A hybrid system for strategic marketing planning

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A combination of the advantages of the expert system and decision support system technology

Introduction
Most companies today are experiencing difficulties with planning, and there is a growing realization that survival and success in the future will come only from sound strategic planning and market preparation. The tremendous impact that expert systems (ESs) could have in the field of marketing has been highlighted by several people (Keon, 1991; Mentzer and Gandhi, 1992, 1993; Moutinho and Paton, 1993; Steinberg and Plank, 1990). Some previous research has been carried out to tackle the marketing domain with ES techniques (Borch and Hartvigsen, 1991; Burke, 1991; Burke et al., 1990; McDonald and Wilson, 1990; Moutinho et al., 1993; Rangaswamy et al., 1989). However, despite the availability of sophisticated programming tools, the development of marketing ESs has proven to be difficult and time consuming (Burke, 1991). As a result, there are few satisfactory marketing ESs reported. The application of ES techniques in the marketing domain presents a significant intellectual challenge to ES developers (Curry and Moutinho, 1991).

There are two opposing views about the use of ESs in marketing: a more optimistic view believes that ESs will have a tremendous impact on marketing and thus can be used for many marketing tasks where companies will gain great benefits; on the other hand, while not denying that ESs can play a role in marketing, some people argue that application of such tools in the marketing area is likely to be severely limited (Dubelaar et al., 1991). The authors believe that pure ESs do have limitations in marketing, but these limitation can be reduced by developing hybrid systems which combine the advantages of ESs, decision support systems (DSSs) and other computer facilities.

A prototype system called HYMS (HYbrid Marketing System) has been developed to help marketing managers make more consistent and better decisions. It is a hybrid ES which integrates the ES and DSS technology in order to enhance its ability in supporting the strategic marketing planning process. This article first presents a brief introduction on ESs and DSSs in marketing, and the strategic marketing planning techniques. It then describes the "directional policy matrix" which is used as a core model for the HYMS system. The article discusses the selection of software for the HYMS, the architecture of the prototype system and the knowledge elicitation for it.

Finally, the further extension and enhancement of the HYMS system is proposed with a brief conclusion from the current research.

ESs and DSSs in marketing
DSSs and ESs are two growing areas in computer applications. Both of them share the same aim of supporting users in decision making and problem solving. The fundamental goal of a DSS and an ES is basically the same: they seek to improve the quality of the decision process. Some researchers have made comparisons between them. Ford (1985) found that the objective of a DSS is to support the user in the decision-making process by providing access to data and models; while an ES is to provide the user with a conclusion or decision significantly better, and more often correct, than the user could reach otherwise. A DSS allows the user to confront a problem in a flexible, personal way in manipulating the data and models, while an ES, the user has little or no flexibility. Turban and Watkins (1986) argue that the problem area attacked by a DSS is broad and complex, while an ES is restricted to a much more structured and narrow domain. Instead of the fixed problem-solving process to be found in an ES, the DSS provides a flexible problem-solving environment of tools and data for the user to manipulate in his or her own way (Doukidis, 1988).

ESs have been applied to a variety of domains, and marketing has been one of these. Several systems have been developed to assist with marketing decisions:
ESs for marketing is still a research area which has not yet received enough attention. It has also been realized that both ESs and DSSs have limitations. As a result, each as a single system has its shortcomings. This might be the reason why ESs for marketing are, so far, not very satisfactory. However, because of the complexity of strategic analysis, a hybrid system which combines the advantages of both an ES and a DSS will be more appropriate in tackling this complex domain. In some stages of strategic marketing planning, a DSS is adequate if the human expert cannot explain the decision-making mechanism behind it or if it is difficult to represent human knowledge. Therefore, a hybrid system is more flexible and gives the user more choices during the decision-making process.

The selection of a strategic marketing planning model

Marketing planning is a knowledge intensive domain. It is an area which has been well studied and documented. However, although a huge amount of information is available on this subject, it is lacking a framework which can be transferred easily into a computer system or which is directly applicable to building an ES or DSS. There are several well-known marketing planning models and McDonald's nine-step marketing planning process is one of them (McDonald, 1989, 1992). McDonald has made his nine-step model more amenable to computerization. He indicates the relationships between the marketing analysis techniques and the planning process stages. Each technique emphasizes different aspects of the same situation and the same tools can be used in different process stages. McDonald's planning process provides a systematic picture of how to implement different analytical tools for different purposes at the different planning process stages.

Following advice not to try to make the system do too much at first (Keon, 1991), it was realistic to build the prototype system with one or two key techniques initially and add other techniques later. It was decided that the HYMS prototype system would follow McDonald's market planning process model, but focus on key stages of competitive analysis and marketing strategy selection by using Porter's five-force model (Porter, 1988) and the directional policy matrix (DPM) (McDonald, 1992).

"The essence of strategy formulation is coping with competition" (Porter, 1988, p. 87). The five-force model, proposed by Porter, determines the competitive pressures in any industry or market segment in order to form an appropriate strategy. This five-force model provides a structured analysis in assessing competitive threats. These threats are classified by Porter as:

1. Threat of new entrant;
2. Bargaining power of customers;
The result of five-force analysis will be used as part of criteria to determine market attractiveness and business strengths in DPM analysis. Five-force analysis is built as a subsystem for HYMS, while the DPM model is the core module of HYMS.

DPM is one of the popular matrix analysis tools.

The matrix analysis technique has dominated strategic thinking and practice (McIvor et al., 1992) and as a result, DPM is one of the popular matrix analysis tools. General Electric with McKinsey pioneered this model, making use of many variables to assess the company’s situation in the two dimensions, with one dimension representing the scale of business strength and the other one representing market attractiveness. The matrix is divided into three columns and three rows as shown in Figure 1. The dimensions used for assessing position represent the significant elements of the internal and external environment from which strengths, weaknesses, opportunities and threats arise. However, the relative importance of these dimensions varies between firms and industries. This business assessment matrix, through qualitative analysis, assesses a business as being strong, medium or weak in terms of business strength, and assesses its market attractiveness as high, medium or low. Nine boxes are formulated and each of these positions calls for a different marketing strategy, such as investment, divestment or selective growth or harvesting strategies. Alternatively, the DPM matrix can be used to display the competitor’s position since the method lends itself to evaluating competitors’ ratings. A further use of DPM is to analyse the company’s future positions by assessing the change of variables in determining the matrix positions.

Similar research related to using the DPM in building knowledge bases for strategic marketing planning are EXMAR (McDonald, 1992) and SMILE (McIvor et al., 1992), but these two systems are considered, by the authors, as quite limited compared with HYMS. The original EXMAR system is purely a demonstration system and no further enhancement has been mentioned afterwards. SMILE is only used as a teaching/training aid in a university environment. Neither EXMAR nor SMILE have covered the stages in identifying the strategic business unit (SBU) which are also considered important and need expert advice during using DPM. Furthermore, neither EXMAR nor SMILE could provide decision support models to help users to make their own judgement about the weights of the important factors. SMILE can only offer advice on one product at a time. This is a drawback because the DPM analysis should present the result in a way that shows the different positions of each SBU. This character is claimed as one of the important advantages of DPM.

Software selection
The initial requirements when considering selection of a development tool for building HYMS are:

- facilities to build knowledge bases;
- facilities to build a user-friendly interface;
- interface with graphic capabilities, other computer languages and databases;
- facility to create a standalone application; and
- PC-based software.

Having tried several types of software available, it was found that an object-oriented development tool working under the Windows environment provides the features required. For example, knowledge can be represented by using both object-oriented and rule-based methods; it can treat uncertainty by using a combination of fuzzy sets and probability in the internal computation of confidence factors; it can also provide graphics and interface with databases; and it has hypertext features. Object-oriented knowledge representation represents the domain in a more natural way and it has reusability, extendability and modifiability. For example, a general ES can be developed for each domain, and it can be customized later based on the needs of each organization. Furthermore, modularity enables the developers to start with a small prototype and expand it by adding new classes to the system, and modifying some of the existing ones. Similarly, as the domain knowledge changes, the system should be modified to incorporate these changes.
System architecture
The system architecture of the initial prototype system is shown in Figure 2. The system consists of several modules. Some modules contain knowledge bases, such as: pre-diagnosis module, SBU identification module, five-force module and DPM Module; and some contain decision support models, such as analytic hierarchy process (AHP) module.

Pre-planning diagnosis module
At the very beginning of the consulting session, the system will ask the user some questions concerning the company's planning procedure and the level of top managers' involvement. The point of this exercise is to:

(1) alert the user if his or her planning procedures are not formalized in a way which is consistent with his or her company size/diversity;
(2) make the user aware of the fact that key personnel's intervention in the planning process is a necessary requisite for successful plan execution.

SBU identification module
Day (1986) found out that during the planning process, considerable time was spent in identifying the meaningful planning unit. Many managers become confused about exactly what to plot on the DPM (McDonald, 1992). The question of the appropriate level of analysis has probably caused more confusion than any other issue, so the priority must be to define the unit of analysis correctly. Advice is needed to help in identifying the meaningful planning unit and what should be plotted on the matrix. SBU identification modules contain help to clarify this issue. The user is asked to provide information about company products and markets. The system will display the relationships in figures and give the suggested units of analysis which can then be plotted on the matrix.

Market attractiveness evaluator
Used for assessing the market attractiveness of the business unit analysed. The selection of the main factors, which are believed important in determining the market attractive position, are based on interviewing experts and searching from relevant documents. They are: market factor, competitive factor, economic factor, technology factor, social-political factor and user-related factors which are not included in the named factors, but are important for the user's specific SBU. This gives the user a chance to put his or her own factors into the market attractiveness consideration.

It is not an easy task to scale the factors because each may be determined by several subfactors, so the system will provide a break-down subfactor analysis making up each main factor or even break the subfactors into elements analysis. There are three levels of analysis: main factor analysis (first level), subfactor analysis (second level) and element analysis (third level). If users think that they understand the subfactors and can make their own judgement, there is no need to go further to conduct the third level analysis in which the HYMS system will provide a recommended scale by asking further questions related to each subfactor. In summary, users need to carry out two levels of assessment to score main factors and subfactors, but if users have difficulty in scoring some of the factors they can enter the third level analysis which breaks down subfactors into a set of related elements. At this stage the recommended score is supplied by HYMS.

Business strength evaluator
Having a similar structure to that of the market attractiveness evaluator, the business strength evaluator is for assessing a SBU's business strengths. The main
factors in determining business strengths are: market strength, product strength, production strength, financial strength, economic strength, management strength, technology strength and user-related strengths which are not covered in the named strengths, but are also important in determining the SBU’s business strength position.

Strategy generator
Based on the positions of market attractiveness and business strength, the strategy generator provides the recommended strategy for each unit analysed.

Porter’s five-force module
This subsystem uses Porter’s five-force model to assess competitive pressures in current markets and prospective markets. There are five forces named by Porter as the main threats in determining a company’s profitability. Porter discusses these forces and some characteristics which are critical to the strength of each competitive force. This subsystem can be used as a separate analytical tool and also as a HYMS’s subsystem. Its own knowledge base contains rules to assess competitive forces. The five-force subsystem can provide:

- an overall single rating of market vis-à-vis competitive pressures; and
- a breakdown of the nature of competitive pressures.

The output of the five-force model is used directly to determine the position of the same critical factors in market attractiveness and business strength evaluation.

AHP module
Having identified the important factors in determining the position of market attractiveness and business strength, the question arose as to whether each of these factors should be of equal importance. It is somewhat unrealistic to assume that they are, but again this leads to more questions: how to assign weight to each of the factors to reflect the differences in importance? As Day (1986) indicated, there are several problems: first, many of the factors are interrelated; second, a factor such as technological position may be of minor significance in one market while the dominant determinant of survival in another market being swept by a new generation of technology. However, assigning weights to various factors depends entirely on different circumstances and the user’s personal judgement. As a supporting system, HYMS provides the user with three choices:

1. to use HYMS’s built-in weighting system;
2. to assign weights him/herself;
3. to use the decision support tool, the AHP model.

The AHP has been applied to a variety of marketing decisions. The basic idea of AHP is to introduce structure and objectivity into the largely subjective process of attaching “weights” to a set of decision criteria in a multicriteria decision making situation. This approach consolidates both quantitative and qualitative considerations and can be used for different purposes. AHP has gained widespread acceptance as a valuable tool for multicriteria decision making. It offers the method of pairwise comparison for solving the weighting problem. It was chosen as an appropriate tool to help users to produce their own weighting system based on their own specific situation. This method makes a complicated comparison into a simple pairwise comparison. The AHP subsystem is being developed at the present and will be integrated into the system at a later date.

Graphic module
The graphic support subsystem provides all the necessary graphic support required by HYMS. For example, one of the outputs of DPM analysis will be a graphic display of the SBU’s positions on the matrix. Each circle in the matrix represents a product/market group and the area of each circle is proportional to each SBU’s contribution to total company sales volume. This graphic display system will have the ability to show a single SBU’s position and the positions of a group of SBUs which users have selected. The future graphic tool also will have functions to illustrate the company’s information in different types of diagrams. This module is also in the process of development.

Knowledge acquisition for HYMS
The knowledge for HYMS has come from two sources: published documentation, such as books, papers and reports and from interviews with experts. Using published documents as a major source of knowledge is quite common in the marketing area. COMSTRAT (Curry et al., 1992; Mentzer and Gandhi, 1993) and NEGOTEX (Rangaswamy et al., 1989) used the relevant academic literature to generate their knowledge bases. McDonald (1989, 1990 (with Wilson), 1992) has published several books, papers and reports about his marketing planning model. These were good sources from which to acquire general knowledge for the HYMS knowledge base. However, although the knowledge from published documentation is easy to access, it is limited to generalities and is not sufficient to build a specific rule base. Thus the interviewing of experts was seen as another major source for knowledge acquisition. Interviews were conducted for the prototype system, and the knowledge elicited from documents and interview for HYMS is represented in the form of rules within the knowledge base. It is proposed that more interviews will needed for further enhancement.

System evaluation
It is difficult to evaluate the performance of an ES because there is no objective standard against which it
can be measured (Wensley, 1989). Therefore, ES evaluation is seen as another challenging task confronting the ES developers and many issues in testing ESs are still unresolved (Gupta, 1992). The functions of HYMS are to help users with formal strategic marketing models, guide them in using these tools, provide expert judgement based on the user’s own situation and, finally, to make recommendations for users in their objective setting and strategy selecting. The evaluation of HYMS should cover the system’s effectiveness and usability. Owing to the system’s characteristics, it is impossible to test the system in a commercial environment. The effectiveness and usability of the prototype system cannot be assessed by field tests, but it can be evaluated by experts’ hands-on experience and their comments. These comments can be gained by interview and questionnaires.

The program had proven thought provoking

Although all indications suggest that HYMS is an appropriate tool, it is still premature to test all of the modules of HYMS formally. However, one of the HYMS’s subsystems, five-force module, has been evaluated by several users. Two separate questionnaires were designed to test the system’s usability and effectiveness. The response towards using the system was generally favourable (Shaw, 1994). The users reported positively on the efficiency and effectiveness of the program. The type, clarity and meaning of conclusions were all deemed acceptable. Furthermore, test conclusions were considered to be accurate “given that this is by nature a fairly inexact science”. Most favourable and promising of all was a comment by one user that “the program had proven thought provoking” and had helped him to identify, and challenged him to think about, programmatic areas in his real-life plan. The formal evaluation will be necessary for the enhanced system before delivering it to the real business practice.

Further development of HYMS

User interface design
User interface design is another important issue associated with expert systems and decision support systems. People argue that most expert systems which have been produced have a poor or inadequate user interface. The chosen implementation tool has enabled us to build a better user interface more easily than can traditional artificial intelligence language. It is proposed that further work will be carried out on the interface when the system is subjected to the formal evaluation.

More marketing analytic tools
Other future developments could be to include more marketing planning techniques, such as Porter’s matrix, Ansoff matrix, product life cycle, cost experience curve, gap analysis, etc. The system should also be able to suggest the most appropriate techniques according to the user’s own specific circumstances.

Strategic movement analysis
One of the advantages of the DPM is that it can be used to display the SBU’s strategic movement in the future. To conduct the future movement analysis, a thorough forecasting for changes in the positions of factors determining the future market attractiveness and business strength is essential. A forecasting subsystem can be integrated easily into HYMS to enable it to carry out the strategic movement analysis.

Uncertainty treatment
In reality, an ES as a decision-making tool must have the ability to accommodate the inexact nature of human knowledge processing. This need was recognized early in the development of ESs, and a number of methods have been proposed to superimpose uncertainty over the logical structure of ESs (Zahedi, 1993). Another potential enhancement of HYMS would be the ability to process uncertainty factors. This is believed to be useful, as the system could present the conclusion to the user with levels of confidence. This could provide an important aid for those with less experience at making marketing decisions.

HYMS as a training tool
HYMS also has the potential to be used as a teaching or training tool for junior marketing managers or students in the marketing area. This would require system enhancements to include detailed explanations and help facilities.

Conclusion
Marketing provides many opportunities for the application of expert systems and decision support systems but progress in this area is still relatively slow. This project has shown that HYMS is an effective hybrid decision support tool, and can demonstrate its capability to marketing executives by helping them to make more consistent and better decisions.

The system developed combines the advantage of ES and DSS. It provides more systematic analysis using selected marketing techniques, such as the DPM and five-force models. It shows that although expert systems are
suitable for some tasks involved in strategic marketing planning, especially if a task is well defined and has a large number of factors to be considered, it also has some limitations owing to its lack of flexibility. For example, weights for important factors vary among different situations and it is difficult for an ES to provide standard weights applicable to all users. The embedded AHP model in HYMS provides a solution for this difficult task. It asks users to conduct pairwise comparisons for different factors and finally gives the processed weights. The contribution of AHP is to provide users with a decision support aid to match their individual situation and their own decision making style.

A hybrid system like HYMS is a collaborator or decision supporter rather than a replacement. The system shares the decision-making responsibility with users. It was decided that in designing decision-making aids, tasks should be distributed between ES and DSSs, depending on which one is more suitable and effective.

This research provides a platform for developing more powerful decision support tools by building hybrid systems which integrate knowledge bases, decision support models and other computer facilities, such as graphic tools and hypermedia. It demonstrates that the hybrid system can provide a better support than a sole ES or DSS.

References


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