the analysis of the company's environment is much better than to the analysis of a company.

Many different methods are used for a strategic analysis; two clearly common characteristics can be recognized.

First the present position of a company is analyzed, second the company's environment and its changes are examined. For both kinds of analyses tools and techniques are used that are developed especially for this purpose. Over the years a great number of these tools and techniques have been designed and developed and described in the strategy and management literature. The initiators of these developments are the influential management consultants such as Boston Consulting Group, McKinsey, Arthur D. Little and big companies such as General Electric and Shell. They have designed own concepts. Examples are well-known tools such as portfolio matrices, financial company models, the technology life cycle and the experience curve. Each of these tools is meant to analyze one specific facet of the company or environment. The results of these analyses are used as the basis of the formulation of a strategy.

Standard works in the field of strategy largely consist of explanations about the use of existing tools and techniques and enumerate a number of pros and cons of these techniques. The pros indicate that using these techniques [We 89; Aa 88]:

- forces the user to concentrate on facts. The tool or technique immediately indicates what must be analyzed and what information is necessary to come to certain statements.
- helps to structure the problem and makes the analysis conveniently arranged.
- motivates to critical thinking. Both pros and cons of the problem must be taken into account and arguments must be well considered.
- not only leads to the right description of the analyzed situation, but also to understanding.

There are also some cons:

- Using these techniques leads to a (over)simplified representation of reality, with the consequence that the analyst does not take possibly relevant information into account.
- A number of these tools and techniques are directed towards the greatest common denominator. This can cause practically wrong results, particularly when an advice is based on this analysis.
- The analyst is expected to make certain a priori judgments; these can have relatively great consequences for the final results because of the rigidity of the tools.
- The tools and techniques have a restricted applicability. They are less applicable in unusual situations.

In order to test tools and techniques on applicability to external strategic analysis, an exhausting stock-taking has been carried out [Jo 93], finally leading to SESAM..

3. SESAM

The complete model SESAM[3] is described in a university report [Jo 93] and is a means to assess the strategic performance of a company.

SESAM is a conceptual model providing an aid for the (external) strategic analyst who has to report about a business strategic marketing performance in less than 24 hours. The report is mainly based on publicly available information such as annual reports, articles in magazines and publications by organizations representing the line of business. SESAM uses 24 tools and techniques carefully selected from more than 120 described in literature (such as the Five Forces Model, Growth Vector Analysis, BCG Advantage Matrix, Generic Strategies Matrix). SESAM only uses the knowledge that is included these models.

In practice SESAM is used in cases in which it is required that a preliminary judgment has to be given on a business strategic performance. The analyst inputs the (many) required business data related to, for example, management, competition, technology, and finance. Based on the models incorporated and indications presented in SESAM, he is able to construct a preliminary report about the company's performance.

An analyst using SESAM first attempts to gain insight in the company itself: its strengths and weaknesses. Then, on a second level, he analyzes the company's environment: its market, line of business and macro-environment. This second level shows the company's opportunities and threats. These first two levels together produce a SWOT matrix (*S*trengths, *W*eaknesses, *O*pportunities and *T*hreats) plus strategic advice and several conclusions.

On a third level the actual strategy of the company is analyzed and characterized using concepts known in the theory of strategic analysis. Then all is set for a fourth and final level of research on which the actual strategy is compared with the strategic advice and conclusions based on the theoretical prescriptions in the models. This *match* leads to a report containing the analyst's judgment on the company's strategic performance. On each of the first three levels SESAM uses tools that are well known and accepted in the literature of strategic analysis; in fact the authors have scrutinized some 120 of such tools before they finally selected the 24 they found suitable for SESAM.

Automating the expert knowledge of SESAM in an expert system has been a major objective of the research project. The resulting basic expert system must come to conclusions and summarize these in a final report, based on the production rules incorporated in the knowledge base) and the data input by the analyst. As such it supports the analyst in his task to provide a quick analysis of a company. Because of its modular design it must be able to complete a full analysis based on both internal and external data available. Furthermore, this modular set up allows the expert system to be easily expanded so that it can give advice also when more than one SBU is involved.

4. Strategic Analysis and Expert Systems

The expertise of strategic analysts is very well suited to be formalized in expert systems. Partly, a strategic analysis consists of completing a financial analysis for which various numerical software packages are available. However, a major part of the analysis concerns knowledge that is difficult to capture in numerical models and generally describes the real expertise. This type of knowledge is generally represented by a great number of rules of thumb (also known as production rules) and concerns aspects such as the quality of the company's management, the stage of the life cycle of the product, the market the company operates on and the branch of

[3] SESAM is a Dutch acronym for Fast External Strategic Analysis Model

industry the company belongs to. These aspects have their influence on the strategic performance of the company.

In recent years only a few expert systems have been built in the field of marketing which cover various sub-branches. In [Wi 92] 27 of such expert systems are enumerated: sales promotion (7), following market developments and report generation (5), advertisements (4), media planning (3), new product development (3), automated data analysis (2), negotiating (1), determining strategies (1) and prediction (1). According to [Wa 92; Me 93] the field of marketing is promising with respect to the development of expert systems.

One conceptually sound and commercially successful software package is Business Insight [BI 93]. It generates a report on the strategic performance of a company, based on the response to about 400 questions and a few hundred production rules of expert knowledge. Business Insight is widely recognized (also in every day's practice) as a good step towards using decision support tools. It generates a report containing hypertext links enabling the expert system to explain its lines of reasoning, it provides features to show the highlights and lowlights of the company and the end user can experiment with the results by using the what-if analysis. Business Insight also has some drawbacks. First, it is primarily meant to be used in the United States which in many ways significantly differs from Europe. Furthermore, it has not been designed to carry out a partial analysis such as in SESAM. Finally, it cannot deal with companies having more than one Strategic Business Unit (SBU). The SESAM expert system, however, is designed to deal with these (sub)tasks.

For the development of the SESAM expert system it has been decided to apply an expert system shell, a software environment especially designed for the development of (rule-based) expert systems. Using such a tool decreases the development time considerably and enhances the quality of the expert system.

Earlier experiments have been carried out with Delfi2+ [Sw 89], a tool developed at Delft University of Technology. This system does not meet the requirements; it does not support knowledge modules and it lacks a GUI. However, the results achieved with this system have been sufficiently promising to continue the project. At present, the research is continued by using two expert system shells. One is EXSYS, the other is Aion DS. Both have excellent reasoning and report features. EXSYS has, on top of that, some extra features such as hypertext and various models for inexact reasoning [EX 94]. Aion DS has excellent and widely accepted knowledge representation structures such as classes and instances, each with their slots and methods, inheritance of slots and methods and user-defined relations between classes and instances [Ai 94].

5. SESAM expert system

On the first level (internal analysis), one of the tools used is known in literature as *Traits of Excellence*, [Ke 90]. It makes the analyst score points on a scale from 1 to 5 on topics such as *Closeness to customer* and *Entrepreneurial culture*, etc. Because of SESAM's well-structured method and particularly because of the way it makes use of tools, to some extent the model appeared to be very appropriate for transforming it into an expert system. Up to the point of comparing the company's actual strategy with the strategic advice and conclusions implementation showed to be straightforward.

The first prototype of the SESAM expert system has been built with Delfi2+. This expert system shell forces the knowledge engineer to define a number of objects, each having a number of attributes. In the domain of strategic analysis objects have been created such as: *the company*, *the market*, *the line of business*, *the product*, and *the management*. Next, these objects were given attributes and finally, a set of production rules express the logical connections between these attributes. The thus created knowledge base is supported by a few external routines to supply data to the expert system and to generate a report. Below a typical example of a production rule is given:

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RULE 24
IF
[ company.strength > 3.33 ] AND
[ line_of_business.attractiveness_text = "high" ]
THEN
CONCLUDE company.theoretical_conclusion_1 := "Grow, seek dominance, maximize investments"
CF (1.00)
WRITE "The theoretical conclusion #1 reads like this: ", company.theoretical_conclusion_1
FI
ENDRULE
```

In this rule *strength*, *attractiveness_text* and *theoretical_conclusion_1* are attributes, whereas *company* and *line_of_business* are objects. The keyword WRITE means that one or more strings are written to screen. FI indicates the end of the IF-statement. Left out are calls to external routines, one of which, for example, could add a sentence to a report file if the IF-statement were to be true and hence the rule would fire.

Almost all of the tools from the first three levels of SESAM have been used and combined in a similar way by the automated version to produce the material for the match. It then proved however, that the principles by which the tools had been selected, namely *external information only*, *low cost*, *short time* and *relevance to the subject (company, market etc.)*, by no means lead to tools that would automatically generate the desired strategic advice or the typification of the actual strategy, let alone the matching of the two. Instead, the tools performed more like a checklist, to see to it that the analyst, in the intuitive process of forming strategic advice, would leave no ground uncovered. In practice, students using the non-automated version of SESAM, tend to stick to two or three striking results from the enormous checklist that the sum of tools in fact is, and then combine these items to form their judgment. In a second version of the automated SESAM everything that could be used for a match, was matched. To make further progress 8 new parameters were introduced, forming a minimal set of judgments in the match area that SESAM should at least generate based on the tools on the first three levels.

The end user has the option of asking how a particular result was brought about by means of hypertext or otherwise. Finally a series of explicit questions concerning the strategic performance of the company in question is asked. So, although the final judgment remains up to the analyst, and automating SESAM in this respect has not fully lived up to its expectations, automating it has come a long way. It forces the analyst to be more objective by enlarging the automated part of the analysis, thus narrowing his path and postponing, so to speak, the moment of intuition. Moreover, the fact that SESAM is not fully automated needs not only be regarded as a failure, but may well be felt as a benefit too, because it gives the analyst more freedom.

6. Results and conclusions

The prototype expert system that has been constructed with the expert system shell Delfi2+ proved that it is possible to formalize the expert knowledge of the strategic analyst. Since

Delfi2+ has some restrictions with respect to modularization, report generating and GUI, a second version of the expert system SESAM will be developed using a more appropriate expert system shell. At the moment there are two candidates EXSYS and Aion DS. They have excellent report features; EXSYS can use hypertext. On the other hand, Aion DS supports well-known knowledge representation structures such as classes. A final choice has not yet been made.

Both systems make it possible to satisfy the requirements that have been formulated with respect to the sesam expert system: modularization of the knowledge base in order to use it for both external and full (also internal) analysis.

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